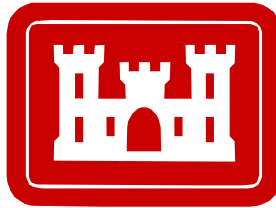


**BASEWIDE UNIFORM FEDERAL POLICY
QUALITY ASSURANCE PROJECT PLAN
UPDATE 1**

Optimized Remediation Contract
at
Avon Park Air Force Range, Florida

December 2023 - Revision 1

Prepared for:



**U.S. Army Corps of Engineers
Mobile District
109 St. Joseph St
Mobile, AL 36602-0001**

In Accordance with:

**Contract No: W9127821D0063
Delivery Order No: W9127821F0305**

Florida DEP ID#: DOD_1_3338

Prepared by:



**Tanaq Environmental, LLC
2480 West 26th Avenue, Suite B-26
Denver, Colorado 80211**

This page was intentionally left blank.

TABLE OF CONTENTS

Table of Contents.....	i
List of Figures	iii
List of Attachments.....	iii
List of Acronyms.....	v
Introduction	1
QAPP Worksheet Nos. 1 and 2 Title and Approval Page	7
QAPP WorksheetS No. 3 and 5 QAPP Distribution List and Project Organization.....	11
QAPP Worksheets No. 4, 7, and 8 Personnel Qualifications and Sign-Off SHeet	15
QAPP Worksheet No. 6 Communication Pathways	19
QAPP Worksheet No. 9 Project Scoping Session Participants Sheet	23
QAPP Worksheet No. 10 Conceptual Site Model	25
QAPP Worksheet No. 11 Data Quality Objectives	35
QAPP Worksheet No. 12 Method Measurement Performance Criteria Tables	39
QAPP Worksheet No. 13 Secondary Data Criteria and Limitations Table	51
QAPP WorksheetS No. 14 and 16 Project Tasks and Schedule.....	53
QAPP Worksheet No. 15 Reference Limits and Evaluation Tables	55
QAPP Worksheet No. 17 Sampling Design and Rationale	59
QAPP Worksheet No. 18 Sampling Locations and Methods/SOP Requirements Table	61
QAPP WorksheetS No. 19 and 30 Sample Containers, Preservation, and Holding Times.....	63
QAPP Worksheet No. 20 Field QC Summary	65
QAPP Worksheet No. 21 Project Field SOP Reference Table	67
QAPP Worksheet No. 22 Field Equipment Calibration, Maintenance, Testing, and Inspection Table.....	69
QAPP Worksheet No. 23 Analytical SOP References Table	71
QAPP Worksheet No. 24 Analytical Instrument Calibration Table	75
QAPP Worksheet No. 25 Analytical Instrument and Equipment Maintenance, Testing, and Inspection ..	83
QAPP Worksheet Nos. 26 and 27 Sample Handling, Custody, and Disposal	87
QAPP Worksheet No. 28 Analytical Quality Control and Corrective Action	93
QAPP Worksheet No. 29 Project Documents and Records	105
QAPP Worksheet Nos. 31, 32, and 33 Assessments and Corrective Action	107
QAPP Worksheet No. 34 Data Verification and Validation Inputs.....	111
QAPP Worksheet No. 35 Data Verification Procedures.....	113
QAPP Worksheet No. 36 Data Validation Procedures	115
QAPP Worksheet No. 37 Data Usability Assessment.....	117

This page was intentionally left blank.

LIST OF FIGURES

Figure 1	LTM IRP Sites, Avon Park AFR, FL
Figure 2	OT045 Stressed Vegetation Site, Avon Park AFR, FL
Figure 3	OT059A Cattle Dip Vat A, Avon Park AFR, FL
Figure 4	OT059C Cattle Dip Vats, Avon Park AFR, FL
Figure 5	OT059D Cattle Dip Vats, Avon Park AFR, FL
Figure 6	ST065 Former Government Vehicle Refueling Area, Avon Park AFR, FL
Figure 7	OW500 Building 73 OWS Pesticide and Hazardous Waste Storage Site, Avon Park AFR, FL

LIST OF ATTACHMENTS

Appendix A	Data Management and Validation
Appendix B	Usability Assessment Procedures
Appendix C	Laboratory Certification and Standard Operating Procedures
Appendix D	Field Standard Operating Procedures
Appendix E	Accident Prevention Plan/Site Safety and Health Plan
Appendix F	Waste Management Plan

This page was intentionally left blank.

LIST OF ACRONYMS

°C	degrees Celsius
°F	degrees Fahrenheit
%D	percent difference
%R	percent recovery
µg/L	micrograms per liter
mL	milliliters
AED	automated external defibrillator
AES	atomic emission spectroscopy
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AFFF	Aqueous Film Forming Foam
amsl	above mean sea level
APAFR	Avon Park Air Force Range
APYA	Avon Park Youth Academy
AVPCI	Avon Park Correctional Institution
APP	Accident Prevention Plan
Bgs	below ground surface
bls	below land surface
BS	blank spike
CA	corrective action
CAS	Chemical Abstracts Service
CCB	continuing calibration blank
CCV	continuing calibration verification
CDGP	Certified Dangerous Goods Professional
CE	Civil Engineering
CHMM	Certified Hazardous Materials Manager
COC	contaminant of concern
CPR	cardiopulmonary resuscitation
CQCSM	Contractor Quality Control System Manager
CQMC	Construction Quality Management for Contractors
CSHM	Certified Safety and Health Manager
CSP	Certified Safety Professional
CY	cubic yard
DDT	dichlorodiphenyltrichloroethane
DL	detection limit
DO	dissolved oxygen
DoD	U.S. Department of Defense
DQCR	Daily Quality Control Report
DQI	data quality indicator
DQO	data quality objective

DUP	Duplicate Sample
EB	equipment blank
EDD	electronic database deliverable
EPA	U.S. Environmental Protection Agency
ERP	Environmental Restoration Program
ERPIMS	Environmental Restoration Program Information Management System
F.A.C.	Florida Administrative Code
FAS	Floridan Aquifer System
FB	Field Blank
Florida DEP	Florida Department of Environmental Protection
FTL	Field Team Leader
FWC	Florida Fish and Wildlife Conservation Commission
GCTL	Groundwater Cleanup Target Level
GIT	Geologist in Training
H&S	health and safety
HAZWOPER	Hazardous Waste Operations and Emergency Response
HNO ₃	nitric acid
HSWA	Hazardous and Solid Waste Amendments
ICAL	Initial Calibration
ICB	initial calibration blank
ICP	inductively coupled plasma
ICS	interference check standards
ICV	initial calibration verification
ID	identification
IDW	investigation derived waste
IRP	Installation Restoration Program
ISSB	In-situ Soil Blending
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LLCS	Low Level Laboratory Control Sample
LOD	limit of detection
LOQ	limit of quantitation
LUC	Land Use Control
LTM	Long Term Monitoring
MAFB	MacDill Air Force Base
MB	method blank
MS	matrix spike
MSD	matrix spike duplicate
NA	not applicable
NTU	nephelometric turbidity units

ORC	Optimized Remediation Contract
ORP	Oxidation Reduction Potential
OWS	oil/water separator
PARCCS	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PDS	post-digestion spike
PE	Professional engineer
PFAS	Per- and polyfluoroalkyl Substances
PG	Professional Geologist
pH	hydrogen ion
PM	Project Manager
PMP	Project Management Professional
POC	point of contact
PoP	Period of Performance
PWS	Performance Work Statement
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
r^2	correlation
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
RPD	relative percent difference
RPM	Remedial Project Manager
RRT	relative retention time
SAS	surficial aquifer system
SDG	sample delivery group
SEDD	Staged Electronic Data Deliverable
SOP	standard operating procedure
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SWFWMD	Southwest Florida Water Management District
Tanaq	Tanaq Environmental, LLC
TM	Technical Manager
UDSC	Undifferentiated Sands and Clays
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
USAF	United States Air Force
WMP	Waste Management Plan

This page was intentionally left blank.

INTRODUCTION

Tanaq Environmental, LLC (Tanaq) prepared this Basewide Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP) for the United States Army Corps of Engineers (USACE), Mobile District under Contract W9127821D0063, Delivery No. W9127821F0305. This UFP-QAPP has been prepared to support Optimized Remediation Contract (ORC) services for the United States Air Force (USAF) Installation Restoration Program (IRP) at Avon Park Air Force Range (APAFR). This document describes procedures and provides guidelines for performance of environmental restoration activities described in the Performance Work Statement (PWS) for this delivery order dated 19 May 2021. Specifically, this UFP-QAPP addresses the provision of long-term management at six APAFR sites, including groundwater monitoring and land use control (LUC) inspections. Protocols for sample collection, handling, and storage; chain-of-custody, laboratory, and field analyses; data validation; and reporting are also addressed in this UFP-QAPP. Table 1 provides the crosswalk for the optimized UFP-QAPP worksheets to the appropriate 2106-G-05 QAPP guidance section.

Updates to this Basewide UFP-QAPP will be prepared as needed for potential scope changes and/or future work components..

BASEWIDE UFP-QAPP FRAMEWORK AND ORGANIZATION

This Basewide UFP-QAPP provides a framework for obtaining data of sufficient quality and quantity to satisfy project needs and provides information regarding five general aspects of the site activities at APAFR, including: (1) project management and objectives, (2) measurement and data acquisition, (3) field sampling rationale, (4) assessment and oversight, and (5) data review. Data acquisition, reporting, and evaluation will be completed in accordance with this UFP-QAPP.

This document meets the requirements and elements set forth in the following:

- *UFP-QAPP Manual* (Intergovernmental Data Quality Task Force, U.S. Environmental Protection Agency [EPA] Publication No. EPA-505-B-04-900A, U.S. Department of Defense [DoD] Publication No. DTIC ADA 427785, Version 1, March 2005 including the 2012 optimized worksheets where applicable.
- *DoD Quality Systems Manual (QSM) for Environmental Laboratories*, Version 5.4 (DoD, 2021).

This document also meets the general requirements for a UFP-QAPP, as described in the USACE Mobile District Chemistry Instructions for Scope of Services for Contracted Environmental Studies, issued in July 2019. Table 1 provides an outline of the worksheets included in this document.

Table 1: Crosswalk – UFP-QAPP Workbook to 2106-G-05 QAPP ¹

UFP-QAPP Worksheets		2106-G-05 QAPP Guidance Section	
1 & 2	Title and Approval Page	2.2.1	Title, Version, and Approval/Sign-Off
3 & 5	QAPP Distribution and Project Organization	2.2.3	Distribution List
		2.2.4	Project Organization and Schedule

UFP-QAPP Worksheets		2106-G-05 QAPP Guidance Section	
4, 7 & 8	Personnel Qualifications and Sign-off Sheet	2.2.1	Title, Version, and Approval/Sign-Off
		2.2.7	Special Training Requirements and Certification
6	Communication Pathways	2.2.4	Project Organization and Schedule
9	Project Planning Session Summary	2.2.5	Project Background, Overview, and Intended Use of Data
10	Conceptual Site Model	2.2.5	Project Background, Overview, and Intended Use of Data
11	Project/Data Quality Objectives	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
12	Measurement Performance Criteria	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
13	Secondary Data Uses and Limitations	3	QAPP Elements for Evaluating Existing Data
14 & 16	Project Tasks & Schedule	2.2.4	Project Organization and Schedule
15	Project Action Limits and Laboratory-Specific Detection / Quantitation Limits	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
17	Sampling Design and Rationale	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
18	Sampling Locations and Methods	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
		2.3.2	Sampling Procedures and Requirements
19 & 30	Sample Containers, Preservation, and Hold Times	2.3.2	Sampling Procedures and Requirements
20	Field Q	2.3.5	QC Requirements
21	Field SOPs	2.3.2	Sampling Procedures and Requirements
22	Field Equipment Calibration, Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and
23	Analytical SOPs	2.3.4	Analytical Methods Requirements and Task Description
24	Analytical Instrument Calibration	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection		
26 & 27	Sample Handling, Custody, and Disposal	2.3.3	Sample Handling, Custody Procedures, and Documentation

UFP-QAPP Worksheets		2106-G-05 QAPP Guidance Section	
28	Analytical QC and Corrective Action	2.3.5	Quality Control Requirements
29	Project Documents and Records	2.2.8	Documentation and Records Requirements
31, 32 & 33	Assessments and Corrective Action	2.4	Assessments and Corrective Action
		2.5.5	Reports to Management
34	Data Verification and Validation Inputs	2.5.1	Data Verification and Validation Targets and Methods
35	Data Verification Procedures	2.5.1	Data Verification and Validation Targets and Methods
36	Data Validation Procedures	2.5.1	Data Verification and Validation Targets and Methods
37	Data Usability Assessment	2.5.2	Quantitative and Qualitative Evaluations of Usability
		2.5.3	Potential Limitations on Data Interpretation
		2.5.4	Reconciliation with Project Requirements

Note:

¹ Table retrieved from *Intergovernmental Data Quality Task Force, Uniform Policy Plan for Quality Assurance Project Plan Optimized UFP-QAPP Worksheets*. March 2012.

Supplemental information supporting data validation, data usability, and analytical laboratory certifications and standard operating procedures (SOPs) are provided in this UFP-QAPP in the following appendices:

- Appendix A – Data Management and Validation: Following sample collection and analysis, the data must be reviewed, reported, and validated. The procedures described in this attachment are conducted to ensure that the data was collected and obtained in accordance with this QAPP, the applicable guidance documents, and good practices to ensure that the data quality requirements of the project are met.
- Appendix B – Usability Assessment Procedures: Usability assessment procedures include procedures for assessing data usability, which is the final step in the data evaluation process. The assessment process is summarized in Worksheet No. 37 and is described in more detail in this attachment.
- Appendix C – Laboratory Certification and Standard Operating Procedures: This attachment provides the DoD Environmental Laboratory Accreditation Program Certification and analytical laboratory SOPs.
- Appendix D – Field Standard Operating Procedures: This attachment provides the Tanaq SOPs for field activities conducted by on-site field staff.

- Appendix E – Accident Prevention Plan (APP)/Site Safety and Health Plan (SSHP): The APP/SSHP identifies the safe work practices and procedures that will be followed during implementation of ORC fieldwork. Included with the APP/SSHP are health and safety (H&S) field forms, activity hazard analysis forms, (H&S) certifications and emergency contact and hospital route information.
- Appendix F – Waste Management Plan (WMP): This attachment describes the procedures for the storage, management, and disposal of investigation-derived waste (IDW) generated from remediation activities.

RESPONSIBILITIES AND AUTHORITIES

Tanaq, as the primary contractor for this project, maintains ultimate responsibility for managing project performance, quality, H&S, and meeting performance objectives. All Tanaq Team staff members participating in project and field sampling efforts are required to read this UFP-QAPP and become familiar with the analytical procedures and the implementation of these procedures to ensure that analytical and sampling goals are consistently met. In addition, key personnel are responsible for training assigned staff in aspects of this UFP-QAPP that would have a potential impact on the work assigned to them. Subcontracted construction, laboratory, and data validation staff, as appropriate, will also be required to understand and comply with the requirements of the UFP-QAPP that relate to their project activities.

This document will be reviewed and approved by representative Tanaq, USACE Mobile District, APAFR, and Florida Department of Environmental Protection (Florida DEP) regulatory personnel, as shown in Worksheet No. 1. Other stakeholders will receive a copy of this UFP-QAPP for informational purposes. Any updates to this UFP-QAPP will require approval from the applicable regulators, base personnel, and other stakeholders. These personnel are identified in Worksheets No. 3 and 5.

PROGRAM DESCRIPTION

The LTM activities at APAFR are being conducted in accordance with the Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendments (HSWAs) permit at APAFR (EPA site identification [ID] number FL8 572 128 587, Permit Number 38564-009-HH). Regulatory oversight is provided by the Florida DEP. All environmental efforts for Solid Waste Management Units shall be consistent with the RCRA Corrective Action Permit Number 38564-009-HH (expiration date 04/15/2033), which was issued and is enforced by Florida DEP and shall be accomplished to avoid violations associated with the permit.

GENERAL TECHNICAL APPROACH

The objective of this contract is to provide environmental remediation services through long-term management at APAFR. This includes groundwater monitoring and land use control (LUC) inspections at the following sites:

- OT045 (Former Stressed Vegetation Area)
- OT059A (Keene Dip Vat)
- OT059C (Kissimmee River Dip Vat)
- OT059D (Charlie Range Dip Vat)
- OW500 (Pesticide and Hazardous Waste Storage Site Oil/Water Separator)
- ST065 (Former Government Vehicle Refueling Area)

LUC inspections occur annually at the sites listed above. The full sampling design and rationale is provided in Worksheet 17. Based on the site history and regulatory status, basewide groundwater monitoring is currently conducted at the sites in accordance with the following schedule:

Site	Frequency	2022	2023	2024	2025	2026	2027
OT045	Biennial	X		X		X	
OT059A	Biennial	X		X		X	
OT059C	Biennial	X		X		X	
OT059D	Triennial	X			X		
OW500	Biennial	X		X		X	
ST065	Triennial	X			X		

This page was intentionally left blank.

QAPP WORKSHEET NOS. 1 AND 2 TITLE AND APPROVAL PAGE

Basewide Uniform Federal Policy for Quality Assurance Project Plan, Update 1, ORC at Avon Park Air Force Range, Florida, Revision 0

Site Name/Project Name: Basewide FL Central ORC at APAFR

Site Location: Avon Park Air Force Range, Avon Park, Florida

Contract Number: Contract No: W9127821D0063; Delivery Order No: W9127821F0305

Contract Title: Florida Central ORC

Lead Organization: USACE Mobile District

Preparer's Name and Organizational Affiliation: Melaina Pierce, PMP – Tanaq

Preparation Date: October 2023

Preparer's Address and Telephone Number: 2480 W. 26th Ave, Suite B-26
Denver, Colorado 80211
860-881-5292

Identify guidance used to prepare QAPP:

Uniform Federal Policy for QA Project Plans, March 2005 and March 2012; *EPA Requirements for QA Project Plans EPA QA/R-5* (EPA 2000); *EPA Guidance for QA Project Plans, EPA QA/G-5* (EPA, 2002c); *EPA Guidance on Systematic Planning Using the Data Quality Objective Process, EPA QA/G-4* (EPA, 2006); *U.S. Department of Defense Quality Systems Manual, Versions 5.4* (October 2021); *EPA UFP-QAPP Manual, Intergovernmental Data Quality Task Force*, EPA Publication No. EPA-505-B-04-900A, DoD Publication No. DTIC ADA 427785, Version 1, March 2005.

Identify regulatory programs:

Environmental monitoring and restoration at APAFR is being conducted in accordance with the RCRA HSWA permit (38564-009-HH). Florida DEP currently regulates environmental restoration at contaminated sites using the Contaminated Site Cleanup Criteria, Chapter 62-780 of the Florida Administrative Code (F.A.C), most recently updated in 2017 (FAC and Florida Administrative Register [FAR], 2017).

Identify approval entities: USACE Mobile District, USAF, Florida DEP.

Indicate whether the QAPP is a generic or project-specific QAPP: Project-specific

List dates of scoping sessions that were held: Informal Kickoff Meeting held on September 14, 2021; Formal Kickoff Meeting held on October 8, 2021.

QAPP Worksheet Nos. 1 and 2 (Continued)

Title and Approval Page

Previous Plans and Reports Relevant to Project: Tanaq, 2022. *Basewide Uniform Federal Policy Quality Assurance Project Plan, Avon Park Air Force Range, Florida. Revision 3.* November.

Tanaq, 2023. *2022 Basewide Monitoring Report, Environmental Remediation Services at Avon Park Air Force Range, Florida, Revision 3.* February.

Gilbane Federal, 2021. *2020 Basewide Monitoring Report, OT045, OT059A, OT059C, OT059D, OW500, and ST065, Avon Park Air Force Range, Florida. Revision 2.* April.

List organizational partners (stakeholders): USACE Mobile District: contracting agency, technical oversight, construction support; USAF: funding agency, program oversight, technical support; Florida DEP: RCRA authority, regulatory review, and approval.

List data users: USACE, USAF, Florida DEP, and Tanaq.

QAPP Worksheets No. 1 and 2 (Continued)

Title and Approval Page

Prime Contractor's Project Manager (PM):

Signature/Date

Melaina Pierce, PMP, Tanaq

Prime Contractor's Program Manager:

Signature/Date

Meriam Senoussi, PG, Tanaq

Prime Contractor's Project Contractor
Quality Control System Manager (CQCSM):

Signature/Date

Brantley Rudd, Tanaq

Prime Contractor's Project Chemist

Signature/Date

Meg Michell, Environmental Standards, Inc

USACE Project Manager:

Signature/Date

Bradley Jackson, PG, CHMM

Environmental Restoration Chief:

Signature/Date

Karen Campbell-Fraze, PE

APAFR Remedial Project Manager (RPM):

Signature/Date

Kristy Snyder

Florida DEP Regulator:

Signature/Date

Opeyemi Kehinde

This page was intentionally left blank.

QAPP WORKSHEETS NO. 3 AND 5

QAPP DISTRIBUTION LIST AND PROJECT ORGANIZATION

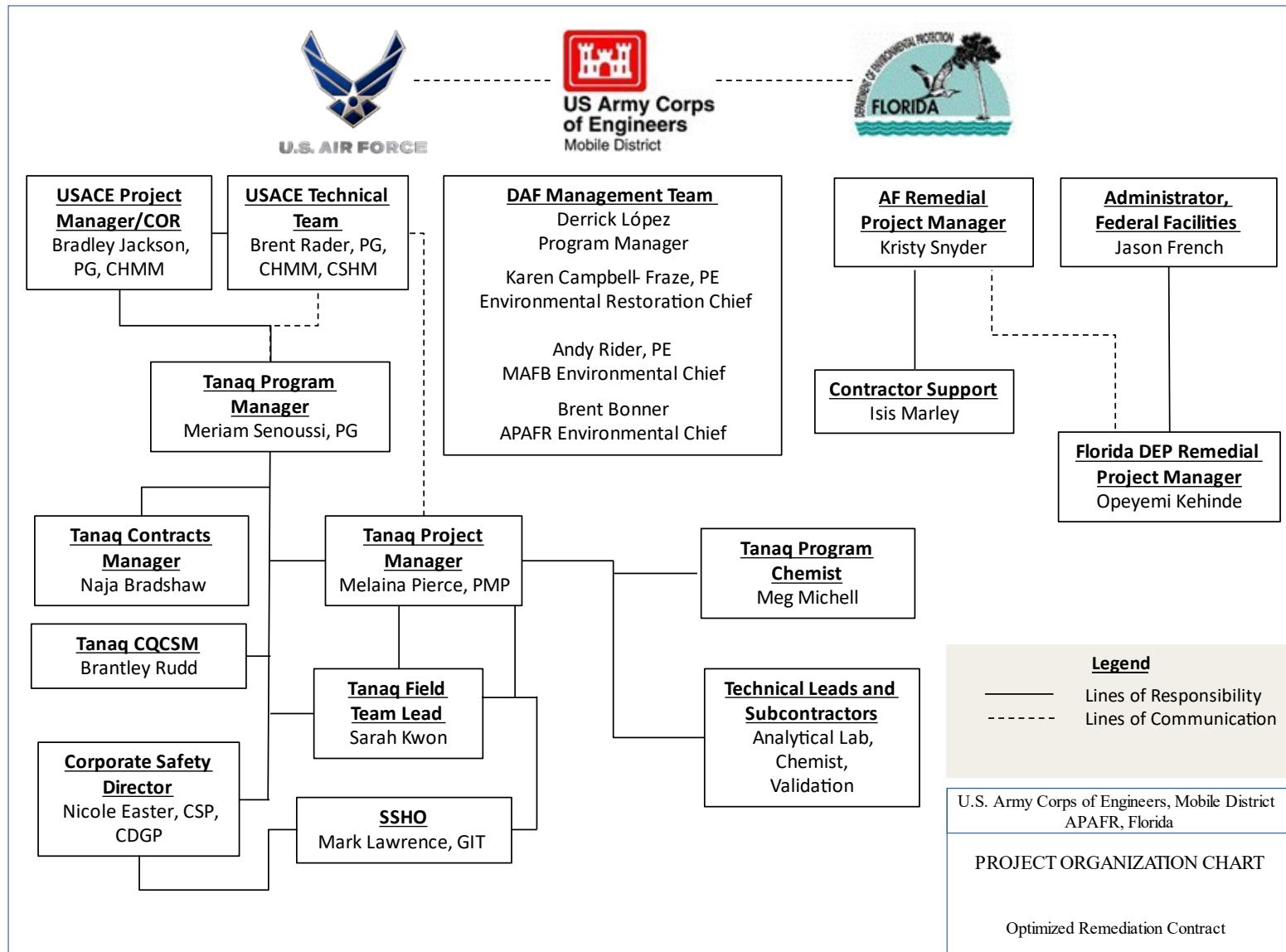
The following is the distribution list for the UFP-QAPP. Team members include the Field Team Leader (FTL), the PMs of each project laboratory (including the primary and subsidiary laboratory support), and senior data validation staff.

QAPP Recipients	Title	Organization	Telephone Number	Email Address	Mailing Address
Bradley Jackson, PG, Certified Hazardous Materials Manager (CHMM)	USACE PM	USACE Mobile District	(251) 694-3670	ronald.b.jackson@usace.army.mil	U.S. Army Corps of Engineers Mobile District 109 St. Joseph Street, Mobile, AL 36602
Brent Rader, PG, CHMM, Certified Safety and Health Manager (CSHM)	USACE Technical Manager™		(251) 694-3628	nelson.b.rader@usace.army.mil	
Opeyemi Kehinde	Regulator	Florida DEP	(850) 245-8887	Opeyemi.Kehinde@FloridaDEP.gov	2600 Blair Stone Rd. MS 4535 Tallahassee, FL 32399-2400
Karen Campbell-Fraze, PE	Environmental Restoration Chief	USAF	(813) 828-0764	karen.campbell-fraze@us.af.mil	6 CES/CEVR 7621 Hillsborough Loop Dr. MacDill Air Force Base (MAFB), FL 33621-5207
Kristy Snyder	USAF RPM	USAF	(813) 828-0776	kristy.snyder.2@us.af.mil	
Isis Marley	USAF Contractor Support	Contractor, AFCEC/CZOE	(352) 249-8339	isis.marley.ctr@us.af.mil	
Meriam Senoussi, PG	Program Manager	Tanaq	(773) 504-4406	msenoussi@tanaq.com	Greater Tampa Bay Area
Melaina Pierce, PMP	PM		(860) 881-5292	mpierce@tanaq.com	2480 W. 26 th Ave. Suite B-26, Denver CO 80211

QAPP Worksheets No. 3 and 5 (Continued)

QAPP Distribution List and Project Organization

QAPP Recipients	Title	Organization	Telephone Number	Email Address	Mailing Address
Meg Michell	Program Chemist	Environmental Standards, Inc.	(610) 935-5577 x110234	mmichell@envstd.com	1140 Valley Forge Rd, PO Box 810, Valley Forge, PA 19482
Brantley Rudd	CQCSM/Site Superintendent	Tanaq	(404) 944-1077	bruidd@tanaq.com	2480 W- 26th Ave. Suite B-26 Denver, CO 80211
Sarah Kwon	Field Team Lead	Tanaq	727-301-5865	skwon@tanaq.com	Greater Tampa Bay Area
Nicole Easter, Certified Safety Professional (CSP), Certified Dangerous Goods Professional (CDGP)	Corporate H&S	Tanaq	(813) 732-8691	neaster@tanaq.com	
Julianne Ryan	Quality Assurance (QA) Manager	Tanaq	(906) 281-0022	jryan@tanaq.com	2480 W- 26th Ave. Suite B-26 Denver, CO 80211
Ariel Hartney	Laboratory PM	SGS North America, Inc.	(407) 425-6700 Ext. 14	Ariel.Hartney@sgs.com	4405 Vineland Rd. Suite C-15 Orlando, FL 32811
Cindy Lee Westergard	Data Validation Senior Chemist	Verdantas, LLC	(813) 968-7722	cwestergard@verdantas.com	15711 Mapledale Blvd, Suite B Tampa, FL 33624



This page was intentionally left blank.

QAPP WORKSHEETS NO. 4, 7, AND 8 PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET

Site personnel, including the FTL and sampling personnel, are required to read this QAPP before field activities begin. Signatures will also be required from each laboratory PM and data validation staff (either Tanaq personnel or subcontracted data validation firm); these support roles will be filled on a site-specific basis. Note that it is possible that the primary subcontracted laboratory may assign analyses to other laboratories, either secondary subcontracted laboratories or other facilities within the primary laboratory's corporate network. The signature of the PM of each laboratory facility that will be receiving samples will be included. All applicable signatures and dates can be found on Worksheets No. 1 and 2.

Name	Title/Role	Education/ Experience	Specialized Training/Certifications	Responsibilities
USACE Personnel				
Bradley Jackson, PG, CHMM	USACE PM	Available upon request	Available upon request	Provides general oversight and overall technical direction of work conducted by contractor. Reviews contractor submittals to ensure they conform to contract and PWS requirements. Coordinates USACE Technical Team review of contractor submittals as required to ensure appropriate USACE technical resources are involved in review; identifies additional resources or technical expertise as required for specific submittals.
Brent Rader, PG, CHMM, CSHM	USACE Technical Manager (TM), Contracting Officer Representative (COR)	Available upon request	Available upon request	Provides technical support and review.
Avon Park Personnel				
Karen Campbell-Fraze, PE	USAF Environmental Restoration Chief	Available upon request	Available upon request	Provides USAF oversight and direction for execution of all APAFR Environmental Restoration Program (ERP)/Military Munitions Response Program (MMRP) projects. Reviews contractor technical submittals to ensure they meet USAF program and project requirements within the framework of the PWS.

QAPP Worksheets No. 4, 7, and 8 (Continued) Personnel Qualifications and Sign-off Sheet

Name	Title/Role	Education/ Experience	Specialized Training/Certifications	Responsibilities
Avon Park Personnel				
Kristy Snyder	USAF RPM	Available upon request	Available upon request	Acts as primary USAF Point of Contact (POC) for all communication with Florida DEP, including submission of regulatory documents to the agency. Reviews contractor technical submittals to ensure they meet USAF program and project requirements within the framework of the PWS.
Isis Marley	USAF Contractor Support	Available upon request	Available upon request	Provides technical support to USAF RPM with document reviews and Administrative Record maintenance.
Bill Buchans	APAFR Environmental Element Chief	Available upon request	Available upon request	Support and management to environmental programs at APAFR.
Brent Bonner	USAF ERP Environmental Flight Chief	Available upon request	Available upon request	Provides overall USAF management of environmental programs at APAFR (including management oversight of ERP), and coordinates ERP activities with other environmental programs at the base and other APAFR operations.
Derrick López	Air Force Civil Engineer Center (AFCEC) Program Manager	Available upon request	Available upon request	Provides general USAF oversight of ERP work at APAFR. Supports development of USAF ERP programs, including funding requirements, for both bases.
Florida DEP Personnel				
Jason French	Florida DEP Administrator for Federal Facilities	Available upon request	Available upon request	Provides overall management and guidance of regulatory oversight for ERP at federal facilities throughout Florida. Ensures that all ERP submittals from federal facilities meet statutory and regulatory requirements of the state of Florida.
Opeyemi Kehinde	Florida DEP Regulator	Available upon request	Available upon request	Provides regulatory oversight of RCRA/HSWA corrective measures implementation at all APAFR sites using Florida Chapter 62-780 F.A.C. rules. Reviews all APAFR regulatory submittals for conformance to Chapter 62-780 rules and other applicable state of Florida rules and regulations. Provides regulatory direction and guidance to USAF, USACE, and performance-based remediation contractor team for implementation of restoration programs in conformance with Florida DEP requirements.

QAPP Worksheets No. 4, 7, and 8 (Continued)

Personnel Qualifications and Sign-off Sheet

Name	Title/Role	Education/ Experience	Specialized Training/Certifications	Responsibilities
Tanaq Personnel				
Meriam Senoussi, PG	Tanaq Program Manager	B.S. Marine Science – Geology Experience: 18 years	40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) with current 8-hour refresher, 30-hour OSHA Construction, First Aid/Cardiopulmonary resuscitation (CPR)/Automated external defibrillator (AED) training, Construction Quality Management for Contractors (CQMC)	Oversees performance of the Tanaq Team to ensure USACE and USAF requirements are met in accordance with the contract and PWS.
Melaina Pierce, PMP	Tanaq Project Manager	B.S. Environmental Studies Experience: 13 years	40-hour HAZWOPER with current 8-hour refresher, 30-hr OSHA Construction, First Aid/CPR/AED training, CQMC, Project Management Professional (PMP)	POC for USACE PM and IRP RPM and is primarily responsibility for overall execution and oversight of the contract. Ensures that Tanaq achieves performance objectives and milestones. Manages administrative aspects of the delivery order, tracks and reports delivery order performance. Supports FL Central ORC partnering meetings and focused meetings as required to achieve contract goals.
Meg Michell	Environmental Standards, Inc. Program Chemist	B.S.: Chemistry M.S.: Organic Chemistry Experience: 32 years	Qualification provided upon request.	Oversees Tanaq's QA program for environmental sampling and laboratory analysis.
Julianne Ryan	Tanaq Quality Assurance Manager	B.S. Environmental Engineering Experience: 3 years	40-hour HAZWOPER with current 8-hour refresher and First Aid/CPR/AED training	Assists Tanaq's QA program for environmental sampling and laboratory analysis.

Name	Title/Role	Education/ Experience	Specialized Training/Certifications	Responsibilities
Sarah Kwon	FTL	B.S., M.S., Marine Science Experience: 5 years	40-hour HAZWOPER with current 8-hour refresher, OSHA 30-hr Construction training, First Aid/CPR/AED training, CQMC	Responsible for ensuring that field work is carried out according to all plans and SOPs, in a safe and timely manner.
Brantley Rudd	Tanaq CQCSM	H.S. College Prep Experience: 21 years	40-hour HAZWOPER with 8- hour refresher, Construction Quality Management certification, 30-hr OSHA Construction	Implements field-related quality control (QC) activities, initiates necessary rework and/or corrective actions (CAs).
Mark Lawrence, Geologist in Training (GIT)	Tanaq Site Safety and Health Officer (SSHO)	B.S. Geology Experience: 3 years	40-hour HAZWOPER with current 8-hour refresher, First Aid/CPR/AED training, CQMC	Reports to Corporate H&S Manager. Coordinates with Program Manager, PM, and onsite staff. Provides site safety and health oversight for all field activities at APAFR.
Ariel Hartney	SGS Laboratory PM	Available upon request	Available upon request	Serves as the laboratory's primary contact for the project. Ensures laboratory compliance with project needs in both QC and project deliverables.
Nicole Easter, CSP, CDGP	Tanaq Corp H&S Manager	B.S. Environmental Science and Policy Experience: 13 years	40-hour HAZWOPER with 8- hour refresher, CQMC, 30-hr OSHA Construction, CDPG CSP	Reports to Tanaq Program Manager and oversees Tanaq's Health and Safety Program. Coordinates with Program Manager, PM and onsite staff.

QAPP WORKSHEET NO. 6 COMMUNICATION PATHWAYS

(UFP-QAPP Manual Section 2.4.2) (EPA 2106-G-05 Sections 2.2.4)

Communication Driver	Organization	Name/ Title	Contact Information	Procedure
Regulatory agency interface	USAF	Karen Campbell-Fraze, PE Environmental Restoration Chief Kristy Snyder USAF RPM	karen.campbell-fraze@us.af.mil (813) 828-0764 kristy.snyder.2@us.af.mil (813) 828-0776	All materials and information about the project will be forwarded to the Florida DEP PM by the USAF RPM. The USAF RPM will coordinate all partnering meetings, progress meetings, and review meetings, as required, with the Florida DEP PM. The USACE RPM will also notify the Florida DEP PM of any schedule changes, technical issues, or field activities that will potentially affect the regulatory outcome of work at any APAFR site.
Primary POC with USAF	USACE	Bradley Jackson, PG, CHMM USACE PM	ronald.b.jackson@usace.army.mil (251) 694-3670	The USACE PM will communicate all contractual issues, including contractor progress, schedules, milestone payments and performance issues, with the USAF RPM. The USACE PM will also coordinate partnering meetings, progress meetings, and key teleconferences between the USACE, contractors, and/or regulators with the USAF RPM. The USACE PM will keep the USAF RPM up to date on all contractor activities that affect the performance of the contract effort.
Primary contractual POC with USACE	Tanaq	Naja Bradshaw Contracts Manager	nbradshaw@tanaq.com	All contractual communications with the USACE Contracting Officer will be conducted by the Tanaq Contract Manager, with coordination and support from the Tanaq PM and the Tanaq Program Manager.

Communication Driver	Organization	Name/ Title	Contact Information	Procedure
Primary technical POC with USACE	Tanaq	Melaina Pierce, PMP Tanaq PM	mpierce@tanaq.com (860) 881-5292	The Tanaq PM will communicate project-related issues, including changes in schedule, changes in scope of fieldwork or delays, and recommendations to stop work, to the USACE PM by phone, email, or fax by close of business the next business day. The Tanaq PM will also provide project information to the USACE PM through monthly progress reports, email updates, teleconference calls, and meetings. They will document deviations from QAPP and CA in memoranda to USACE PM and will notify USACE of laboratory CA within 24 hours of notification from the laboratory or Project Chemist. The PM will communicate all chemistry-related issues to the USACE project chemist.
Field progress reports and Daily Quality Control Reports (DQCRs)	Tanaq	Brantley Rudd, CQCSM	brudd@tanaq.com (440) 944-1077	Field progress reports will vary based on the project objectives. Examples of these reports are surveying results, waste disposal manifests, and DQCRs. Generally, field progress reports will be transmitted to the Tanaq PM by the end of each day of field work, and then distributed by the Tanaq PM to the USACE PM and USACE Technical Team by the end of the following business day.
Stop work because of safety issues	Tanaq USACE USAF Florida DEP	All project staff	See project contact list	If unsafe work conditions are observed, all project staff are empowered and obligated to issue a Stop Work immediately and alert the SSHO. Work will not be allowed to resume until the unsafe condition is corrected. The SSHO will immediately notify the Corporate Tanaq H&S Officer and PM when a stop work situation is encountered. In some cases, such as inclement weather (such as lightning or high winds), no CA is required and work may resume when the SSHO and Corporate H&S Officer determine that conditions allow. Depending on circumstances, the SSHO or PM will notify the USACE PM and USAF RPM as soon as practicable following any work stoppage.

QAPP Worksheet No. 6 (Continued)

Communication Pathways

Communication Driver	Organization	Name/ Title	Contact Information	Procedure
QAPP changes before fieldwork	Environmental Standards, Inc.	Meg Michell Environmental Standards, Inc. / Julianne Ryan Tanaq QA Manager	mmichell@envstd.com (610) 935.5577 x110234 jryan@tanaq.com (906) 281-0022	If errors or changed conditions require the modification of the QAPP before fieldwork begins, the Project Chemist will prepare revised text in collaboration with the PM. All changes to the QAPP will require final approval from USACE PM, the USAF RPM, and Florida DEP.
QAPP changes during project execution	Tanaq	Brantley Rudd, CQCSM Mark Lawrence, SSHO	brudd@tanaq.com (440) 944-1077 mlawrence@tanaq.com (325) 660-1738	The FTL will notify the PM and Project Chemist of field deviations from QAPP within 2 business days and provide rationale for changes. The FTL will document changes in field daily progress reports and memoranda to the PM, review field operations daily and evaluate need for field CAs (in collaboration with PM), and document CA in the daily logs and in memoranda to the PM and USACE PM. All changes to the QAPP will require final approval from USACE and regulatory agencies.
Field CAs	Tanaq			CA resulting from either failure to follow QAPP requirements or because of changes in site conditions will be documented by the FTL; the FTL will communicate the need for CA to the PM on the same business day. The FTL may initiate interim CA in the field subject to final approval by the Tanaq PM and CQCSM.
Sample receipt discrepancies (e.g., broken or missing samples, improper preservation, missing analysis requests)	SGS	Ariel Hartney SGS North America, Inc.	Ariel.Hartney@sgs.com (407) 425-6700 Ext. 14911	The laboratory PM will communicate discrepancies in sample receipt to the Tanaq PM on the same business day that the discrepancy is identified. The Tanaq PM will notify the USACE PM and USACE Chemist, and in consultation with the Project Chemist and the USACE Chemist, will instruct the laboratory PM on the appropriate course of action.

QAPP Worksheet No. 6 (Continued)

Communication Pathways

Communication Driver	Organization	Name/ Title	Contact Information	Procedure
Laboratory QC variances	Environmental Standards, Inc.	Meg Michell Environmental Standards, Inc. Program Chemist	mmichell@envstd.com (610) 935-5577 Ext. 110234	The Tanaq Program Chemist will prepare variance requests in collaboration with laboratory PMs for transmittal to USACE for approval. The USACE Chemist will be notified of all laboratory variances.
Analytical CAs				The need for laboratory CAs will be determined by the Tanaq Program Chemist and/or laboratory PM or QA Manager and will be documented in memoranda to the USACE PM, USACE Chemist, and Tanaq PM.
Data validation issues, (e.g., noncompliance with procedures)				Where it is determined that the laboratory is not in compliance with the requirements of the QAPP, the Project Chemist will coordinate with the laboratory PM to bring the laboratory's practices into compliance and will notify the USACE Chemist of any noncompliance. In some cases, this process will require the preparation of the variance request (see above).
Data review CAs				Final analytical data cannot be released until any required validation is complete and the Project Chemist has approved release.
Data Tracking and Management	Tanaq	Julianne Ryan Tanaq QA Data Manager	jryan@tanaq.com (906) 281-0022	The database manager or designee will track data from collection of samples through login at laboratory to delivery by technical report/sample delivery group (SDG) and electronic data delivery into database.

QAPP WORKSHEET NO. 9

PROJECT SCOPING SESSION PARTICIPANTS SHEET

A formal virtual kickoff meeting was held on October 8, 2021, with the participants of that meeting are listed in the table below, to discuss the schedule for execution of the Environmental Remediation Services prime contract No. W9127821-D-0063, Delivery No. W9127821F0305 at APAFR, Florida.

Name	Organization	Title/Role	Email/Phone
Tiffany Seibt	USACE	Former USACE Project Manager	tiffany.h.seibt@usace.army.mil (251) 694-4539
Cade Burgin, PE		Former USACE Technical Manager	cade.a.burgin@usace.army.mil (251) 441-5599
Tish Matty	AFCEC/CZOE	Former RPM	patricia.matty@us.af.mil (813) 833-1997
Kristy Snyder		Current RPM	Kristy.snyder.1.ctr@us.af.mil (813) 828-0776
Richard Burnette		Former Environmental Flight Chief	rburnette@tampabay.rr.com (813) 293-2998
Andrew Rider, PE		Chief Environmental Element	Andrew.rider.2@us.af.mil (813) 828-2718
Derrick López	AFCEC/CZRE	Program Manager, Air Force Program Management Restoration Program Manager, CZRE	derrick.lopez.2@us.af.mil 863-452-4166
Roby Gregg		Program Manager, Air Force Program Management Restoration Program Manager, CZRE	Roby.gregg@us.af.mil (210) 481-2855
Rachael Greller	USAF, APAFR	Base Support, APAFR	Rachael.greller.ctr@us.af.mil (210) 533-5100
Don Boyle, PE, PMP	Tanaq	Former Program Manager	dboyle@tanaq.com (303) 503-8496
Meriam Senoussi, PG		Former PM/Current Program Manager	msenoussi@tanaq.com (773) 504-4406
Ethan Blatt		Former FTL	eblatt@tanaq.com (315) 378-7296
Kelsey Cates		Operations Manager	kcates@tanaq.com (970) 217-0045 mailto:

This page was intentionally left blank.

QAPP WORKSHEET NO. 10 CONCEPTUAL SITE MODEL

10.0 BACKGROUND AND HISTORY

10.1 APAFR BACKGROUND

APAFR is in central Florida in Polk and Highlands Counties, approximately 95 miles east of the city of Tampa. The APAFR covers 106,074 acres, of which 103,484 acres are unimproved land used for APAFR activities, including management of installation natural resources as shown in **Figure 1**. Some of these activities include cattle grazing/ranching, outdoor recreation, and timber management. The APAFR consists of three main areas, as follows: 1) the cantonment area, which includes an Auxiliary Airfield and Range support facilities for personnel and equipment, 2) the active and inactive Range Complexes, and 3) the public recreational areas, which are identified by management units and shared by the cattle leasing and timber harvesting programs.

The APAFR was acquired by the federal government as a training range in 1942 and is located approximately 10 miles east of Avon Park, Florida. The property, prior to becoming an Air Force Range, was used primarily for turpentine production, cattle grazing, and timber harvesting. Several settlements and homesteads were also present prior to acquisition of the Range during 1942. This installation, formerly known as the Avon Park Army Air Field, was utilized by the Army Air Corps during World War II for training B-17 aircraft crews. To meet the demand for training requirements of the Range, the government acquired approximately 218,224 acres. At the close of 1945, the Air Force declared 111,000 acres in Okeechobee County as surplus. As the property was relinquished, the Range no longer included the adjacent land on the east side of the Kissimmee River. In 1947, the Army Air Field was deactivated and placed in caretaker status. Two years later (1949), the installation was transferred to the Air Force and became known as the Avon Park AFR. Two years later (1951), the DoD granted approximately 800 acres, which included the officer's quarters, in the northern part of the cantonment area, to the Department of Justice, as a federal prison. After six years of operating under the U. S. Bureau of Prisons, this facility was relinquished in 1957 to the State of Florida as a correctional facility, currently known as the Avon Park Correctional Institution (AVPCI). In 1956, the main base and airfield were merged with the Avon Park Range and assigned to the Strategic Air Command under MAFB as the APAFR. In 1962, APAFR was reassigned to Tactical Air Command and later, reassigned in 1992 to Air Combat Command. In 1993, all active military authorizations were deleted from the work force and operation of the installation became the responsibility of the DoD civilians employed by the Air Force. On October 1, 1996, operational command of the APAFR was transferred from the 6th Support Group of MAFB, Florida to the 347th Wing of Moody Air Force Base, Georgia.

The current mission of the APAFR is to provide a World Class Joint Expeditionary Forces Training Complex to all Department of Defense agencies. Since the initial construction as a military bombing range in 1942, thousands of bombing and strafing missions have occurred at the Range for combat readiness training. Although some training operations involve live ordnance, most of the training activities use inert munitions.

The APAFR is the largest bombing and gunnery range east of the Mississippi River comprising approximately 106,074 acres across parts of Polk and Highlands Counties, Florida. The APAFR supports various types of aircraft, including F-15 and F-16 fighters, B-1 and B-52 bombers, A-10 attack aircraft, and various types of helicopters. The Range also supports artillery firing, parachute jump training, and other ground exercises conducted by the Florida Army National Guard, the U.S. Army, the U.S. Navy, the U.S. Marines, and the Air Force and Army Reserves.

In addition to the AVPCI, the Avon Park Youth Academy (APYA) is another in holding on the installation. AVPCI houses approximately 1,200 minimum, medium, and close custody inmates with the assistance of 353 staff members as of the year 2003. In addition, approximately 60 resident staff members reside on nearby state property, consisting of old barracks and mobile homes near Lake Arbuckle. On May 15, 1998, the APYA began to operate a Level 6 juvenile correction facility on lands formerly occupied by the APAFR. The lands and facilities at the site were transferred to Highlands County by the Fiscal Year 1998 Defense Appropriations Act. In June 2005, the number of youth residents at the APYA was listed at 200 (out of a capacity of 200), with a staff of 156 personnel.

As part of its responsibilities as a federal land-holding agency, the USAF actively protects and manages cultural resources, endangered species and their habitats and wetlands. The USAF also has an active natural resources land management program, which includes forest management, native rangeland cattle grazing, and public access for recreation.

10.2 ENVIRONMENTAL SETTING

This section provides a general description of the physiography, topography, surface drainage, demography, land use, and climate of APAFR and the surrounding area. The information presented here was compiled from the Basewide Environmental Restoration Work Plan, Revision 5, Avon Park Air Force Range, Florida (Earth Tech, 2005).

10.2.1 Physiography and Topography

The APAFR is located within the Lake Wales Ridge and Osceola Plain Physiographic Regions of the Eastern Flatwoods Physiographic District. The Lake Wales Ridge consists of an elongated area of rolling uplands ranging between 40 ft and 200 ft above mean sea level (amsl) from Haines City to the north and Lake Placid to the south. An associated north-south trending ridge, commonly referred to as the “Bombing Range Ridge” is distinguishable across the central part of the Range. The Osceola Plain consists of relatively flat areas ranging in elevation from 60 ft to 100 ft amsl. This plain is bounded to the west by the Lake Wales Ridge and to the east by the eastern Valley and coastal ridges parallel to the Atlantic coastline. Topographical elevations close to 40 ft amsl are common near the Kissimmee Marsh at the southeastern part of the Range while higher elevations around 140 amsl are more prevalent within the “Bombing Range Ridge” that extends through the central part of the range.

10.2.2 Surface Drainage

Two of the major surface water bodies at APAFR are Lake Arbuckle and Arbuckle Creek, which form the western boundary of the installation. Another surface water body known as Morgan Hole Creek generally

flows from north to south paralleling the east side of the central ridge, then discharges to the southwest into Arbuckle marsh.

10.2.3 Demography and Land Use

As stated above, the majority of the APAFR property is unimproved land that is managed for cattle grazing and ranching activities, timber production, recreational opportunities, and wildlife habitat. The major habitat types found within the central-Florida peninsula and the APAFR are flatwoods, swamps, marshes, sloughs, and sand scrub. Most of the undeveloped land at the Range consists of flatwoods, characterized by slash and longleaf pine, with an herbaceous and woody brush understory. Cypress, gum, bay, oaks, slash pine, and cabbage palms are dominant within swampy and low-lying forests, whereas scrub oak, palmetto, longleaf and sand pine are more prevalent along the upper, north-south trending, ridge sands across the center of the range. The swamps, marshes, and sand scrub areas are environmentally the most sensitive areas on the range. The natural habitat on the Range supports a diversity of fauna including white-tailed deer, bobcat, rabbits, alligators, snapping turtles, gopher tortoises, and a wide variety of wading birds.

Approximately 57 federal and state listed endangered and threatened plant and animal species can be found on the APAFR. Historical sites, such as the Fort Kissimmee Cemetery, cattle dipping vats, and numerous pre-historic sites, are also located on the property. Through the efforts of the Environmental Flight, and as part of the recreation program, the APAFR provides opportunities for public participation in hiking, camping, wildlife watching, fishing, and hunting activities. It is these programs that bring many different user-groups to APAFR.

10.2.4 Climate

The APAFR is in both Polk and Highland counties, Florida. The climate in this area is characterized by long, warm, humid summers and short, mild winters. The mean annual precipitation for the region is 50 inches, with the greatest amount occurring during July and the least during December. The average annual temperature for the area is 73 degrees Fahrenheit (°F). During the winter, the average temperature is 62°F and during the summer, the average temperature is 82°F.

10.3 REGIONAL GEOLOGY

10.3.1 Geology

The geologic units that underlie the site are described in *Florida Geological Survey Open File Report 61* (Green et al., 1995), *Open File Report 15* (Campbell, 1986), *Report of Investigations 44* (Stewart, 1966), and *Report of Investigations 15* (Bishop, 1956). Report of Investigations 15 contains a regional geologic cross-section (A-A') that shows the geologic units near APAFR to a depth of approximately 1,000 feet below land surface (bls).

According to the Report of Investigations 15 (Bishop, 1956), the geologic units from land surface to a depth of approximately 1,000 feet bls beneath APAFR and the approximate depth intervals at which they occur are presented on the following table.

Geologic Unit	Age	Approximate Depth (feet bls)
Undifferentiated sands and clays (UDSC)	Post-Miocene	Land Surface to 35 feet
Hawthorn Group	Miocene	35 feet to 440 feet
Suwannee Limestone	Lower Oligocene	440 feet to 505 feet
Ocala Limestone	Upper Eocene	505 feet to 760 feet
Avon Park Formation	Middle Eocene	760 feet to greater than 1000 feet

Descriptions of these geologic units, as presented in Green et al. (1995), are contained in the following sections.

10.3.1.1 Undifferentiated Sands and Clays

The UDSC are post-Hawthorn Group deposits that are post-Miocene in age. The UDSC consists of interbedded sand, clay, and shell deposits that contain varying amounts of organics and reworked phosphate. Near APAFR, the UDSC deposits unconformably overlie the Tampa Member of the Arcadia Formation.

10.3.1.2 Hawthorn Group

The Arcadia Formation, part of the lower Hawthorn group, outcrops in the Avon Park area. The Tampa Member is the Upper Oligocene to Lower Miocene member of the Arcadia Formation. The remainder of the Arcadia Formation is undifferentiated. The Tampa Member consists of white to yellowish-gray limestone that ranges from wackestone to packestone, with varying amounts of micrite, clay, and quartz sand. Also present in this unit are minor amounts of dolomite, chert, and phosphate. The Tampa Member unconformably overlies the Suwannee Limestone in the vicinity of APAFR.

10.3.1.3 Suwannee Limestone

The Suwannee Limestone is Lower Oligocene in age and consists of light gray to yellowish-gray limestone that ranges from packestone to grainstone. Chert and organics occur in trace amounts throughout these carbonates. Trace amounts of sand and clay occur in the upper portion of this unit. A dolostone or dolomitic limestone (approximately 10 to 20 feet thick) often occurs in the lower one-third portion of this unit. Near APAFR, the Suwannee Limestone unconformably overlies the Ocala Limestone.

10.3.1.4 Ocala Limestone

The Ocala Limestone is Upper Eocene in age and consists of light gray to light-orange limestone. The upper portions of the carbonate unit consist of weathered wackestone to packestone, while the middle and lower portions of this unit consist of biogenic packestone to grainstone. These carbonates contain trace amounts of organics and clays, and variable amounts of dolomite. The Ocala Limestone unconformably overlies the Avon Park Formation in the vicinity of APAFR.

10.3.1.5 Avon Park Formation

The Middle Eocene Avon Park Formation occurs from approximately 550 feet below ground surface (bgs). The upper portion of the Avon Park Formation in this area consists of very light orange to yellowish gray calcarenitic limestone that contains varying amounts of dolomite and organic-rich laminations. The lower

portions of the Avon Park Formation in this area consist of tan to buff dolostones and dolomitic limestones that occasionally contain organic-rich laminations.

10.4 REGIONAL HYDROGEOLOGY

In general, three aquifer systems exist in this area of Florida and include, in the following descending order: 1) surficial aquifer system (SAS); 2) intermediate aquifer system/intermediate confining unit; and 3) Floridan Aquifer System (FAS). The SAS is comprised of unconsolidated sand, clay, and shell deposits of UDSC. Groundwater in this aquifer system typically occurs under unconfined (water table) conditions (Green et al., 1995). If present, the intermediate aquifer system/intermediate confining unit occurs within the Hawthorne Group which, in the vicinity of APAFR, is comprised primarily of the dolomites and limestones of the Arcadia Formation. Typically, the top of FAS coincides with the top of the Suwannee Limestone. However, where sufficient hydraulic vertical connection exists between the Hawthorne Group and underlying Suwannee Formation, the Hawthorne Group is considered a part of the FAS.

The Floridan Aquifer is the principal aquifer in both Polk and Highland Counties. The Floridan Aquifer serves as the source of all major municipal, industrial and irrigation water supplies in Polk and Highland counties (Campbell, 1986).

10.4.1 Surficial Aquifer System

As previously mentioned, the SAS is comprised of the unconsolidated sand, clay, and shell deposits of UDSC. Near APAFR, UDSC, and thus SAS, extends from the surface to depths of approximately 35 feet (ft) bgs. Groundwater in this aquifer system typically occurs at less than 5 ft bgs. Groundwater in SAS discharges to local surface water bodies. Consequently, the groundwater flow in SAS generally is toward nearby surface water bodies. Water levels in SAS can exhibit seasonal fluctuations of several feet depending on the local recharge and evapotranspiration conditions. At locations where low permeability deposits are absent or discontinuous within the range of UDSC (and on top of the intermediate Hawthorne Group), SAS may recharge the underlying FAS. Site-specific lithologic, hydraulic, and chemical data are needed to determine if SAS and FAS are hydraulically connected at a particular site.

10.4.2 Floridan Aquifer System

As discussed above, the Arcadia Formation of the Hawthorne Group directly underlies UDSC in the vicinity of APAFR and is considered part of FAS. The FAS in this area is more than 1,000 ft thick and extends from the top of the Hawthorne Group to evaporite deposits found in the lower portion of the Avon Park Formation. Groundwater in FAS typically occurs under confined conditions.

Groundwater in the upper portions of FAS discharges into nearby lakes, streams, and rivers (i.e., Kissimmee River and Lake Arbuckle). As previously mentioned, locally, FAS may be recharged by the overlying SAS. The permeability of FAS is highly variable depending on lithology and can range from 10-4 ft/day to 10 ft/day.

10.4.3 Local Groundwater Usage

The Floridan Aquifer, specifically the lower portion of the Avon Park Formation, previously called the Lake City Limestone, provides nearly all the municipal and irrigation water supplies in the area. APAFR receives its drinking and general use water supply from two wells located near Lake Arbuckle and two wells located near the airfield. Additionally, several wells at the campground and along hiking trails are completed in the SAS.

10.5 FLORA AND FAUNA

The major habitat types found within the central-Florida peninsula and the APAFR are flatwoods, swamps, marshes, sloughs, and sand scrub. Most of the undeveloped land at the range consists of flatwoods, characterized by slash pine (*Pinus elliottii*) and longleaf pine (*Pinus palustris*), with an herbaceous and woody brush understory. Cypress, gum, bay, oaks (*Quercus* spp.), slash pine, and cabbage palms (*Sabal palmetto*) are dominant within swampy and low-lying forests, whereas scrub oak, palmetto (*Serenoa repens*), longleaf and sand pine are more prevalent along the upper, north-south trending, ridge sands across the center of the Range. The swamps, marshes, and sand scrub areas are environmentally the most sensitive areas of the Range. The natural habitat on the Range supports a diversity of fauna including white-tailed deer, bobcat, rabbits, alligators, snapping turtles, gopher tortoises, and a wide variety of wading birds.

Historical sites, such as the Fort Kissimmee Cemetery, cattle dipping vats, and numerous pre-historic sites are also located on the property. Through the efforts of the Environmental Flight, and as part of the recreation program, the APAFR provides opportunities for public participation in hiking, camping, wildlife watching, fishing, and hunting activities. It is these programs that bring many different user-groups to APAFR. Approximately 50 federal and state listed endangered and threatened plant and animal species can be found at APAFR, including, but not limited to, the following:

- Bonneted bat (*Eumops floridanus*)
- Grasshopper Sparrow (*Ammodramus savannarum*)
- Scrub-jay (*Aphelocoma coerulescens*)
- Red-cockaded woodpecker (*Picoides borealis*)
- Sandhill crane (*Grus Canadensis pratensis*)
- Northern crested caracara (*Caracara cheriway*)
- Wood stork (*Mycteria americana*)
- Bald eagle (*Haliaeetus leucocephalus*)
- Southeastern American Kestrel (*Falco sparverius paulus*)
- Florida Panther (*Puma concolor coryi*)
- Florida Mouse (*Podomys floridanus*)
- Eastern indigo snake (*Drymarchon corais couperi*)
- Gopher tortoise (*Gopherus polyphemus*)
- American Alligator (*Alligator mississippiensis*) and
- Everglade snail kite (*Rostrhamus sociabilis plumbeus*)

Several other species of special concern are also located on base.

10.6 OT045, OT059, ST065, OW500

This section includes brief site background descriptions. Table 10-1 provides a brief description of the technical approaches used at OT045, OT059, ST065, OW500.

Table 10-1

AVON PARK AFR, FL			
Site	Brief description of Technical Approach	Duration	Performance Standard
OT045	LTM in accordance with the approved Statement of Basis and latest monitoring reports/surveillance plans. Maintain nonresidential LUCs and groundwater restrictions. Conduct annual LUCs surveillance and certification.	Through the duration of the Period of Performance (POP) ¹	USAF, USACE, and regulatory approval of LTM documentation (e.g., LUC Inspection Reports, Annual Basewide Monitoring Reports, etc.).
OT059	LTM in accordance with the approved Statement of Basis and latest monitoring reports/surveillance plans. Maintain nonresidential LUCs and groundwater restrictions. Conduct annual LUCs surveillance and certification.	Through the duration of the POP ¹	USAF, USACE, and regulatory approval of LTM documentation (e.g., LUC Inspection Reports, Annual Basewide Monitoring Reports, etc.).
ST065	LTM in accordance with the approved Statement of Basis and latest monitoring reports/surveillance plans. Maintain nonresidential LUCs and groundwater restrictions. Conduct annual LUCs surveillance and certification.	Through the duration of the POP ¹	USAF, USACE, and regulatory approval of LTM documentation (e.g., LUC Inspection Reports, Annual Basewide Monitoring Reports, etc.).
OW500	LTM in accordance with the approved Statement of Basis and latest monitoring reports/surveillance plans. Maintain nonresidential LUCs and groundwater restrictions. Conduct annual LUCs surveillance and certification.	Through the duration of the POP ¹	USAF, USACE, and regulatory approval of LTM documentation (e.g., LUC Inspection Reports, Annual Basewide Monitoring Reports, etc.).

¹The period of performance ends on September 30, 2026.

10.6.1 Site Background

Site OT045, Former Stressed Vegetation Area, is in the Cantonment area of APAFR, west of the runway as shown in **Figure 2**. Site OT045 is the former location of Building 82, which was used for pesticide drum storage and for storage of herbicides and herbicide-application equipment. Well-maintained grassy areas are located within the site boundary. The area referred to as the “formerly stressed vegetation area,” consisting of a group of pine trees and shrubs, was reportedly located east of where Building 82 and the concrete pad were located. However, during a 1994 site reconnaissance, no remaining stressed vegetation was noted in this area.

Site OT059 has three sub-site locations specified by names OT059A, OT059C, and OT059D. OT059A, also known as the Keene Dip Vat, is located east of the intersection of Billig Road and Degagne Road at what used to be the Nalaka Settlement, northeast of the Old Turpentine Distillery (ERP Site No. SS103). **Figure**

3 shows the site location. Site OT059A consists of a cattle dip vat and three other concrete structures, which are assumed to be a water tank foundation and two building foundations.

Site OT059C, also known as the Kissimmee River Dip Vat or Cattle Dip Vat C, is located less than 1,000 feet west of the Kissimmee River. **Figure 4** shows the site location. Several wetland areas are located within 150 to 300 feet south, east, and west of OT059C. At the eastern end of OT059C, a Florida National Scenic Trail sign identifies this site as a cattle dip vat used during the 1920s and 1930s. Site OT059C consists of the cattle dip vat and surrounding area, with no other structures present at this site.

Site OT059D is also known as the Charlie Range Dip Vat, due to its location on an active bombing range. **Figure 5** shows the site location. The dip vat that was present at OT059D was removed during an Interim Remedial Action (RA) conducted in 2009 because the structure was in poor condition.

Site ST065 is located approximately 0.6 miles east of the APAFR main gate and approximately 400 feet south of South Boulevard (**Figure 6**). Site ST065 is the location of a former 10,000-gallon aboveground fuel storage tank associated with former Building 431. Former buildings 432, 433, and 434 were used as a grease house, oil rack, and wash rack, respectively. Activity at this site began as early as 1945 and continued as late as 1986. In 1994, the aboveground storage tank was removed from the site.

Site OW500 includes the former site of Building 73 and is in the Cantonment area of APAFR (**Figure 7**). Building 73 was built in 1943, and it was used as a warehouse until the early 1970s when it was used for administrative purposes, supply and tool storage for range target maintenance, and maintenance for refrigeration, air conditioning, and power generation within the maintenance shop. From September 1993 until December 1995, the facility was used for covered storage of entomology shop mobile spray equipment and was the central accumulation point for hazardous waste generated at APAFR. The facility was demolished in August 2006. A septic tank and drain field system were located adjacent to the south end of Building 73. The septic tank was closed in 2004 in accordance with notice and permit conditions of the Highlands County Health Department. A 500-gallon fiberglass underground oil/water separator (OWS) was present along the west-central side of the building between two small concrete slabs, to collect rinse water and other fluids resulting from servicing and cleaning of generators and air conditioners. The date of the installation is unknown. The OWS was removed on January 28, 1997, as part of OWS closure activities.

QAPP Worksheet No. 10 (Continued)

References

- Bishop, E.W. *Geology and Groundwater Resources of Highland County, Florida*, Florida Geological Survey, Tallahassee, Florida. 1956.
- Campbell, K.M. *Geology of Polk County, Florida*, Open File Report 13, Florida Geological Survey, Tallahassee, Florida. 1986.
- EarthTech, 2005. *Basewide Environmental Restoration Work Plan, Avon Park Air Force Range, Florida*. June.
- Gilbane, 2021. *2020 Basewide Monitoring Report, OT045, OT059A, OT059C, OT059D, OW500, and ST065*. April.
- Green et al. *Florida Geological Survey, Open File Report 61, Tallahassee, Florida*. 1995.
- Stewart Jr., H.G. *Groundwater Resources of Polk County, Florida*, Florida Geological Survey, Tallahassee, Florida. 1966.

This page was intentionally left blank.

QAPP WORKSHEET NO. 11 DATA QUALITY OBJECTIVES

This worksheet presents the Data Quality Objectives (DQOs) that were developed for the LTM being conducted at APAFR. These DQOs were developed using a systematic planning process in accordance with EPA QA/G-4, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006). The DQOs for each site are developed and described below.

Data Quality Objectives for LTM:

1. State the Problem. Routine LTM consisting of LUC inspections and groundwater sampling at IRP sites OT045, OT059, ST065, and OW500, along with management of the associated IDW that is generated from groundwater sampling activities.
2. Identify the Goals of the Study. Maintain compliance with all Decision Documents and permits (currently in place or to be approved) throughout the PoP. In addition, the Contractor will follow approved recommendations from the most recent Annual Basewide Monitoring Report. Update or revise site-specific work plans, monitoring plans, and/or Decision Documents, as appropriate. Manage IDW appropriately (see the Waste Management Plan, **Appendix F**). Evaluate and report on compliance of the LUCs that are in place at the subject sites.
3. Identify Information Inputs. The first information input consists of groundwater samples to be collected from monitoring wells at OT045 for laboratory analysis of arsenic and the organochlorine pesticide chlordane; from OT059 for laboratory analysis of arsenic and the organochlorine pesticide alpha-BHC, beta-BHC, and dieldrin; ST065 for laboratory analysis of arsenic and manganese; and from OW500 for laboratory analysis of arsenic, iron, manganese and the organochlorine pesticides alpha-chlordane, gamma-chlordane, total chlordane, dieldrin, and heptachlor epoxide. For QA/QC purposes, field duplicates will be collected at a rate of approximately 1 per 10 field samples. Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples will be collected at a rate of approximately 1 per 20 field samples. Groundwater samples will be analyzed for Metals by EPA Method 6020B and pesticides by 8081B. The groundwater and QA/QC samples will be sent to SGS North America, Inc in Orlando, Florida for laboratory analysis. These compounds will be collected and analyzed in groundwater to determine if RAs have successfully reduced residual concentrations to below Florida DEP's Groundwater Cleanup Target Levels (GCTLs). Additional details for basewide groundwater sampling can be found in Worksheet 17.
4. Define the Boundaries of the Study. The boundaries of this project are LTM at six sites (OT045, OT059A, OT059C, OT059D, ST065, and OW500), which includes the sampling of groundwater from select monitoring wells and conducting annual LUC inspections. The ORC scope of work covered by this UFP-QAPP is expected to run through September 2026, which is when the POP expires. All groundwater sampling will occur within the physical boundaries of the listed sites.
5. Develop the Analytic Approach. Groundwater samples will be sent to SGS North America in Orlando, Florida for laboratory analysis. The information inputs are outlined under Section 3. These compounds will be analyzed in groundwater to determine if concentrations of contaminants of concern (COCs) are below GCTLs.

6. Specify Performance or Acceptance Criteria. The limit of detection (LOD) for each analyte should be less than the GTCL identified in Worksheet No. 15. In cases where the laboratory is unable to reduce the LOD below the GTCL, this will be highlighted in the data table and non-detects will be considered in compliance. Reporting non-detects at the LOD is considered acceptable. Definitive data, as described in Worksheet No. 12, will be necessary to continue LTM. Data recommended for rejection via the data validation process will be evaluated by the project management team for final inclusion or exclusion in the dataset, as described in **Appendix B**.
7. Develop the Plan for Obtaining Data. Before groundwater samples are collected, groundwater levels will be measured in all groundwater monitoring wells to provide data that will inform the interpreted flow directions at the site. Depth to groundwater will be measured from the top of the casing at the designated measuring point and recorded to the nearest 0.01 foot. If no measuring point is identified on the well casing, the water level will be measured from the top of the casing on the north rim.

Groundwater sampling will be performed using low-flow sampling techniques with a peristaltic pump and polyethylene drop-down tubing. All constituents will be sampled via direct sampling from the peristaltic pump in compliance with *FDEP-SOP-001/01 FS 2200 (Appendix D)*. From the time purging starts, water quality parameters and water levels will be recorded and will continue every 3-5 minutes thereafter until stabilization and total volume removed are compliant with the Florida DEP SOP FS2200 for Groundwater Sampling. Water quality parameters to be measured in the field will include pH, temperature, turbidity, oxidation reduction potential (ORP), dissolved oxygen (DO), turbidity, and specific conductivity. The water quality instruments will be calibrated daily before use and calibrations will be recorded on a calibration log. Water quality parameters will be recorded on the groundwater sampling data sheet.

Tanaq understands that ongoing environmental investigation work is being conducted at APAFR by another contractor at potential Aqueous Film Forming Foam (AFFF) release areas. The AFFF release areas are being sampled for Per- and Polyfluoroalkyl Substances (PFAS) analysis. Therefore, Tanaq is managing IDW generated as part of the groundwater sampling activities, knowing that the IDW could be impacted with PFAS. The WMP is provided in **Appendix F**.

Data management

Laboratory analytical data will be delivered electronically in two database formats: (1) a format that complies with the current requirements of the Environmental Restoration Program Information Management System (ERPIMS), and (2) in a format that complies with the requirements of a Staged Electronic Data Deliverable (SEDD) Stage 2a. Field teams are required to provide the following data to the Tanaq Database Manager to ensure complete ERPIMS deliverables: sampling logs, well completion diagrams, borehole logs, and access to all field notes. The ERPIMS database format will be used to populate a site database. The SEDD Stage 2a deliverable will be made available to the validators to expedite the validation effort as applicable.

Hardcopy data reports will be delivered as PDF files either transmitted by email or posted to a password-protected website. The overall data management procedures associated with this project are described in Worksheet No. 34. The laboratory will be required to submit reports containing enough information and detail to perform the validation activities identified for each project dataset. Generally, level IV

reports (full set of sample results and QC summary sheets, plus all associated raw data) will be required of the laboratory. However, with concurrence with the project chemist, the PM may decide that the required level of reporting may be reduced on a sample-specific basis depending on such factors as the end use of the data, e.g., data that will only be used for waste characterization, or for screening purposes (such as groundwater grab samples intended to inform the location for permanent wells). All analytical data will be delivered by the laboratory with laboratory data qualifiers (laboratory flags) applied as defined in the DoD QSM (see **Appendix A**).

Data Validation

The data validation activities will be performed in accordance with DoD General Data Validation Guidelines (DoD, 2019) and any applicable method-specific data validation guidelines. Data validation will support the required level of data quality, as discussed in Worksheets Nos. 35 and 36, and **Appendix A**. Waste characterization and definitive levels of data quality are defined in Worksheet No. 12, Section 12.2. Data validation will include a manual review of analytical results to achieve the appropriate level of review. Data validation results will be summarized in reports that will include all findings of the review and any qualifiers applied to the data. Each data validation report will be reviewed by a peer or senior reviewer before delivery to Tanaq. The data validator will enter all qualifier changes in an Excel spreadsheet provided by the Tanaq Database Manager; the Database Manager will then import these qualifiers into the project dataset.

References:

- U.S. Environmental Protection Agency (EPA), 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA, QA/G-4. February.
- United States Department of Defense (DoD), 2019. *General Data Validation Guidelines*. November 2019, Revision 1.
- DoD, DoE Consolidated Quality Systems Manual (QSM) for Environmental Laboratories. Version 5.4, 2021.

This page was intentionally left blank.

QAPP WORKSHEET NO. 12

METHOD MEASUREMENT PERFORMANCE CRITERIA TABLES

12.0 MEASUREMENT PERFORMANCE CRITERIA

This worksheet documents the quantitative measurement performance criteria (MPC) in terms of precision, bias, and sensitivity for both field and laboratory measurements and is used as guidance for selecting appropriate techniques and analytical methods. The overall QC objective for this project is to develop and implement procedures for sample collection, laboratory analysis, field measurement, and data reporting that will provide data of a degree of quality consistent with its intended use, as described in the DQO process (Worksheet No. 11).

Worksheet No. 12 and the associated tables present the performance criteria for the analytical measurements performed in support of this project. In conjunction with Worksheet 11, these MPC ensure data will satisfy the project quality objectives (PQOs) and DQOs. MPC should be determined for each matrix and analytical group. MPC were established for each analytical parameter. Refer to the following worksheets for the required information in this worksheet:

- Worksheet 15 (Reference Limits and Evaluation) for data quality indicators (DQIs) consisting of precision and accuracy;
- Worksheet 24 (Analytical Instrument Calibration);
- Worksheet 28 (Laboratory Quality Control Sample Summary);
- Worksheet 36 (Data Validation Procedures – Validation [Stage 2a and 2b] Summary) for data review and validation process; and
- Worksheet 37 (Data Usability Assessment) for precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS).

12.1 DATA QUALITY INDICATORS

Measurement performance criteria usually are expressed in terms of the data quality indicators (DQIs) precision, accuracy, representativeness, completeness, comparability, and sensitivity, which are known collectively as precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS). Of the PARCCS parameters, precision, accuracy, completeness, and sensitivity can be quantitatively measured and assessed. The parameters of comparability and representativeness are primarily qualitative in nature.

12.1.1 Quantitative Data Quality Indicators

Quantitative DQIs can be measured and assessed by performing QC checks and evaluating the results against numerical acceptance criteria. Where available, the method- and matrix-specific measurement performance criteria that are presented in the QSM (DoD, DoE, 2021) will be used by the off-site

laboratory to control quantitative DQIs. Where the QSM does not list QC criteria, the control limits for routine analyses will be used by the project laboratory. These QC limits will be sufficient to ensure that the analytical methods are performed under acceptable conditions and that results can be used as reported for the intended purposes, as described in Worksheet No. 37 and **Appendix B**.

12.1.1.1 Precision

Precision is the measure of variability between individual sample measurements under prescribed conditions. Precision can be assessed by replicate measurements of known laboratory standards and by analysis of duplicate environmental samples (spiked or unspiked). Precision is determined by evaluating the relative percent difference (RPD) between duplicate sample (DUP) results. Replicate measurements of known standards (laboratory control sample [LCS]/laboratory control sample duplicate [LCSD] pairs), spiked samples (MS/MSD pairs), and laboratory duplicate analyses are routinely monitored by the laboratory by comparing the RPD with established control limits. The formula for calculating RPD is as follows:

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

where:

- S = first sample value (original sample, LCS, or MS value) and
- D = second sample value (duplicate sample, LCSD, or MSD value).

12.1.1.2 Accuracy

Accuracy is the degree of agreement of a measurement to an accepted reference or true value. An evaluation of the accuracy of a measurement system provides an estimate of measurement bias. Overall analytical accuracy is assessed on a batch-specific basis by evaluating the percent recovery (%R) of known concentrations for each analyte in the LCS (and LCSD) against the QC limits. One known reference standard or LCS is analyzed for every batch (maximum of 20 samples). The accuracy of specific sample analyses is assessed by evaluating the %R of the surrogate spike compounds (organic analyses). The %R QC criteria for MS/MSDs will be used to assess the potential for matrix interferences. The formula for calculating %R is as follows:

$$\%R = \frac{A - B}{C} \times 100$$

where:

- A = the analyte concentration determined experimentally from the spiked sample,
- B = the background level determined by a separate analysis of the unspiked sample (for calibration standards, LCSs, and surrogate compounds, the value of this term is zero), and
- C = the amount of the spike added.

Accuracy is also measured using percent difference (%D) between a result and the expected value. The %D is typically used to evaluate accuracy when the acceptance of a QC result is dependent on another

analytical result and not on a pre-defined window of acceptance. The formula for calculating %D is as follows:

$$\%D = \frac{A - B}{A} \times 100$$

where:

A = the original quantity measured and

B = the comparison quantity measured.

12.1.1.3 Completeness

Completeness is a measure of the amount of valid data obtained compared with the amount that was expected to be obtained under correct, normal conditions. It is calculated for the aggregation of data measured for any sampling event or other defined set of samples (such as by site). Valid data is data which is usable in the context of the project goals and DQOs. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the dataset.

Sampling completeness is defined as the percentage of analytical results obtained compared with the projected number of analytical results that would be obtained from all planned sample locations. Analytical completeness is defined as the percentage of valid (nonrejected) analytical results obtained from measurement systems compared with the total number of analytical results requested. The formula for calculating sampling completeness is as follows:

$$\text{Sampling Completeness} = \frac{\text{Number of Planned Data Points}}{\text{Number of Data Points Obtained}} \times 100\%$$

The formula for calculating analytical completeness is as follows:

$$\text{Analytical Completeness} = \frac{\text{Number of Acceptable Laboratory Measurements}}{\text{Number of Laboratory Measurements Reported}} \times 100\%$$

The overall completeness for each aspect of this project is defined as the sampling completeness multiplied by the laboratory completeness. Although the ideal of 100 percent data completeness may not be achieved for a dataset, that dataset may still be usable to make site-specific decisions. The impact of rejected or missing data on project decisions will be evaluated on a case-by-case basis, in accordance with Worksheet No. 37 and **Appendix B**. In addition to calculating overall completeness for project datasets, completeness can be evaluated as subsets of the overall dataset, including subsets selected by method, matrix, or analyte. Completeness will generally be calculated on a task-specific and site-specific basis. The types of completeness evaluation performed for each project should be specified in the site-specific QAPP and should be selected based on DQOs.

Completeness is calculated at the end of the data validation process and generally is not used to evaluate an ongoing data generation process. However, the potential impact on completeness is one of the deciding factors in determining the appropriate course of CA when sample results are affected by a QA discrepancy.

12.1.1.4 Sensitivity

Sensitivity is defined as the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest.

The QSM defines the detection limit (DL) as the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99 percent level of confidence. At the DL, the false positive rate (Type I error) is 1 percent. DLs are specific to an individual determination performed at an individual laboratory.

The QSM defines the LOD as the smallest amount or concentration of a substance that must be present in a sample to be detected at a high level of confidence (99 percent). At the LOD, the false negative rate (Type II error) is 1 percent. The QSM requires non-detected results to be reported as the LOD with the qualification "U."

The QSM defines the limit of quantitation (LOQ) as the lowest concentration that produces a quantitative result within specified limits of precision and bias. The QSM requires each LOQ to be set at or above the concentration of the lowest initial calibration standard.

12.1.2 Qualitative Data Quality Indicators

The DQIs of representativeness and comparability have only a limited ability to be evaluated using QC analysis results. These DQIs are primarily controlled by project planning and execution.

12.1.2.1 Representativeness

Representativeness is the degree to which data accurately and precisely expresses a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Although representativeness is a qualitative measurement, it is evaluated through a multistep process beginning with evaluation of precision and accuracy data. Project design (see Worksheet No. 14) is one of the critical inputs that determine if the data collected is representative of the population sampled.

Representativeness of individual samples will be controlled by sample collection and handling in accordance with the requirements of Worksheet No. 14 and the Tanaq SOPs presented in **Appendix D**. The sample containers and preservation methods presented in Worksheet No. 19 will be used to ensure that samples arriving at the laboratory retain the appropriate degree of representativeness. The holding times presented in Worksheet No. 19 have been established to ensure that samples retain representativeness at the time of extraction and analysis.

Representativeness will also be assessed using field and laboratory blank samples. A method blank (MB) will be analyzed with every analytical or preparation batch (as appropriate to the analytical method) to determine potential contamination introduced during routine laboratory procedures. Initial calibration blanks (ICBs) and continuing calibration blanks (CCBs) will be analyzed as required by analytical methods. Trip blanks and equipment blanks (EBs) can be collected to assess potential contamination due to field conditions. The assessment of blank samples will determine if compounds detected in the environmental samples are site-related or have been introduced through shipping, storage, field procedures, or laboratory procedures.

12.1.2.2 Comparability

Comparability expresses the confidence with which one dataset can be compared to another. Comparability also involves a multistep evaluation and can be related to accuracy and precision, as these quantities are measures of data reliability. Data is comparable if site considerations, collection techniques, and measurement procedures, methods, and sensitivity limits are equivalent for the samples within a sample set.

In cases where sample collection is intended to fill data gaps or otherwise extend an already-existing dataset, comparability of analytical results from the follow-on sampling event with results in the historical dataset is of great importance. However, the desire for comparability may be superseded by other considerations, such as improvements in sampling or analytical methodologies. In such cases, project design must ensure that the data collected using the updated methodologies can be integrated with the existing dataset.

12.2 DATA QUALITY CATEGORIES

There are two general categories of data that will be generated for use in project decision making as follows: (1) waste characterization data and (2) definitive data. The data validation requirements for each matrix and analytical parameter are specific to each project data source and end use. These requirements are summarized in Worksheet No. 11. The full process will be described in the format presented in Worksheet No. 36 of this QAPP, as modified in site-specific QAPPs. The waste characterization and definitive data validation protocols for this project are presented in **Appendix A**. The data usability evaluation procedures are summarized in Worksheet No. 37 and **Appendix B**.

12.2.1 Screening Data

Screening data is typically derived from the use of analytical methods in the field that are more rapid and less precise than those used by an off-site laboratory. The screening data provides analyte identification and quantification; however, the data are less precise. Waste characterization data, although not collected using field instrumentation, is generally considered screening data. Waste characterization samples are collected for use by the waste disposal contractor, to identify whether or not the waste is considered hazardous, and how it should be transported and disposed of. Screening data does not need to go through the validation process, though it is still reviewed for completeness, hold times, and use of appropriate analytical methods. Generally, selection of waste characterization analytes depends on the source of the waste. In the case of Avon Park, analyte selection will be based on the base's history of pesticide use, known metals contamination and known former use for fire training .

12.2.2 Definitive Data

Definitive data is generated using rigorous analytical methods, such as approved EPA reference methods. The data can be generated in a mobile or fixed-base laboratory. Definitive data is analyte-specific, and both ID and quantitation are confirmed. Definitive analytical methods have standardized QC and documentation requirements and produce data for which analytical error (bias) can be determined. For data to be classified as definitive, the data must be validated after the results are reported in order to verify that the appropriate QC measures were taken and were in control. Also, the sample must be

collected in a manner that is representative of current site conditions. Samples not collected in accordance with the procedures presented in Worksheet No. 14 and the applicable SOPs will not be considered definitive. Definitive data is not restricted in its use unless quality problems identified in the validation process require data qualification. The analytical methods that will be required to produce definitive level data will be indicated in Worksheet Nos. 11, 23, and 36.

12.3 MEASUREMENT PERFORMANCE CRITERIA TABLES

The data quality elements presented in the Worksheet No. 12 tables are divided into two categories as follows: waste characterization level elements and definitive level elements. Each data quality element is associated with one or more of the DQIs discussed in Section 12.1. In addition to the PARCCS parameters, some methods also include analyte ID as a DQI. Analyte ID is an essential performance component of those methods and is included even though is not a PARCCS parameter.

The analytical acceptance criteria presented in Worksheet No. 12 tables are linked to the data validation protocols presented in **Appendix A**. Each project laboratory is required to ensure compliance with method and SOP requirements regardless of the level of data validation that will be performed on the resulting data. If a QC element does not meet control criteria, the appropriate qualifier, as defined in **Appendix A**, will be applied to all associated results. The overall impact of QC discrepancies, including data gaps resulting from rejected data points, will be assessed in accordance with Worksheet No. 37 and **Appendix B**.

12.3.1 Blank Evaluation

It should be noted that tables on Worksheet No. 12 present acceptance criteria for reporting data associated with low levels of blank contamination. It is acceptable for the laboratory to report analytical data with low levels of blank contamination meeting the acceptance criteria on Worksheet No. 12. However, during the data validation process, all detected values in blanks will be used to evaluate the associated sample data, regardless of whether the reported blank results met the acceptance criteria presented in Worksheet No. 12. This is the one of the few cases where QC data that meets reporting acceptance requirements may still result in qualification of the associated data.

References

DoD, DoE Consolidated Quality Systems Manual (QSM) for Environmental Laboratories. Version 5.4, 2021.

QAPP Worksheet No. 12.1

Measurement Performance Criteria Tables

Matrix	Aqueous: Groundwater and IDW	
Analytical Group	Metals SW-846 6020B	
Concentration Level	Low	
Data Quality Indicator (DQI)	QC sample or measurement performance activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	All Target Compounds RPD \leq 30%
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples (Blank Spikes)	Within DoD QSM 5-series Appendix C limits Statistical limits if not listed in DoD QSM
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes/Matrix Spike Duplicates	%R Within LCS limits RPD \leq 20%
Analytical Accuracy/Bias (matrix interference)	Serial Dilution	\pm 20% of the true value as long as the analyte concentration is within linear range of the instrument and sufficiently high (minimally, a factor of 25 times greater than the LOQ)
Analytical Accuracy/Bias (matrix interference)	Post-Digestion Spikes (PDSs)	%R 75-125
Overall accuracy/bias (contamination)	Equipment Blanks	All analytes \leq $\frac{1}{2}$ LOQ
Sensitivity	LOQ verification sample (spiked at LOQ)	%R Within LCS limits
Completeness	See Worksheet #34	See Worksheet #34

QAPP Worksheet No. 12.2

Measurement Performance Criteria Table – Pesticides, Herbicides, and PCBs

Matrix	Aqueous: Groundwater and IDW	
Analytical Group	Pesticides SW-846 8081B	
Concentration Level	Low	
Data Quality Indicator (DQI)	QC sample or measurement performance activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	All Target Compounds RPD \leq 30%
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples (Blank Spikes)	Within DoD QSM 5-series Appendix C limits Statistical limits are not listed in DoD QSM
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes/Matrix Spike Duplicates	%R Within LCS limits RPD \leq 30
Overall accuracy/bias (contamination)	Equipment Blanks	All analytes \leq ½ LOQ
Sensitivity	LOQ verification sample (spiked at LOQ)	%R Within LCS limits
Completeness	See Worksheet #34	See Worksheet #34

Matrix	Aqueous: Groundwater and IDW		
Analytical Group	Herbicides SW-846 8151A		
Concentration Level	Low		
Data Quality Indicator (DQI)		QC sample or measurement performance activity	Measurement Performance Criteria
Overall Precision		Field Duplicates	All Target Compounds RPD \leq 30%
Analytical Accuracy/Bias (laboratory)		Laboratory Control Samples	Within DoD QSM 5-series Appendix C limits Statistical limits if not listed in DoD QSM
Analytical Accuracy/Bias (matrix interference)		Matrix Spikes/Matrix Spike Duplicates	%R Within LCS limits RPD \leq 30
Overall accuracy/bias (contamination)		Equipment Blanks	All analytes \leq ½ LOQ
Sensitivity		LOQ verification sample (spiked at LOQ)	Within LCS limits
Completeness		See Worksheet #34	See Worksheet #34

Matrix	Aqueous: IDW	
Analytical Group	PCBs SW-846 8082A	
Concentration Level	Low	
Data Quality Indicator (DQI)	QC sample or measurement performance activity	Measurement Performance Criteria
Overall Precision	Field Duplicates	All Target Compounds RPD \leq 30%
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples (Blank Spikes)	Within DoD QSM 5-series Appendix C limits Statistical limits if not listed in DoD QSM
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes/Matrix Spike Duplicates	%R Within LCS limits RPD \leq 30
Overall accuracy/bias (contamination)	Equipment Blanks	All analytes \leq 1/2/ LOQ
Sensitivity	LOQ verification sample (spiked at LOQ)	%R Within LCS limits
Completeness	See Worksheet #34	See Worksheet #34

QAPP Worksheet No. 12.3

Measurement Performance Criteria Table – PFAS

Matrix	Aqueous: IDW	
Analytical Group	PFAS EPA Draft Method 1633	
Concentration Level	Low	
Data Quality Indicator (DQI)	QC sample or measurement performance activity	Measurement Performance Criteria
Overall Precision	Not applicable – no QC samples are associated with IDW sampling.	Not applicable
Analytical Accuracy/Bias (laboratory)	Laboratory Control Samples (Blank Spikes)	Within statistically derived limits. Until these are developed, preliminary 40-150% are used. Lower statistical limit must be $\geq 40\%$
Analytical Accuracy/Bias (matrix interference)	Matrix Spikes/Matrix Spike Duplicates	%R Within LCS limits RPD ≤ 30
Overall accuracy/bias (contamination)	Field Blanks/Equipment Blanks	All analytes $\leq \frac{1}{2}$ LOQ
Sensitivity	LOQ verification sample (spiked at LOQ)	%R $\pm 30\%$ of true value, Signal-to-noise ratio $> 3:1$
Completeness	See Worksheet #34	See Worksheet #34

This page was intentionally left blank.

QAPP WORKSHEET NO. 13

SECONDARY DATA CRITERIA AND LIMITATIONS TABLE

Data Type: Site History and Background Information – Data is reliable and usable.
Data Uses Relative to the Current Project: Historical data is used to describe the site’s history and define the environmental problem. Background information and data from APAFR’s records pertaining to site-specific industrial processes, process by-products, past and current chemical uses, waste disposal practices, and potential chemical breakdown products.
Reliability of Data and Limitations on Data Use: Data collected within this investigation was collected in accordance with USACE and/or USAF QA/QC requirements at the time of the investigation. All site history and background information referenced is final and therefore is reliable for use by Tanaq for the purposes of optimizing LTM based on the levels of COCs at APAFR.
Data Source (Organization, Year, Report Title, Month): Innovative Technical Solutions, Inc. (ITSI), 2013. <i>Final First Annual Basewide Monitoring Report ERP Site Numbers LF-42, WP-44, OT-45, OT-59, ST-65, SS-100, and LF-106 Avon Park Air Force Range, Florida.</i> February. ITSI, 2015. <i>2014 Basewide Monitoring Report LF042, WP044, OT045, OT059A, OT059C, OT059D, ST065, SS100, and LF106, Avon Park Air Force Range, Florida, Revision 1.</i> May. Gilbane Federal (Gilbane), 2015. <i>Basewide Uniform Federal Policy Quality Assurance Project Plan and Basewide Environmental Restoration Work Plan for Performance Based Remediation, Avon Park Air Force Range, Florida. Revision 3.</i> September. Gilbane, 2016. <i>2015 Basewide Monitoring Report OT045, OT059A, OT059C, OT059D, ST065, SS100, and LF106, Avon Park Air Force Range, Florida, Revision 1.</i> May. Gilbane, 2017. <i>2016 Basewide Monitoring Report OT045, OT059A, OT059C, OT059D, ST065, and LF106, Avon Park Air Force Range, Florida, Revision 1.</i> May. Gilbane, 2018. <i>2017 Basewide Monitoring Report, OT045, OT059A, OT059C, OT059D, ST065, Avon Park Air Force Range, Florida, Revision 1.</i> May. Gilbane, 2019. <i>2018 Basewide Monitoring Report, OT045, OT059A, OT059C, OT059D, OW500, and ST065, Avon Park Air Force Range, Florida, Revision 1.</i> May. Gilbane, 2020. <i>2019 Basewide Monitoring Report, OT045, OT059A, OT059C, OT059D, OW500, and ST065, Avon Park Air Force Range, Florida, Revision 2.</i> April. Gilbane, 2021. <i>2020 Basewide Monitoring Report, OT045, OT059A, OT059C, OT059D, OW500, and ST065, Avon Park Air Force Range, Florida, Revision 2.</i> April.

This page was intentionally left blank.

QAPP WORKSHEETS NO. 14 AND 16

PROJECT TASKS AND SCHEDULE

Project Schedule

The Integrated Master Schedule for contracted environmental remediation work being conducted at APAFR is provided in the Monthly Progress Report. Site-specific schedule information will be provided with site-specific work plans.

Project Tasks

General descriptions of field activities and associated SOPs and guidance documents are summarized below. Field SOPs are provided in **Appendix D**.

Task Description	Objective	Associated SOP(s) and/or Guidance
Obtain base access	Submit personal and contractual information to support gaining base access passes for contract personnel working on base for extended periods.	<ul style="list-style-type: none"> • Contact APAFR POCs to coordinate range access
Dig permitting	Obtain base permit prior to any digging, drilling, or other intrusive activity by completing AF Form 103 and routing through Base Civil Engineering (CE) Organizations on form.	<ul style="list-style-type: none"> • Base CE Work Clearance Request (AF Form 103)
Mobilization	Procure equipment to take to the sites prior to daily fieldwork. Ensure sampling coolers have ice for preserving samples.	<ul style="list-style-type: none"> • FM 1000: Field Mobilization
Daily Safety Meetings	Review daily activities and ensure the onsite team is familiar with safety requirements and concerns. Ensure field teams are adequately prepared with respect to equipment, training, anticipated hazards, weather, COCs, and other environmental concerns.	<ul style="list-style-type: none"> • APP/Site Safety and Health Plan, QAPP and/or work plans.
Field Equipment Calibration	Calibrate field equipment (water level meter, turbidimeter, and water quality meter) to ensure accuracy and precision of readings.	<ul style="list-style-type: none"> • FT 1000: General Field Testing and Measurement
Field Documentation	Maintain the required documentation of field sampling procedures and field testing.	<ul style="list-style-type: none"> • FD 1000: Documentation Procedures
General Sampling	Conduct proper field sampling activities.	<ul style="list-style-type: none"> • FS 1000: General Sampling Procedures
Groundwater Sampling	Conduct proper groundwater sampling of installed monitoring wells using low-flow methods.	<ul style="list-style-type: none"> • FS 2200: Groundwater Sampling
Decontamination	Ensure that all equipment that contacts a sample during sample collection is free from the analytes of interest and constituents that would interfere with the analytes of interest.	<ul style="list-style-type: none"> • FC 1000: Cleaning / Decontamination Procedures
Field QC	Monitor sampling event to ensure the collected samples are representative of the sample source.	<ul style="list-style-type: none"> • FQ 1000: Field Quality Control Requirements
Chain of Custody	Use proper chain of custody and tracking methods for environmental sampling.	<ul style="list-style-type: none"> • MAFB-CP-02: Chain of Custody

Task Description	Objective	Associated SOP(s) and/or Guidance
Field Logbook Use	Ensure proper data entry into project field logbooks.	<ul style="list-style-type: none">• SOP-19 Fieldbook Use and Maintenance

QAPP WORKSHEET NO. 15

REFERENCE LIMITS AND EVALUATION TABLES

The following tables provide a comprehensive analyte list for the analytical methods that will be used by this project. The associated limits for sensitivity and accuracy are also included in each table. The accuracy control limits presented in the Worksheet No. 15 tables are based on those presented in the DoD QSM for Environmental Laboratories, Version 5.4.

The laboratory-specific sensitivity limits and accuracy control limits presented in Worksheet No. 15 tables are subject to change over time based on periodic review at the laboratory. When sensitivity or accuracy control limits are updated, the laboratory will present the most up-to-date limits in the associated data reports. A majority of the accuracy control limits presented in Worksheet No. 15 tables are stipulated by the QSM; these limits are required and cannot be altered without prior review and consent from Tanaq, USACE and AFCEC.

In all cases, the laboratory is required to report concentrations at or greater than the DL as detected results. Non-detected results and results below the corresponding DL will be reported by the laboratory at the LOD and qualified U. For contaminants with GCTLs that are below routinely achievable laboratory quantitation limits (where the LOQ and DL exceed the GCTL), the DoD QSM convention of reporting non-detects at the LOD is acceptable. Laboratory-assigned qualifiers may be subsequently modified during the data validation process (see Worksheet No. 36 and **Appendix A**).

QAPP Worksheet No. 15.1

Reference Limits and Evaluation Table – Arsenic in Groundwater by 6020B

Analyte	CAS Number	SGS Orlando			Florida DEP GCTLs ⁽¹⁾ (µg/L)	Accuracy Control Limits (%)
		Sensitivity Limits (µg/L)				
		DL	LOD	LOQ		
Arsenic	7440-23-5	0.212	1	2	10	87-113

- (1) Florida DEP (February 2005) Groundwater criteria, [Contaminant Clean Up Target Levels-TechRprt-Table1-Groundwater-CTLs_Feb2005.xlsx](#).
 µg/L = micrograms per liter
 CAS = Chemical Abstracts Service

QAPP Worksheet No. 15.2

Reference Limits and Evaluation Table – Pesticides in Groundwater by 8081B

Analyte	CAS Number	SGS Orlando Sensitivity Limits (µg/L)			Florida DEP GCTLs ⁽¹⁾ (µg/L)	Accuracy Control Limits (%)
		DL	LOD	LOQ		
Alpha-BHC ⁽²⁾	319-84-6	0.0087	0.02	0.04	0.006	66-129
Beta-BHC	319-85-7	0.01	0.02	0.04	0.02	66-132
Chlordane	12789-03-6	0.15	0.20	0.40	2	62-141
Dieldrin ⁽²⁾	60-57-1	0.0095	0.01	0.04	0.002	66-138
Alpha-chlordane	5103-71-9	0.0077	0.02	0.04	N/A	66-131
Gamma-chlordane	5103-74-2	0.0088	0.02	0.04	N/A	68-128
Heptachlor epoxide	1024-57-3	0.0081	0.02	0.04	0.2	67-129

(1) Florida DEP (February 2005) Groundwater criteria, [Contaminant Clean Up Target Levels- TechRprt-Table1-Groundwater-CTLs Feb2005.xlsx](#).

(2) DL, LOD and/or LOQ exceeds the GCTL. Non-detected results are reported as LOD U.

µg/L = micrograms per liter

CAS = Chemical Abstracts Service

This page was intentionally left blank.

QAPP WORKSHEET NO. 17

SAMPLING DESIGN AND RATIONALE

A summary of the sampling design and rationale are provided below. Detailed site background and sampling history can be found in the *2022 Basewide Monitoring Report* (Tanaq, 2023). The sampling plan and frequency for the basewide monitoring events will be based on the approved monitoring plan from the prior monitoring report.

OT045

This site is sampled biennially. The most recent sampling event was in 2022, with the next scheduled sampling event to take place in 2024. Based on the recent remedial history and analytical results, the groundwater COCs are as follows:

- Arsenic – monitoring wells OT45-EW03, OT45-MW02, OT45-MW03, OT45-MW07, OT45-MW09, OT45-MW16, and OT45-MW18.
- Chlordane – monitoring well OT45-MW04.

OT059A

This site is sampled biennially. The most recent sampling event was in 2022, with the next scheduled sampling event to take place in 2024. Based on the recent remedial history and analytical results, the groundwater COCs are as follows:

- alpha-BHC – monitoring wells OT59A-MW13 and OT59A-MW25.
- Arsenic – monitoring wells OT59A-MW06, OT59A-MW07, OT59A-MW08, OT59A-MW09, OT59A-MW10, OT59A-MW13, OT59A-MW22, OT59A-MW25, OT59A-MW26, OT59A-MW27, and OT59A-MW29.
- beta-BHC – monitoring wells OT59A-MW13 and OT59A-MW25.
- Dieldrin – monitoring well OT59A-MW25.

OT059C

This site is sampled biennially. The most recent sampling event was in 2022, with the next scheduled sampling event to take place in 2024. Based on the recent remedial history and analytical results, the groundwater COC is as follows:

- Arsenic - monitoring wells OT59C-MW05, OT59C-MW09, OT59C-MW12, OT59C-MW13, OT59C-MW14, OT59C-MW15, and OT59C-MW19.

OT059D

This site is sampled triennially. The most recent sampling event was in 2022, with the next scheduled sampling event to take place in 2025. Based on the recent remedial history and analytical results, the groundwater COCs are as follows:

- Arsenic – monitoring wells OT59D-MW01, OT59D-MW05, OT59D-MW06, OT59D-MW07R, OT59D-MW09, OT59D-MW11, OT59D-MW12, OT59D-MW13, OT59D-MW14, OT59D-MW24,

OT59D-MW25, OT59D-MW28, OT59D-MW30R, OT59D-MW31, OT59D-MW33, and OT59D-MW34.

- beta-BHC – monitoring wells OT59D-MW28 and OT59D-MW31.

OW500

This site is sampled biennially. The most recent sampling event was in 2022, with the next scheduled sampling event to take place in 2024. Based on the recent remedial history and analytical results, the groundwater COCs are as follows:

- Alpha-chlordane – monitoring wells OW500-MW23, OW500-MW32, OW500-MW34, and OW500-MW35.
- Arsenic – monitoring wells OW500-MW02, OW500-MW03, OW500-MW10, and OW500-MW35.
- Chlordane – monitoring wells OW500-MW10, OW500-MW21R, OW500-MW23, OW500-MW32, OW500-MW33R, OW500-MW34, and OW500-MW35.
- Dieldrin - monitoring well OW500-MW10.
- Gamma-chlordane – monitoring wells OW500-MW32 and OW500-MW34.
- Heptachlor epoxide – monitoring wells OW500-MW32, OW500-MW34, and OW500-MW35.
- Iron – monitoring wells OW500-MW08, OW500-MW10, and OW500-MW21R.
- Manganese – monitoring well OW500-MW21R.

Note: Dieldrin was approved for removal as a COC from OW500-MW10 in the November 2022 Partnering meeting due to the agreement that there had been no detections in several years and a reporting limit below the GCTL was not achievable.

ST065

This site is sampled triennially. The most recent sampling event was in 2022, with the next scheduled sampling event to take place in 2025. Based on the recent remedial history and analytical results, the groundwater COCs are as follows:

- Arsenic – monitoring wells B431-MW05, B431-MW06, B567-MW02, ST65-MW01, ST65-MW08R, ST65-MW18, and ST65-MW29.
- Manganese – monitoring wells B431-MW05 and B431-MW06.

References:

Tanaq, 2022. *2022 Basewide Monitoring Report – Environmental Remediation Services at Avon Park Air Force Range, Florida*. September.

QAPP WORKSHEET NO. 18

SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE

The sampling locations are provided in **Figures 2 through 7**. The SOPs for sampling are summarized in Worksheet No. 21. Sample naming is described in Worksheets No. 26 and 27.

This page was intentionally left blank.

QAPP WORKSHEETS NO. 19 AND 30

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

The following table includes all analytical methods listed in Worksheet No. 23. Prior to sampling at a site, the project laboratory will be provided with a list of analyses to be performed and required turnaround times. The field sampling team should work with the project laboratory to identify samples for analytical methods that can be combined in the same sampling container to optimize sampling time and reduce shipping costs and sample waste.

Holding times expressed in hours and minutes should be measured from the time of collection to the time of preparation or analysis. Holding times expressed in days should be evaluated based on calendar days elapsed, with the sampling date considered day “0”.

Analytical Group	Matrix	Analytical and Preparation Method/ SOP Reference	Accreditation Expiration Date	Containers (Number, Size, and Type)	Preservation Requirements (Chemical, Temperature, Light Protected)	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
Metals	Aqueous	SW-846 6020B SGS Orlando SOPs MET107 MET103	DoD Expiration December 15, 2024	1 – 500 ml plastic bottle	HNO ₃ to pH < 2, Cool to 4 ± 2 degrees Celsius (°C)	6 months	6 months	Varies
Pesticides	Aqueous	SW-846 8081B SGS Orlando SOPs GC015 OP008	DoD Expiration December 15, 2024	2 – 1 L or 250 ml amber glass with Teflon lined caps	Protect from light, Cool to 4 ± 2°C	7 days	40 days from preparation	Varies
Herbicides	Aqueous	SW-846 8151A SGS Orlando SOPs GC031 OP037 OP037RV	DoD Expiration December 15, 2024	2 – 1 L or 250 ml amber glass bottle with Teflon lined cap	Protected from light, Cool to 4 ± 2°C	7 days	40 days from preparation	Varies
PCBs	Aqueous	SW-846 8082A SGS Orlando SOPs GC014 OP008	DoD Expiration December 15, 2024	2 – 1 L or 250 ml amber glass bottles with Teflon lined caps	Protect from light, Cool to 4 ± 2°C	7 days	40 days from preparation	Varies
PFAS	Aqueous	EPA Draft 1633 SGS Orlando SOPs MS024 OP075	DoD Expiration December 15, 2024	2 x 500 mL and 1 x 60 ml HDPE, no Teflon liners	Chilled to < 6°C for shipping, stored at ≤ 4°C or at ≤ - 20°C	Refrigerated28 days to extract, Frozen – 90 days to extract	28 days to analyze (not to exceed 90 days)	Varies

This page was intentionally left blank.

QAPP WORKSHEET NO. 20 FIELD QC SUMMARY

Field QC samples will be collected in accordance with DEP-SOP-001/01 FQ 1000: Field Quality Control Requirements. Field duplicate pairs will be collected at a rate of approximately 1 per 10 field samples; MS/MSD pairs will be collected at a rate of approximately 1 per 20 samples. Equipment (rinse) blanks will be collected once per week per piece of reusable sampling equipment that potentially touches the sampled material (for example, a water level meter, but not a peristaltic pump). Field blanks will be collected once per sampling event, or more frequently if site conditions change dramatically.

Method	Analytes	Media	No. of Samples	MS/MSD	Field Duplicate
OT045					
6020B	Metals	Groundwater			
	Arsenic		7	1	1
8081B	Pesticides	Groundwater			
	Chlordane		1	1	1
OT059A					
6020B	Metals	Groundwater			
	Arsenic		11	1	2
8081B	Pesticides	Groundwater			
	Alpha-BHC		2	1	1
	Beta-BHC		2	1	1
	Dieldrin		1	1	1
OT059C					
6020B	Metals	Groundwater			
	Arsenic		7	1	1
OT059D					
6020B	Metals	Groundwater			
	Arsenic		15	1	1
8081B	Pesticides	Groundwater			
	Beta-BHC		2	1	1

QAPP Worksheet No. 20
Field QC Summary
(continued)

Method	Analytes	Media	Env. Samples	MS/MSD	QA/QC
OW500					
6020B	Metals	Groundwater			
	Arsenic		3	1	1
	Iron		3	1	1
	Manganese		1	1	1
8081B	Pesticides	Groundwater			
	Dieldrin		1	1	1
	Alpha-chlordane		4	1	1
	Heptachlor epoxide		3	1	1
	Gamma-chlordane		2	1	1
ST065					
6020B	Metals	Groundwater			
	Arsenic		7	1	1

QAPP WORKSHEET NO. 21 PROJECT FIELD SOP REFERENCE TABLE

This worksheet documents specific field procedures and methods that will be implemented for this contract. SOPs listed below are provided in **Appendix D**. The WMP, provided in **Appendix F**, describes the procedures for the storage, management, and disposal of IDW generated from remediation activities.

Florida DEP has established a series of field SOPs that are relevant to execution of environmental restoration activities statewide. Worksheet No. 21.1 identifies all Florida DEP SOPs by name and number and provides rationale for their inclusion in (as an attachment or by reference) in this UFP-QAPP. Worksheet No. 21.2 describes several Tanaq-specific contract procedures and SOPs that will be used to support work conducted at APAFR, or any potential subsequent work conducted by Tanaq. The Tanaq SOPs included in this QAPP are intended to augment the Florida DEP SOPs. Additionally, Worksheet No. 21.3 presents other relevant forms, regulations and guidelines that will be used to direct or guide field activities at APAFR.

QAPP Worksheet No. 21.1 Complete Listing of SOPs and Guidelines

SOP ID No.	Title, Revision, Date	Inclusion in APAFR UFP-QAPP	Rationale for Inclusion
FA 1000	Regulatory Scope and Administration of Procedures for Use of Florida DEP SOPs	Reference	Administrative SOP not required for conducting fieldwork. May be referenced as needed for administration of SOPs.
FC 1000	Cleaning/Decontamination Procedures	Appendix D	All field cleaning and decontamination processes.
FD 1000	Documentation Procedures		All field documentation procedures (optional Section FD 7000 is not used).
FM 1000	Field Planning and Mobilization		This is an advisory SOP intended to convey best management practices for designing and implementing field sampling programs.
FQ 1000	Field Quality Control Requirements		Establishes to field QC procedures.
FS 1000	General Sampling Procedures		APAFR field sampling processes.
FS 2000	General Aqueous Sampling		APAFR field sampling processes.

QAPP Worksheet No. 21.1 (Continued) Complete Listing of SOPs and Guidelines

SOP ID No.	Title, Revision, Date	Inclusion in APAFR UFP-QAPP	Rationale for Inclusion
FS 2200	Groundwater Sampling	Appendix D	APAFR field sampling processes
FT 1000	General Field Testing and Measurement		APAFR field testing processes; also, field equipment calibration requirements are incorporated into Worksheet No. 25
FT 1600	Field Measurement of Turbidity		APAFR field sampling processes
LD 1000	Laboratory Documentation	Reference	These SOPs do not address field procedures. Also, all contract laboratories procured for APAFR must meet Florida DEP requirements, including Florida DEP laboratory SOPs, to be certified by Florida DEP. Therefore, these SOPs are not incorporated into this QAPP, but are incorporated by reference.
LQ 1000	Laboratory Quality Control		
MAFB-CP-01	Field Forms	Appendix D	Provides single location for all field forms to be used at APAFR.
MAFB-CP-02	Chain of Custody Procedure		Describes procedures to be used to maintain and document chain of custody, including completion of Chain of Custody Record forms.
SOP-19	Fieldbook Use and Maintenance		To augment Florida DEP SOPs
SOP-73	Sampling for PFAS		Sampling procedures for IDW characterization sampling

QAPP WORKSHEET NO. 22

FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE

The following are commonly used field equipment. Additional field testing equipment may be required on a site-specific basis and should be included in the site-specific QAPPs, as applicable. The acceptance criteria for turbidity, DO, pH, conductance, and temperature are as presented in Florida DEP SOP FT 1000. The minimum frequencies for instrument calibration are given in the table below; however, calibration may need to be more frequent if environmental or atmospheric conditions change, and/or the operator suspects that changes in readings are not attributable to sample variability.

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Minimum Frequency	Acceptance Criteria	CA ¹	Responsible Person	SOP Reference ²
Turbidity meter	Single standard calibration with Formazin standard per instrument range used	NA	NA	Daily, before sampling	0.1-10 NTU: $\pm 10\%$ of standard value 11-40 NTU: $\pm 8\%$ of standard value 41-100 NTU: $\pm 6.5\%$ of standard value >100 NTU: $\pm 5\%$ of standard value	Recalibrate instrument	Field sampling team	FT 1600
ORP meter	NA		Single standard calibration check		Two successive reading within ± 10 mV	Recalibrate instrument		MAFB-CP-08
	Sensitivity verification		NA		ORP should decrease as pH is increased	If ORP increases, correct the polarity of electrodes. If ORP still does not decrease, clean electrodes and repeat procedure		FT1600
DO meter	NA		Function check		Meter reads within ± 0.3 mg/L of theoretical value (see SOP FT 1500)	Replace instrument		FT1500

QAPP Worksheet No. 22 (Continued)

Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Minimum Frequency	Acceptance Criteria	CA ¹	Responsible Person	SOP Reference ²
Aqueous pH meter	2-point calibration with pH buffers	NA	NA	Daily, before sampling	±0.2 pH units for each buffer	If calibration is not achieved, check meter, buffer solutions, and probe; replace if necessary; repeat calibration	Field sampling team	FT 1100
Conductance meter	Calibration with potassium chloride standard			Daily, before sampling	±5% of standard value	If calibration is not achieved, check meter, standards, and probe recalibrate		FT 1200
Temperature	Verification over a range of applicable values			Daily, before sampling	±0.2 °C of NIST-traceable value (with correction factors)	Replace instrument		FT 1400

Notes:¹ If CA does not solve the problem, the equipment will be removed from service and replaced until proper function can be restored.

² See Project Sampling SOP References table (Worksheet No. 21).

NTU = nephelometric turbidity units

QAPP WORKSHEET NO. 23 ANALYTICAL SOP REFERENCES TABLE

The following table provides a listing of the SOPs for the analytical methods that will be used for site investigations associated with this project. All relevant laboratory SOPs are included in **Appendix A.3** of this QAPP. The laboratory performs periodic review and revision of analytical and preparation method SOPs. The laboratory should use the most recent SOP version when analyzing project samples unless directed to do otherwise.

Standard Operating Procedure (SOP) Reference Number	Title, Revision Date and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
MET107	Metals by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), Rev. 05/23	Definitive	Aqueous, Soil Metals	Agilent 7700x (ICP-MS)	SGS Orlando	N
MET103	Digestion of Water Samples for ICP/ICPMS Analysis, Rev. 05/23	Preparation Method	Aqueous Metals	Hot Block	SGS Orlando	N
MET104	Digestion of Soils for ICP/ICPMS Analysis, Rev. 05/23	Preparation Method	Soil Metals	Hot Block	SGS Orlando	N
GC015	Analysis of Organochlorine Pesticides by Gas Chromatography, Electron Capture Detector, Rev. 06/22	Definitive	Aqueous, Soil OC Pesticides	Agilent 6890 or 7890 (GC/ECD)	SGS Orlando	N
OP008	Standard Operating Procedures for the Extraction of Pesticides and/or PCBs from Water Samples, Rev. 06/22	Preparation Method	Aqueous Pesticides and/or PCBs	Separatory Funnel LLE	SGS Orlando	N

Standard Operating Procedure (SOP) Reference Number	Title, Revision Date and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
OP009	Standard Operating Procedure for the Extraction of Pesticides and/or PCBs from Solid Samples, Rev. 06/22	Preparation Method	Soil Pesticides and/or PCBs	Sonic Disrupter	SGS Orlando	N
OP009-MW	Standard Operating Procedure for the Extraction of Pesticides and/or PCBs from Solid Samples Microwave Option, Rev. 06/22	Preparation Method	Soil Pesticides and/or PCBs	Extraction/Digestion Microwave equipped with carousel and PTFE extraction vessels	SGS Orlando	N
GC031	Analysis of Chlorinated Herbicides by Gas Chromatography, Electron Capture Detector, Rev. 12/20	Definitive	Aqueous, Soil Herbicides	Agilent 6890 or 7890 (GC/ECD)	SGS Orlando	N
OP037	Standard Operating Procedure for the Extraction of Chlorinated Herbicides from Water Samples, Rev. 06/20	Preparation Method	Aqueous Herbicide	Separatory Funnel LLE	SGS Orlando	N
OP037-RV	Standard Operating Procedure for the Extraction of Chlorinated Herbicides from Water Samples Reduced Volume, Rev. 06/20	Preparation Method	Aqueous Herbicides	Separatory Funnel LLE	SGS Orlando	N

Standard Operating Procedure (SOP) Reference Number	Title, Revision Date and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
GC014	Analysis of Polychlorinated Biphenyls by Gas Chromatography, Electron Capture Detector, Rev. 06/22	Definitive	Aqueous, Soil, Wipe PCBs	Agilent 6890 or 7890 (GC/ECD)	SGS Orlando	N
OP008	Standard Operating Procedures for the Extraction of Pesticides and/or PCBs from Water Samples, Rev. 06/22	Preparation Method	Aqueous Pesticides and/or PCBs	Separatory Funnel LLE	SGS Orlando	N
OP009	Standard Operating Procedure for the Extraction of Pesticides and/or PCBs from Solid Samples, Rev. 06/22	Preparation Method	Soil Pesticides and/or PCBs	Sonic Disrupter	SGS Orlando	N
OP009-MW	Standard Operating Procedure for the Extraction of Pesticides and/or PCBs from Solid Samples Microwave Option, Rev. 06/22	Preparation Method	Soil Pesticides and/or PCBs	Extraction/Digestion Microwave equipped with carousel and PTFE extraction vessels	SGS Orlando	N
OP033	Standard Operating Procedure for the Extraction of PCBs from Wipes, Rev. 06/22	Preparation Method	Wipe PCBs (wipes)	Shaker Table	SGS Orlando	N

Standard Operating Procedure (SOP) Reference Number	Title, Revision Date and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
MS024	Standard Operating Procedure for the Analysis of Per- and Polyfluorinated Alkyl Substances by LC/MS/MS, Rev. 08/22	Definitive	Aqueous, Soil PFAS	HPLC Agilent 1260 or 1290	SGS Orlando	N
OP075	Standard Operating Procedure for the Extraction of Per- and Polyfluorinated Alkyl Substances from Water Samples for LC/MS/MS Analysis, Rev 04/22	Preparation Method	Aqueous PFAS	Solid Phase Extraction	SGS Orlando	N
OP076	Standard Operating Procedure for the Extraction of Per- and Polyfluorinated Alkyl Substances from Soil Samples for LC/MS/MS Analysis, Rev 04/22	Preparation Method	Soil PFAS	Vortex Mixer and Shaker Table	SGS Orlando	N

QAPP WORKSHEET NO. 24 ANALYTICAL INSTRUMENT CALIBRATION TABLE

In all cases, the CA required in this worksheet will be the responsibility of the bench analysts and the Laboratory Section Manager responsible for each method. Where an instrumental problem cannot be resolved by CA/routine maintenance, the affected instrument must be removed from service. Following necessary repairs, the instrument will be recalibrated and determined to be fully functional before being cleared for return to service.

QAPP Worksheet No. 24 Analytical Instrument Calibration Table: Metals

Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/Position Responsible for CA	SOP Reference
SW-846 6020B Agilent 7700x (ICP-MS)	Tuning	NA	Prior to ICAL	Mass calibration \leq 0.1amu from the true value; Resolution < 0.9 amu full width at 10% peak height	Retune instrument and verify. Flagging not appropriate, no samples should be analyzed w/o valid tune.	Analyst, Department Manager	SGS Orlando SOP MET107
SW-846 6020B Metals	Initial Calibration (ICAL) – daily prior to sample analysis	Various	At beginning of each day, or if QC is out of criteria	If multiple calibration standards are used, r must be \geq 0.998.	Recalibrate and/or perform necessary equipment maintenance; check calibration standards; reanalyze affected data	Analyst, Department Manager	

Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/Position Responsible for CA	SOP Reference
	Initial Calibration Verification (ICV) – Second Source	Various	Following ICAL, prior to samples analysis	%R must be within 90–110% of the true value.	Investigate reasons for failure, reanalyze once; if still unacceptable, repeat ICAL	Analyst, Department Manager	
	Initial Calibration Blank (ICB)	NA	Before beginning a sample sequence.	No analytes detected > ½ LOD, or <1/10 of the amount measured in the sample	Correct the problem, re-prepare and reanalyze; if fails, rerun ICAL.	Analyst, Department Manager	
	Continuing Calibration Verification (CCV)	Various	At beginning and end of sequence and after every 10 samples	%R must be within 90–110% of true value.	Recalibrate and/or perform necessary equipment maintenance; check calibration standards; reanalyze affected data.	Analyst, Department Manager	
	Continuing Calibration Blank (CCB)	NA	After the initial CCV, after every 10 field samples; and at end of sequence	No analytes detected > ½ LOQ, or < 1/10 of the amount measured in the sample	Correct the problem, then re-prepare and reanalyze calibration blank associated samples and a CCV	Analyst, Department Manager	

Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/Position Responsible for CA	SOP Reference
	Low-Level Check Standard	Various	Daily after ICAL and before samples.	The %R must be within 80–120% of true value.	Investigate and perform necessary equipment maintenance; recalibrate and reanalyze all affected samples	Analyst, Department Manager	
	Interference Check Standards (ICS – ICS A and ICS B)	Various	After ICAL and prior to sample analysis.	ICS A recoveries must be within the absolute value of $< 1/2$ LOQ; and ICS B recoveries must be within 80–120 %R of the true value.	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples	Analyst, Department Manager	

QAPP Worksheet No. 24
Analytical Instrument Calibration Table: Pesticides, Herbicides, PCBs,

Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/Position Responsible for CA	SOP Reference
Agilent 6890 or 7890 (GC/ECD) SW-846 8081B Pesticides	Initial Calibration (ICAL) – A 5-point calibration of individual pesticides with a mid-point calibration of Toxaphene and Chlordane	Various	Instrument receipt, major instrument change, or when the CCV does not meet criteria	The RSD for each analyte must be $\leq 20\%$, or r must be ≥ 0.995 , or correlation (r^2) must be ≥ 0.990 (6 points are required for second order).	Perform multi-point ICAL for Chlordane and Toxaphene if analytes are identified in sample and reanalyze the sample; 5-point calibration run of identified compound with reanalysis of sample	Analyst, Department Manager	SGS Orlando SOP GC015
	Initial Calibration Verification (ICV) second source	Mid-range	Once after each ICAL prior to sample analysis	The %R of all analytes must be within 80–120% of true value.	Identify source of problem, correct, repeat calibration, rerun samples	Analyst, Department Manager	

Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/Position Responsible for CA	SOP Reference
	Continuing Calibration Verification (CCV)	Mid-range	Analyze standard at beginning and end of sequence and every 10 field samples	%R of all analytes must be within 80-120% of true value.	Identify source of problem, correct, repeat ICAL, rerun samples.	Analyst, Department Manager	
	Breakdown Check	NA	Daily prior to sample analysis	The degradation must be $\leq 15\%$ for both Endrin and dichlorodiphenyltrichloroethane (DDT) to verify system inertness.	Column maintenance or replacement; injection port maintenance	Analyst, Department Manager	
Agilent 6890 or 7890 (GC/ECD) SW-846 8151A Herbicides	Initial Calibration (ICAL) - A 5-point calibration for Linear and/or Average model, 6 points minimum for quadratic.	Various	Instrument initial installation, major instrument maintenance, CCV does not meet criteria	RSD for each analyte and surrogate must be $\leq 20\%$, or r must be ≥ 0.995 . Nonlinear calibration requires minimum of 6 points and r^2 must be ≥ 0.990 .	Repeat ICAL and/or perform necessary equipment maintenance; check calibration standards; reanalyze affected data	Analyst, Department Manager	SGS Orlando SOP GC031
	Initial Calibration verification (ICV) Second Source	Mid-range	Once after each ICAL prior to sample analysis	%R of all analytes must be within 80–120% of true value.	Identify source of problem, correct, repeat ICAL, rerun samples	Analyst, Department Manager	

Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/Position Responsible for CA	SOP Reference
	Continuing Calibration Verification (CCV)	Mid-range	Analyze standard at beginning and end of sequence and after every 10 field samples	%R of all analytes must be within 80–120% of true value.	Identify source of problem, correct, repeat ICAL, rerun samples	Analyst, Department Manager	
Agilent 6890 or 7890 (GC/ECD)	Initial Calibration (ICAL) – A minimum 5-point calibration	Various	Instrument receipt, major instrument change, when CCV does not meet criteria	RSD for each Arochlor and surrogates must be $\leq 20\%$, or r must be ≥ 0.995 . Nonlinear calibration requires minimum of 6 points and r^2 must be ≥ 0.990 .	Repeat ICAL and/or perform necessary equipment maintenance; check calibration standards; reanalyze affected data	Analyst, Department Manager	SGS Orlando SOP GC014
SW-846 8082A PCBs	Initial Calibration verification (ICV) Second Source	Mid-range	Once after each ICAL prior to sample analysis	%R of all analytes must be within 80–120% of true value.	Identify source of problem, correct, repeat ICAL, rerun samples	Analyst, Department Manager	

Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/Position Responsible for CA	SOP Reference
	Continuing Calibration Verification (CCV)	Mid-range	Analyze standard at beginning and end of sequence and after every 10 field samples	%R of all analytes must be within 80–120% of true value.	Identify source of problem, correct, repeat ICAL, rerun samples	Analyst, Department Manager	
Agilent 6890 or 7890 (GC/ECD) SW-846 8151A Herbicides	Initial Calibration (ICAL) - A 5-point calibration for Linear and/or Average model, 6 points minimum for quadratic.	Various	Instrument initial installation, major instrument maintenance, CCV does not meet criteria	RSD for each analyte and surrogate must be $\leq 20\%$, or r must be ≥ 0.995 . Nonlinear calibration requires minimum of 6 points and r^2 must be ≥ 0.990 .	Repeat ICAL and/or perform necessary equipment maintenance; check calibration standards; reanalyze affected data	Analyst, Department Manager	SGS Orlando SOP GC031
	Initial Calibration verification (ICV) Second Source	Mid-range	Once after each ICAL prior to sample analysis	%R of all analytes must be within 80–120% of true value.	Identify source of problem, correct, repeat ICAL, rerun samples	Analyst, Department Manager	

Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/Position Responsible for CA	SOP Reference
	Continuing Calibration Verification (CCV)	Mid-range	Analyze standard at beginning and end of sequence and after every 10 field samples	%R of all analytes must be within 80–120% of true value.	Identify source of problem, correct, repeat ICAL, rerun samples	Analyst, Department Manager	

QAPP WORKSHEET NO. 25

ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION

All analytical instruments used for this project will be maintained in accordance with the requirements presented in the individual analytical method SOPs (**Appendix A.3**), as indicated below.

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Agilent 7700x (ICP-MS)	Clean torch assembly and spray chamber when discolored or when degradation in data quality is observed. Clean nebulizer, check argon, replace peristaltic pump tubing as needed.	SW-846 6020B Metals	Torch, nebulizer chamber, pump, pump tubing.	Prior to ICAL and as necessary.	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Laboratory Analyst	SGS Orlando SOP MET107

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Agilent 6890 or 7890 (GC/ECD)	Injector port, column maintenance	SW-846 8081B Pesticides	Leak test, column and injector port inspection	Need for maintenance determined by passing calibration and chromatography	Passing Calibration and DDT breakdown check	Column clipping, seals and liners replacement, recalibrate and reanalyze affected samples	Laboratory Analyst	SGS Orlando SOP GC015
Agilent 6890 or 7890 (GC/ECD)	Injector port, column maintenance	SW-846 8151A Herbicides	Leak test, column and injector port inspection	Need for maintenance determined by passing calibration and chromatography	Passing Calibration	Column clipping, seals and liners replacement, recalibrate and reanalyze affected samples	Laboratory Analyst	SGS Orlando SOP GC031
Agilent 6890 or 7890 (GC/ECD)	Injector port, column maintenance	SW-846 8082A PCBs	Need for maintenance determined by passing calibration and chromatography	Need for maintenance determined by passing calibration and chromatography	Passing Calibration	Column clipping, seals and liners replacement, recalibrate and reanalyze affected samples	Laboratory Analyst	SGS Orlando SOP GC014

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Agilent 1260 or 1290 (LCMS)	Spray chamber, Clean capillary		Check Tune, Leak checks, Pressure Check, Mobile phase filters, Needle Inspection	Need for maintenance determined by passing calibration (see SOP MS024)	Passing calibration	Check LC column Run autotune Check calculations Reanalyze affected samples	Laboratory Analyst	SGS Orlando SOP MS024
Agilent 1260 or 1290 (LCMS)	Spray chamber, Clean capillary	EPA Draft 1633 PFAS	Check Tune, Leak checks, Pressure Check, Mobile phase filters, Needle Inspection	Need for maintenance determined by passing calibration (see SOP MS024)	Passing calibration	Check LC column Run autotune Check calculations Reanalyze affected samples	Laboratory Analyst	SGS Orlando SOP MS024

This page was intentionally left blank.

QAPP WORKSHEET NOS. 26 AND 27 SAMPLE HANDLING, CUSTODY, AND DISPOSAL

The sampling organization and project laboratories will be identified for each site. Sample shipment procedures can include overnight shipment by commercial transport (e.g., FedEx) by commercial courier, laboratory courier, or field team. If a laboratory service center will be used (preferred method), identify the service center location, contact information, and responsible laboratory personnel. Additional sample shipment considerations should also be identified in this worksheet, including any security restrictions on couriers.

Sample Collection, Packaging, and Shipment (Reference Field SOP ¹)
Sample Collection (Personnel/Organization): Site Staff/Tanaq
Sample Packaging (Personnel/Organization): Site Staff/Tanaq
Coordination of Shipment (Personnel/Organization): FTL/Tanaq; Sample Receipt Manager/Laboratory
Type of Shipment/Carrier: Direct delivery by courier
Field Sample Storage (number of days from sample collection): Samples will be held in the field no longer than overnight unless prior arrangements have been made with the laboratory. Holding times will not be compromised by holding samples in the field.
Special Sample Shipment Considerations: None
Sample Receipt and Analysis
Sample Receipt (Personnel/Organization): Sample Management Staff/Laboratory
Sample Custody and Storage (Personnel/Organization): Sample Management Staff/Laboratory
Sample Preparation (Personnel/Organization): Organic Preparation Staff, Inorganic Preparation Staff, and Bench Chemists/Laboratory
Sample Determinative Analysis (Personnel/Organization): Bench Chemists/Laboratory
Sample Archiving
Sample Extract/Digestate Storage (number of days from extraction/digestion): For 60 days from data report release or as required on a site-specific basis
Biological Sample Storage (number of days from sample collection): As required on a site-specific basis
Sample Disposal
Personnel/Organization: Sample Management Staff/Laboratory
Number of Days from Analysis: 60 from data report release; up to 6 months on sample-specific request from Tanaq

⁽¹⁾ Field Procedure SOP References Table (Worksheet No. 21).

Sample Custody Requirements

The following sample ID, labeling, shipping, and custody guidance applies to all projects conducted under this QAPP. Contract-specific sample chain of custody requirements are also described in Procedure MAFB-CP-02 (**Appendix D**). General procedures for assigning sample IDs are presented below. Each site will have specific sample ID conventions that will be described as part of the site field operations described in

Worksheet Nos. 14 and 16. The site samples listed in Worksheet No. 18 will use these site sample ID conventions.

Sample Identification

The sample ID format contains specific information about the sample matrix and location. Each sample is sequentially designated according to site, matrix, and location. Additional designation letters and numbers will be used to denote sample depths or identify QC samples. Prior to collecting each sample, the sample containers will be labeled with the following information: date and time, sample ID, sampling personnel, preservatives (if any), and analytical parameters. All information pertaining to a particular sample is referenced by the sample ID, which is recorded on the sample bottle(s), in the field logbook, and on the Chain-of-Custody Record form. The sample ID format is discussed below.

All samples collected from one location (i.e., from the same coordinates) must have the same sample type designation.

QC samples are denoted by adding a QC extension at the end of the sample ID (item 5 above). The extensions are as follows:

<u>Order</u>	<u>Extension</u>	<u>Description</u>
1	a	field duplicate
2	b	field split (to quality assurance lab)
2	c	trip blank
2	d	rinsate or equipment blank
2	e	field blank
3	ms	matrix spike
3	msd	matrix spike duplicate
3	f	blind regulatory performance evaluation sample
3	g	Characterization of source water used for decontamination or blank collection

If multiple QC extensions are required, list in the order specified above, separated by dashes.

Groundwater

Groundwater samples are designated by the monitoring well ID. QA/QC samples will be labeled with the appropriate extension in the sample code field number. For example, a duplicate groundwater sample collected from OW500-MW10 would be identified as: OW500-MW10-a

Blank Samples

The QA/QC samples will identify the base (APAFR), the sample type (e.g., rinsate blank [RB] or field blank [FB]). For example: APAFR-FB001-d

IDW Characterization

Samples collected to characterize waste for disposal will identify the base (APAFR), the material and an identifier that the sample is for IDW, and a three-digit sequential numbering. For example: APAFR-GW-IDW-001

Sample Labeling

The following information will be included on the sample label:

- Project ID (1038-001)
- Sample ID (described above)
- Type of sample matrix
- Preservative(s)
- Field-filtered (if applicable)
- Date and time of collection (using military time nomenclature, not “am/pm” times)
- Required analytical methods
- Sampler’s initials

The samples labels will be placed on the sample containers so as not to obscure any QA/QC data on the bottles. Sample information will be printed in a legible manner using a permanent (indelible) ink marker or preprinted on a label. The field ID must provide enough information to enable cross-referencing with the appropriate sample documentation forms. Chain of Custody Record forms will be completed at the time of collection and will exactly match the information on the sample labels.

Sample Packaging

Preservation reagents will be added to sample containers before or immediately after collection of the sample, as indicated in Worksheet Nos. 19 and 30. The samples will immediately be placed on ice and will be kept chilled during the workday until packaged for shipment to the laboratory.

Sample coolers will be supplied by the laboratory. When packaging samples for shipment, the cooler drainage plug will be closed, and the cap will be sealed in place with duct tape. Sample containers will be placed inside sealed plastic bags as a precaution against cross contamination caused by leakage or breakage. Bagged sample containers will be placed in the coolers in such a manner as to eliminate the chance of breakage during shipment. Ice will be placed in the coolers in and around the bagged sample containers. Prior to sealing the cooler, the sampler’s copy of the Chain of Custody Record forms will be detached and provided to the FTL for the project file. The remaining portion of the completed Chain of Custody Record forms will be attached to the underside of the cooler lid in a sealed plastic bag. The cooler will then be taped shut and at least two completed custody seals will be affixed across the gap between the lid and body of the cooler.

Field Sample Chain of Custody Procedures

Chain of Custody Record forms will be maintained for all field and field QC samples. A sample is defined as being under a person’s custody if any of the following conditions exist: (1) it is in his or her possession; (2) it is in his or her view after being in the individual’s possession; (3) it was in his or her possession and is locked up; or (4) it is in a designated secure area after being in his or her possession. Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analyses, storage, data generation, reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in the field and laboratory records. All sample containers will be sealed in a manner that will prevent tampering or indicate tampering, should it occur. In no instance will sample containers be sealed with tape. Contract-specific chain of custody requirements are provided in Procedure MAFB-CP-02 in **Appendix D**. Prior to

handing off the physical Chain of Custody form, the field personnel will take a photo of each page of the form.

Sample Shipment

Samples collected in the field will be relinquished to a laboratory courier (preferred method) or shipped to the laboratory as expeditiously as possible. Sample shipment will be performed in accordance with all applicable U.S. Department of Transportation regulations. The samples will be shipped to the laboratory by the procedures identified in this worksheet. Arrangements will be made between the Tanaq Team and the contract laboratory POC for samples that are to be delivered to a laboratory on a weekend, so that sample condition and holding times are not compromised. During transit, it is not always possible to control sample temperature; therefore, a temperature blank sample will be included in every cooler that will be used to determine the internal temperature of the cooler upon receipt at the laboratory. Sufficient ice should be placed in the cooler to maximize the changes of the samples arriving at the laboratory at a sufficiently cold temperature (typically 4 degrees Celsius or below, but not frozen).

Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal)

The designated sample custodian(s) and staff are responsible for samples received at the laboratory. In addition to receiving samples, the sample receipt staff is also responsible for documentation of sample receipt and storage before and after sample analysis. Summaries of the minimal laboratory receipt procedures are as follows:

- Upon receipt, sign, date, and document the time of sample receipt on the airbills or other shipping manifests received from the couriers.
- Sign the Chain of Custody Record form assuming custody of the samples. If a chain of custody form is not received with a set of samples, the laboratory will immediately notify the Tanaq PM.
- Inspect the sample cooler for integrity and then document the following information:
 - Type of courier and whether the samples were shipped or hand delivered (copies of the airbills are maintained).
 - Availability and condition of custody information.
 - Sample temperature.
 - Actual temperature of the temperature blank. If the temperature of the samples upon receipt at the laboratory exceeds the temperature requirements, individual sample containers will be measured. All exceedances will be documented in laboratory records, and the laboratory must contact the Tanaq PM immediately and document any decision regarding the potentially affected samples.
 - Presence of leaking or broken containers and indication of sample preservation.
- Verify that the holding time has not been exceeded. If a sample has exceeded holding time, the Tanaq Project Chemist or PM must be notified.

Match the sample container information (e.g., sample tag/label), chain of custody records, and all pertinent information associated with the sample. The sample custodian then verifies the sample identity

to ensure that all information is correct. Any inconsistencies are resolved with the Tanaq Team through the Laboratory PM and CA measures are documented before sample analysis proceeds.

This page was intentionally left blank.

QAPP WORKSHEET NO. 28

ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION

The following tables provide general guidance for the evaluation of QC analyses and the implementation of CA for out-of-control situations. The method-specific acceptance criteria are presented in the applicable table in Worksheet No. 12 and Worksheet No. 15.

Matrix	Aqueous				
Analytical Group	Metals				
Analytical Method/ SOP Reference	SW-846 6020B SGS Orlando SOP MET107				
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Method Blank (MB)	One per digestion batch of 20 or fewer samples	All analytes $\leq \frac{1}{2}$ LOQ	Reanalyze, and/or stop the run and determine the source of contamination, or document why the data are acceptable.	Analyst, Department Manager	System integrity, freedom of interferences, and absence of contamination
Laboratory Control Sample (LCS) or Blank Spike (BS)	One for each batch of up to 20 samples	Within DoD QSM 5-series Appendix C limits Statistical limits if not listed in DoD QSM	Evaluate and reanalyze if possible. If LCS recoveries are high but the sample results are < LOQ, narrate. Otherwise, re- digest and reanalyze.	Analyst, Department Manager	Performance in ideal matrix

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Duplicate Sample (DUP)	One per preparation batch of 20 or fewer samples of similar matrix	RPD \leq 20	Narrate any results that are outside control limits.	Analyst, Department Manager	Reproducibility in real matrix
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per preparation batch of 20 samples of similar matrix	Within LCS limits RPD \leq 20	Qualify results for affected analytes for all associated samples. Perform PDS to assess matrix effect.	Analyst, Department Manager	Performance Reproducibility in real matrix
Serial Dilution	One for each preparation batch with sample concentration(s) > 50x LOQ	The results of the 1:5 dilution shall agree within 20 percent of the true value as long as the analyte concentration is within the linear range of the instrument and sufficiently high (minimally, a factor of 25 times greater than the LOQ).	If the results are outside these criteria, then matrix interference should be suspected, and the proper footnote entered into LIMS.	Analyst, Department Manager	Matrix effect
Internal Standard	All samples and standards	70 – 120 %R referenced against ICB	Dilute sample until internal standard is within range. Footnote data accordingly.	Analyst, Department Manager	Instrument sensitivity

Matrix	Aqueous				
Analytical Group	Pesticides				
Analytical Method/ SOP Reference	SW-846 8081B SGS Orlando SOP GC015				
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch of 20 or fewer samples of similar matrix	All analytes must be $\leq \frac{1}{2}$ LOQ	(1) Investigate contamination source. (2) Re-prepare and analyze MB and all samples processed with the contaminated blank.	Analyst, Department Manager	System integrity, freedom of interferences, and absence of contamination
Surrogates (Surr.)	Every sample, standard and QC	Within DoD QSM 5-series Appendix C Tables Statistical limits if alternate surrogates are used	(1) Check chromatogram for interference; if found, flag the data. (2) If not found, then check instrument performance; if problem is found, correct and reanalyze. (3) If still out, re-extract and analyze sample. (4) If reanalysis is out, flag the data.	Analyst, Department Manager	Individual sample efficiency control

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Laboratory Control Sample (LCS) or Blank Spike (BS)	One for each batch of up to 20 samples	Within DoD QSM 5-series Appendix C Tables Statistical limits if not listed in DoD QSM	Evaluate and reanalyze if possible. If LCS recoveries are high but the sample results are < LOQ, narrate. Otherwise, re-prepare and reanalyze.	Analyst, Department Manager	Performance in ideal matrix
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per 20 samples of similar matrix	Within LCS limits RPD ≤ 30	Evaluate the samples and associated QC and, if the LCS results are acceptable, narrate.	Analyst, Department Manager	Performance and reproducibility in real matrix
Second Column Confirmation	Must confirm all positive results	Results between primary and second column must be RPD $\leq 40\%$; report higher of the two results unless matrix interference is apparent	None. Apply qualifier if RPD > 40% and discuss in the case narrative.	Analyst, Department Manager	Analyte identification

Matrix	Aqueous				
Analytical Group	Herbicides				
Analytical Method/ SOP Reference	SW-846 8151A SGS Orlando SOP GC031				
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch of 20 or fewer samples of similar matrix	All analytes $\leq \frac{1}{2}$ LOQ	(1) Investigate contamination source. (2) Re-prepare and analyze MB and all samples processed with the contaminated blank.	Analyst, Department Manager	System integrity, freedom of interferences, and absence of contamination
Surrogates (Surr.)	Every sample, standard and QC	Within DoD QSM 5-series Appendix C Tables Statistical limits if alternate surrogates are used	(1) Check chromatogram for interference; if found, flag the data. (2) If not found, then check instrument performance; if problem is found, correct and reanalyze. (3) If still out, re-extract and analyze sample. (4) If reanalysis is out, flag the data.	Analyst, Department Manager	Individual sample efficiency control

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Laboratory Control Sample (LCS) or Blank Spike (BS)	One for each batch of up to 20 samples	Within DoD QSM 5-series Appendix C Tables Statistical limits if not listed in DoD QSM	Evaluate and reanalyze if possible. If LCS recoveries are high but the sample results are < LOQ, narrate. Otherwise, re-prepare and reanalyze.	Analyst, Department Manager	Performance in ideal matrix
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per 20 samples of similar matrix	%R Within LCS limits RPD \leq 30	Evaluate the samples and associated QC and, if the LCS results are acceptable, narrate.	Analyst, Department Manager	Performance and reproducibility in real matrix
Second Column Confirmation	Must confirm all positive results	Results between primary and second column must be RPD \leq 40%; report higher of the two results unless matrix interference is apparent	None. Apply qualifier if RPD > 40% and discuss in the case narrative.	Analyst, Department Manager	Analyte identification

Matrix	Aqueous				
Analytical Group	PCBs				
Analytical Method/ SOP Reference	SW-846 8082A SGS Orlando SOP GC014				
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Method Blank (MB)	One per preparation batch of 20 or fewer samples of similar matrix	All analytes must be $\leq \frac{1}{2}$ LOQ	(1) Investigate contamination source. (2) Re-prepare and analyze MB and all samples processed with the contaminated blank.	Analyst, Department Manager	System integrity, freedom of interferences, and absence of contamination
Surrogates (Surr.)	Each sample, standard and QC	Within DoD QSM 5-series Appendix C Tables Statistical limits if alternate surrogates are used	(1) Check chromatogram for interference; if found, flag the data. (2) If not found, then check instrument performance; if problem is found, correct and reanalyze. (3) If still out, re-extract and analyze sample. (4) If reanalysis is out, flag the data.	Analyst, Department Manager	Individual sample efficiency control

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Laboratory Control Sample (LCS) or Blank Spike (BS)	One for each batch of up to 20 samples	Within DoD QSM 5-series Appendix C Tables Statistical limits if not listed in DoD QSM	Evaluate and reanalyze if possible. If LCS recoveries are high but the sample results are < LOQ, narrate. Otherwise, re-prepare and reanalyze.	Analyst, Department Manager	Performance in ideal matrix
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per 20 samples of similar matrix	Within LCS limits RPD ≤ 30	Evaluate the samples and associated QC and, if the LCS results are acceptable, narrate.	Analyst, Department Manager	Performance and reproducibility in real matrix
Second Column Confirmation	Must confirm all positive results	Results between primary and second column must be RPD $\leq 40\%$; report higher of the two results unless matrix interference is apparent	None. Apply qualifier if RPD > 40% and discuss in the case narrative.	Analyst, Department Manager	Reproducibility

Matrix	Aqueous				
Analytical Group	PFAS				
Analytical Method/ SOP Reference	EPA Draft Method 1633 SGS Orlando SOP MS024				
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Method Blank (MB)	MB - One per preparation batch of 20 or fewer samples of similar matrix	All analytes must be $\leq \frac{1}{2}$ LOQ.	The source of the contamination is investigated and eliminated before proceeding with further analysis. CAs are: Samples ND or $>10^*$ contamination level– report with qualification Samples $<10^*$ contamination – re-extract and reanalyze. Insufficient sample - qualify and footnote.	Analyst, Department Manager	System integrity, freedom of interferences, and absence of contamination

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Low Level Laboratory Control Sample (LLCS) or Low Level Blank Spike	One for each batch of up to 20 samples	Within statistically derived limits. Until these are developed, preliminary 40-150 % are used. Lower statistical limit must be $\geq 40\%$.	Correct problem, then prepare and reanalyze the LLCS and all samples in associated preparatory batch for failed analytes, if sufficient sample material is available.	Analyst, Department Manager	Laboratory Accuracy/Method bias in ideal matrix
Laboratory Control Sample (LCS) or Blank Spike (BS)	One for each batch of up to 20 samples	Within statistically derived limits. Until these are developed, preliminary 40-150 % are used. Lower statistical limit must be $\geq 40\%$.	Correct problem, then prepare and reanalyze the LCS and all samples in associated preparatory batch for failed analytes, if sufficient sample material is available.	Analyst, Department Manager	Laboratory Accuracy/Method bias in ideal matrix
Matrix Spike (MS)	One for each batch of up to 20 samples	%R Within LCS limits	Determine root cause; flag MS/MSD data; discuss in narrative. If due to matrix interference, CA is not necessary.	Analyst, Department Manager	Performance Reproducibility in real matrix
Matrix Spike Duplicate (MSD)	One for each batch of up to 20 samples	%R Within LCS limits $RPD \leq 30$	Determine root cause; flag MS/MSD data; discuss in narrative. If due to matrix interference, CA is not necessary.	Analyst, Department Manager	Performance Reproducibility in real matrix

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Matrix Duplicate (Dup)	One for each batch of up to 20 samples	$RPD \leq 30$ for analytes > LOQ	Determine root cause; flag MS/MSD data; discuss in narrative. If due to matrix interference, CA is not necessary.	Analyst, Department Manager	Reproducibility in real matrix
Extracted Internal Standards	Every sample, standard, and QC	Within statistically derived limits. Until these are developed, preliminary 20-150 % are used. Lower statistical limit must be $\leq 20\%$.	Samples may be considered affected by matrix. Failed QC sample – correct analytical problem and reanalyze all failed samples.	Analyst, Department Manager	Individual sample preparation efficiency control
Injection Internal Standards	Every sample, standard, and QC	50-200% of ICAL average area for the NIS of interest. In any instance NIS area must be >30% average area.	Examine for matrix effect. Correct problem and reanalyzed affected samples. For the hierarchy of reanalysis, refer to QSM 5-series, Table B-24. Apply flag and discuss in Case Narrative.	Analyst, Department Manager	Instrument sensitivity control

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Measurement Performance Criteria
Ion Transitions	Prior to method implementation	Guidance criteria for select analytes: PFOA: 413 → 369 PFOS: 499 → 80 PFHxS: 399 → 80 PFBS: 299 → 80 4:2 FTS: 327 → 307 6:2 FTS: 427 → 407 8:2 FTS: 527 → 507 NEtFOSAA: 584 → 419 NMeFOSAA: 570 → 419	If these transitions are not used, the reason must be technically justified and documented. Flagging is not appropriate.	Analyst, Department Manager	Chemical fragmentation.

QAPP WORKSHEET NO. 29 PROJECT DOCUMENTS AND RECORDS

The following is a list of site records that should be used and maintained for each site investigation and for the whole project, as well as the personnel responsible for generating and verifying the records. All records should be maintained in the Tanaq, laboratory, and other subcontractor (such as construction, design, or data validation firms) project files for a minimum of five years or longer, as required by contract. This worksheet will be revised and presented in site-specific QAPPs and will include the actual identities and organizations of the personnel listed in the QAPP.

Record	Generation	Verification
Sample Collection Documents and Records		
Field notes (bound logbook)	Field staff	FTL
Sample documentation forms	Field staff	FTL
Tailgate safety meeting forms	SSHO	Corporate H&S Officer
Daily QC reports	FTL	PM
Chain of custody records	Field staff	FTL
Airbills	Field staff	FTL
Custody seals	Field staff	FTL
CA action forms	PM	QA Officer
Photographs	Field staff	PM
Geographical Information System data	Field staff	Database Manager
Telephone logs, emails, faxes, and correspondence	Field staff	FTL
On-Site Analysis Documents and Records		
Equipment calibration logs	Field Staff	FTL
Equipment maintenance, testing, and inspection logs	Field Staff	FTL
Equipment calibration logs	Field Staff	FTL
Field sampling data sheets	Field Staff	FTL
Waste disposal records	FTL	PM
Off-Site Analysis Documents and Records		
Sample receipt, custody, and tracking records	Sample Receipt Staff	Laboratory PM
Standard traceability logs	Analytical Staff	Section Manager/QA Manager
Equipment calibration logs	Analytical Staff	Section Manager/QA Manager
Sample preparation logs	Analytical Staff	Section Manager/QA Manager
Analytical run logs	Analytical Staff	Section Manager/QA Manager
Equipment maintenance, testing, and inspection logs	Analytical Staff	Section Manager/QA Manager

QAPP Worksheet No. 29 (Continued)

Project Documents and Records

Record	Generation	Verification
Off-Site Analysis Documents and Records (Continued)		
Analytical discrepancy forms	Analytical Staff	Section Manager/QA Manager
Reported analytical results	Analytical Staff	Section Manager/QA Manager
Reported results for standards, QC checks, and QC samples	Analytical Staff	Section Manager/QA Manager
Data package completeness checklists	Analytical Staff/Section Manager	Laboratory PM/QA Manager
Sample disposal records	Assigned Laboratory Staff	Laboratory Operations Manager/QA Manager
Extraction and cleanup records	Analytical Staff	Section Manager/QA Manager
Raw data (stored electronically)	Analytical Staff	Laboratory Database Manager/QA Manager
Electronic database deliverables (EDDs)	Laboratory Database Manager	Tanaq Database Manager
Telephone logs, emails, faxes, and correspondence	Laboratory PM	Laboratory Operations Manager
Data Assessment Documents and Records		
Data validation reports	Data Validator	Data Validation PM/Project Chemist
Automated data review reports	Data Validator	Data Validation PM/Project Chemist
Database QC spreadsheets	Project Staff	Database Manager
Data usability assessments	Project Chemist	PM
Telephone logs, emails, faxes, and correspondence	Project Staff	PM
Deliverables		
Project planning documents, including QAPP, Work Plans, PMP, SSHP, Community Relations Plan, QA Surveillance Plan	PM	QA Officer
Project deliverables, including monthly Operations and Maintenance Reports, Periodic Groundwater Monitoring Reports, Conceptual Site Model	PM	QA Officer
Telephone logs, emails, faxes, and correspondence	All project staff	PM
Permits	FTL	PM
Site maps	Graphics Staff	PM
Design documents	Design Staff	PM
EDDs	Project Database Staff	Database Manager

QAPP WORKSHEET NOS. 31, 32, AND 33 ASSESSMENTS AND CORRECTIVE ACTION

Assessments

Assessment Type	Responsible Personnel and Organization	Number and Frequency	Assessment Deliverable	Deliverable Due Date
Review of QAPP, SOPs, and SSHP with Field Staff	Tanaq FTL, Tanaq PM	Prior to sampling startup and with all new field staff prior to assignment	Completed acknowledgment signature pages	48 hours following assessment
Work performed in accordance with QAPP and site-specific QAPPs.	Tanaq FTL, CQCSM	Ongoing during all phases of fieldwork	Daily progress reports	24 hours following conclusion of business day
Logbook and Field Form Review	Tanaq FTL	Daily	NA; corrections will be made directly to reviewed documents	24 hours following assessment
DQCRs	Tanaq FTL	Daily	DQCR	24 hours following assessment
Laboratory Assessment for Appropriate Certifications, Capacity, and QAPP Review with Staff	Tanaq Project Chemist	Prior to sampling mobilization, as new laboratories are contracted	Receipt of copies of certifications. Email traffic concerning lab capacity prior to sampling startup. QAPP sign-off sheet received from laboratory.	48 hours following assessment
Tailgate Safety Meeting	Tanaq FTL	Daily	Verbal debriefing and daily sign-off log. If a safety incident occurs, a Supervisor Injury Employee Report is completed.	Weekly; any safety incidents will be reported to the PM and Corporate H&S Officer immediately
Field Sampling and Chain of Custody Form Review Against QAPP Requirements	FTL	Daily	Corrections will be made directly to reviewed documents; communication may be in the form of email	Prior to sample delivery to the laboratory

QAPP Worksheet Nos. 31, 32, and 33 (Continued)

Assessments

Assessment Type	Responsible Personnel and Organization	Number and Frequency	Assessment Deliverable	Deliverable Due Date
Data Validation	Tanaq Project Chemist	Per SDG	Communication may be in the form of email traffic clarification of the analytical report or CAs because of deficiencies identified in the validation process.	24 hours following assessment
Laboratory Report Deliverables and Analytical Results Against QAPP Requirements	Tanaq Project Chemist	As discrepancies are identified in the validation process	Memorandum or email to PM and Project Chemist	72 hours following assessment

Assessment Response and Corrective Action

Assessment Type	Individual(s) Notified of Findings	Assessment Response Documentation	Time Frame for Response	Responsibility for Implementing CA	Responsibility for Monitoring CA
Review of QAPP, SOPs, and SSHP with Field Staff	Tanaq FTL	Completed acknowledgement signature pages	48 hours following assessment	Tanaq FTL	Tanaq CQCSM
Work performed in accordance with basewide and site-specific QAPPs	Tanaq FTL, Tanaq PM	Interim CA documented pending final approval	By close of same business day	Tanaq FTL	Tanaq PM and CQCSM
Logbook and Field Form Review	Tanaq FTL	Corrections will be made directly to reviewed documents	NA	Tanaq FTL	Tanaq PM
Laboratory Assessment for Appropriate Certifications, Capacity, and QAPP Review with Staff	Tanaq Project Chemist	Response to email or memorandum	48 hours after notification	Laboratory PM	Tanaq Project Chemist

**QAPP Worksheet Nos. 31, 32, and 33
 Assessments and Corrective Action (Continued)**

Assessment Type	Individual(s) Notified of Findings	Assessment Response Documentation	Time Frame for Response	Responsibility for Implementing CA	Responsibility for Monitoring CA
Tailgate Safety Meeting	Tanaq FTL	Included as part of the process of the Supervisor Injury Employee Report	24 hours after notification	Tanaq FTL	Tanaq PM
Field Sampling and Chain of Custody Form Review Against QAPP Requirements	Tanaq FTL	Response to email	48 hours after notification	Tanaq FTL	Tanaq PM
Data Validation	Tanaq Project Chemist	If required, laboratory reports will be amended and corrections noted in the analytical narrative and contained with the validation report.	1 business week	Data Validation PM	Tanaq Project Chemist
Laboratory Report Deliverables and Analytical Results Against QAPP Requirements	Tanaq Project Chemist	If required laboratory reports will be amended and corrections noted in the analytical narrative.	72 hours after notification	Laboratory PM	Laboratory QA Manager Tanaq Project Chemist

This page was intentionally left blank.

QAPP WORKSHEET NO. 34 DATA VERIFICATION AND VALIDATION INPUTS

This worksheet lists the inputs that will be used during data verification and validation. Inputs include planning documents, field records, and laboratory records. Data verification is a check that all specified activities involved in collecting and analyzing samples have been completed and documented and that the necessary records (objective evidence) are available to proceed to data validation. Data validation is the evaluation of conformance to stated requirements, including those in the contract, methods, SOPs and the QAPP.

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved QAPP	X	
2	Contract	X	
4	Field SOPs	X	
5	Laboratory SOPs	X	
Field Records			
6	Field logbooks	X	X
7	Equipment calibration records	X	X
8	Chain of custody forms	X	X
9	Sampling diagrams/surveys	X	X
10	Relevant correspondence	X	X
11	Change orders/deviations	X	X
12	Field audit reports	X	X
13	Field CA reports	X	X
14	Base CE Work Clearance Requests (AF Form 103)	X	X
15	Flightline badge and training requests	X	X
16	Background request (for base access badges)	X	X
Analytical Data Package			
17	Cover sheet (laboratory identifying information)	X	X
18	Case narrative	X	X
19	Internal laboratory Chain of custody	X	X
20	Sample receipt records	X	X
21	Sample chronology (e.g., dates and times of receipt, preparation, and analysis)	X	X
22	Communication records	X	X
23	Project-specific PT sample results	X	X
24	LOD/LOQ establishment and verification	X	X
25	Standards Traceability	X	X
26	Instrument calibration records	X	X
27	Definition of laboratory qualifiers	X	X
28	Results reporting forms	X	X
29	QC sample results	X	X
30	CA reports	X	X
31	Raw data	X	X
32	Electronic data deliverable	X	X

This page was intentionally left blank.

QAPP WORKSHEET NO. 35 DATA VERIFICATION PROCEDURES

Verification Input	Description	Responsible for Verification
Chain of custody (shipping)	Chain of custody forms will be reviewed upon completion and verified against the packed sample coolers and site sampling requirements. This QC check will be verified by initialing the chain of custody form next to the shipper's signature. A copy of the chain of custody form will be retained in the project file and the original and one copy will be taped inside the cooler in a waterproof bag.	Tanaq FTL Tanaq CQCSM
Log review	Field log reviews will be performed daily. This review will be performed to verify that all field monitoring equipment was maintained, calibrated, and operated properly. In addition, the review denotes all required information has been correctly documented in the field logbooks and sample documentation sheets. Field logs will be reviewed by the PM prior to samples being relinquished to the laboratory.	Tanaq FTL, Tanaq PM
Chain of custody (receipt)	Chain of custody forms will be reviewed and compared to cooler contents. Any discrepancies (sample bottles, sample IDs, requested methods) will be communicated to the Laboratory PM for resolution with the Tanaq PM.	Laboratory Sample Receipt Manager Laboratory PM
Analytical data package	All data used to prepare analytical data packages will be reviewed at multiple levels throughout the laboratory. The requirements for this review process are described in the laboratory's quality manual. No data packages will be delivered to Tanaq without the necessary approval.	Laboratory QA Manager
Analytical data package	Ensure that the appropriate analytical samples have been collected, appropriate site IDs have been used, and the correct analytical methods have been applied.	Tanaq QA Manager
Analytical data package ¹	Review the analytical reports to establish that all required forms, case narratives, samples, chain of custody forms, logbooks, and raw data have been included.	Data Validator (Tanaq or subcontractor)
EDD (export)	All EDDs (with the exception of data that will be exclusively used for waste characterization) will be verified against the requirements of the ERPIMS database and a SEDD Stage 2b deliverable prior to transmittal to Tanaq. Tanaq does not intend to have Stage 4 validation performed unless determined necessary by the Tanaq Chemist.	Laboratory Database Manager
EDD (import)	Any EDD nonconformances from the laboratory are reviewed and addressed before the data is processed further. This check is performed on the EDD to ensure that it is in the correct format and that it contains the correct standard values. Any errors or warnings are addressed before processing the data further.	Tanaq Database Manager
Project database	All data qualifiers applied to the project database by manual entry will receive a 100% QC check for accuracy and completeness. Prior to final approval, each EDD output will receive a 10% QC check of electronically reported results against the hardcopy laboratory reports.	Tanaq Database Manager

¹ This verification step is performed as part of the data validation process described in Worksheet No. 36 and **Appendix A.1**.

This page was intentionally left blank.

QAPP WORKSHEET NO. 36 DATA VALIDATION PROCEDURES

Validation Stage	Matrix	Analytical SOP ¹	Validation Criteria	Data Validator
Data Review Step IIa				
Data Verification	Groundwater and aqueous IDW	All	Package Completeness Holding Times: Worksheet No. 19 Narrative: Additional items noted for resolution or clarification	Verdantas
Data Validation – Characterization,	Aqueous IDW,	All	DQIs: Method-specific criteria presented in Worksheet Nos. 12, 15, and 28 Qualification: DoD General Validation Guidelines and Method-Specific Modules in Appendix A , screening level items (Stage 2A)	Verdantas
Data Validation - Definitive	Groundwater	All	DQIs: Method-specific criteria presented in Worksheet Nos. 12, 15, 24, and 28 Qualification: DoD General Validation Guidelines and Method-Specific Modules in Appendix A , definitive level items (Stage 2B)	Verdantas
Data Validation – Full Review	As determined by Tanaq Chemist	All	As determined by the Tanaq Chemist. Qualification: DoD General Validation Guidelines and Method-Specific Modules in Appendix A , screening level items (Stage 4) This level of review incorporates evaluation of raw data	Verdantas
Data Review Step IIb				
Senior Review	All	All	See Worksheet No. 37 and Appendix B	Tanaq Project Chemist
Overall Assessment	All	All	See Worksheet No. 37 and Appendix B	Tanaq PM
Data Review Step IIa				
Data Verification	Laboratory data reports (see Worksheet No. 35)		The validator will verify data package completeness, review case narratives, evaluate sample delivery and condition, and evaluate preparation and analysis holding times (Worksheet No. 19).	Verdantas

Validation Stage	Matrix	Analytical SOP ¹	Validation Criteria	Data Validator
Data Validation	Laboratory data reports		The data validator will perform an evaluation of sample- and batch-related QC results (see Appendix A) for definitive QC elements, as required for each method on a site-specific basis. If ADR is performed, review ADR output to ensure compliance with the validation protocols presented in Appendix A .	Verdantas

QAPP Worksheet No. 36 (Continued)

Data Validation Procedures

Validation Stage	Matrix	Analytical SOP ¹	Validation Criteria	Data Validator
Data Review Step IIb				
Senior Review	Data validation reports		Senior review of reports to approve of all validation results and final qualifiers; overall evaluation of analytical performance against QAPP requirements.	Tanaq Project Chemist
Overall Assessment	Project documentation (Worksheet No. 33)		Complete project dataset and documentation: Determine whether the sampling plan was executed as specified (that is, the number, location, and type of field samples were collected and analyzed as specified in the WP); evaluate whether sampling procedures were followed with respect to equipment and proper sampling support (for example, techniques, equipment, decontamination, volume, temperature, and preservatives).	Tanaq PM

¹ Refer to Worksheet No. 23.

QAPP WORKSHEET NO. 37 DATA USABILITY ASSESSMENT

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

The data assessment team will perform the operations summarized in Worksheet No. 35 and Worksheet No. 36 to evaluate sampling team and laboratory compliance with the requirements with this QAPP and other project planning documents. The laboratory will report results using the qualifiers defined in F.A.C. 62-160 Table 1; these Florida DEP-specific qualifiers will be retained and presented in data reports. Any additional qualifiers applied in the data validation process will be added to the Florida DEP qualifiers. When discussing data points in report text, the format “value [Florida DEP qualifiers]/validation qualifier units” will be used. When data is presented in tabular form, the Florida DEP qualifiers and validation qualifiers will be presented in separate columns. The data validation and qualification process is described in **Appendix A**. **Appendix A** also includes a listing of the Florida DEP and validation qualifiers and the associated qualifier definitions.

Evaluation activities will be documented in the QA reports listed in Worksheet No. 29 and will be used to assess the usability of project data in levels of detail ranging from an analyte- and sample-specific basis to the overall dataset for the sampling event. A full description of the activities listed in this summary is presented in **Appendix B**. The PARCCS DQIs and formulas used to evaluate data quality are presented in Worksheet No. 12, with the accuracy and sensitivity requirements presented on an analyte- and matrix-specific basis in the Worksheet No. 15 tables.

Describe the evaluative procedures used to assess overall measurement error associated with the project:

The assessment will include an evaluation of the QC elements relating to precision, accuracy, representativeness, comparability, completeness (both sample collection and analytical), and sensitivity (see **Appendix B**). The impact of any data gaps resulting from sampling incompleteness or rejected data will be evaluated in a data quality evaluation included as an appendix to the project letter report.

Identify the personnel responsible for performing the usability assessment:

Tanaq PMs, project chemists, and database managers.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

Evaluation activities will be documented in the QA reports listed in Worksheet No. 29. An overall assessment of the impact of data usability issues will be presented in the project report. The usability assessment will evaluate the overall dataset from each site.

This page was intentionally left blank.

FIGURES

This page was intentionally left blank.

Figure 1
LTM IRP Sites
Avon Park Air Force Range
Avon Park, Florida

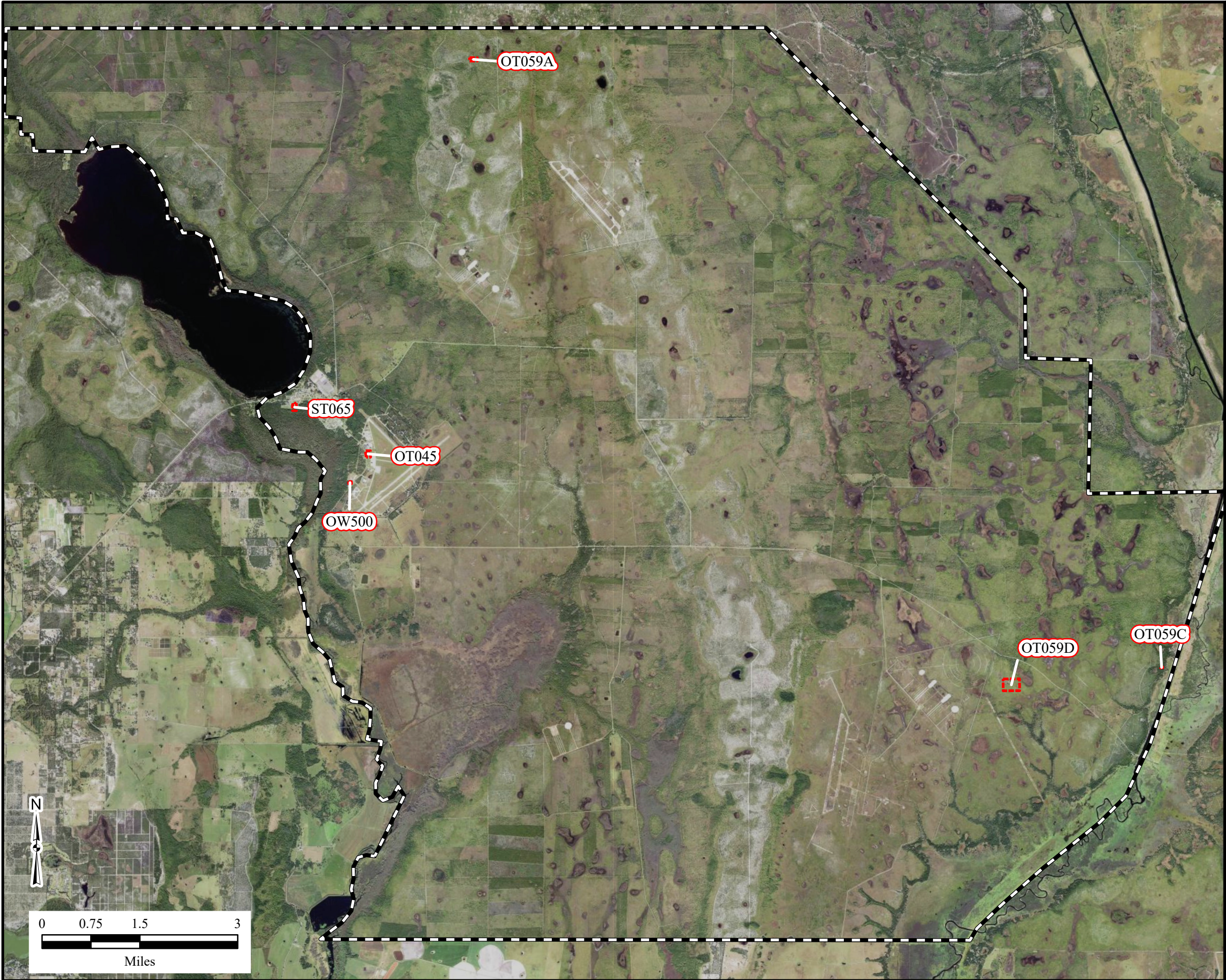
Legend

- IRP Site
- Installation Boundary

Notes:

APAFR = Avon Park Air Force Range
APP = Accident Prevention Plan
IRP = Installation Restoration Program
LTM = Long Term Monitoring
ORC = Optimized Remediation Contract
SSHP = Site Safety and Health Plan





12/13/2021 RO
Source: Tanaq, Esri, USDA FSA, University of South Florida, City of Tampa, FDEP, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USS, EPA, NPS, US Census Bureau



This page was intentionally left blank.

Figure 2
OT045
Stressed Vegetation Site
Avon Park Air Force Range
Florida

Legend

-  Monitoring Well
-  Monitoring Well To Be Abandoned
-  OT045 Boundary
-  Installation Boundary

Notes:

APAFR = Avon Park Air Force Range
ORC = Optimized Remediation Contract
UFP-QAPP = Uniform Federal Policy - Quality Assurance
Project Plan







12/15/2021 RO, MM
Source: Tanaq, Esri, State of Florida, Earthstar Geographics, Maxar,
Microsoft



This page was intentionally left blank.

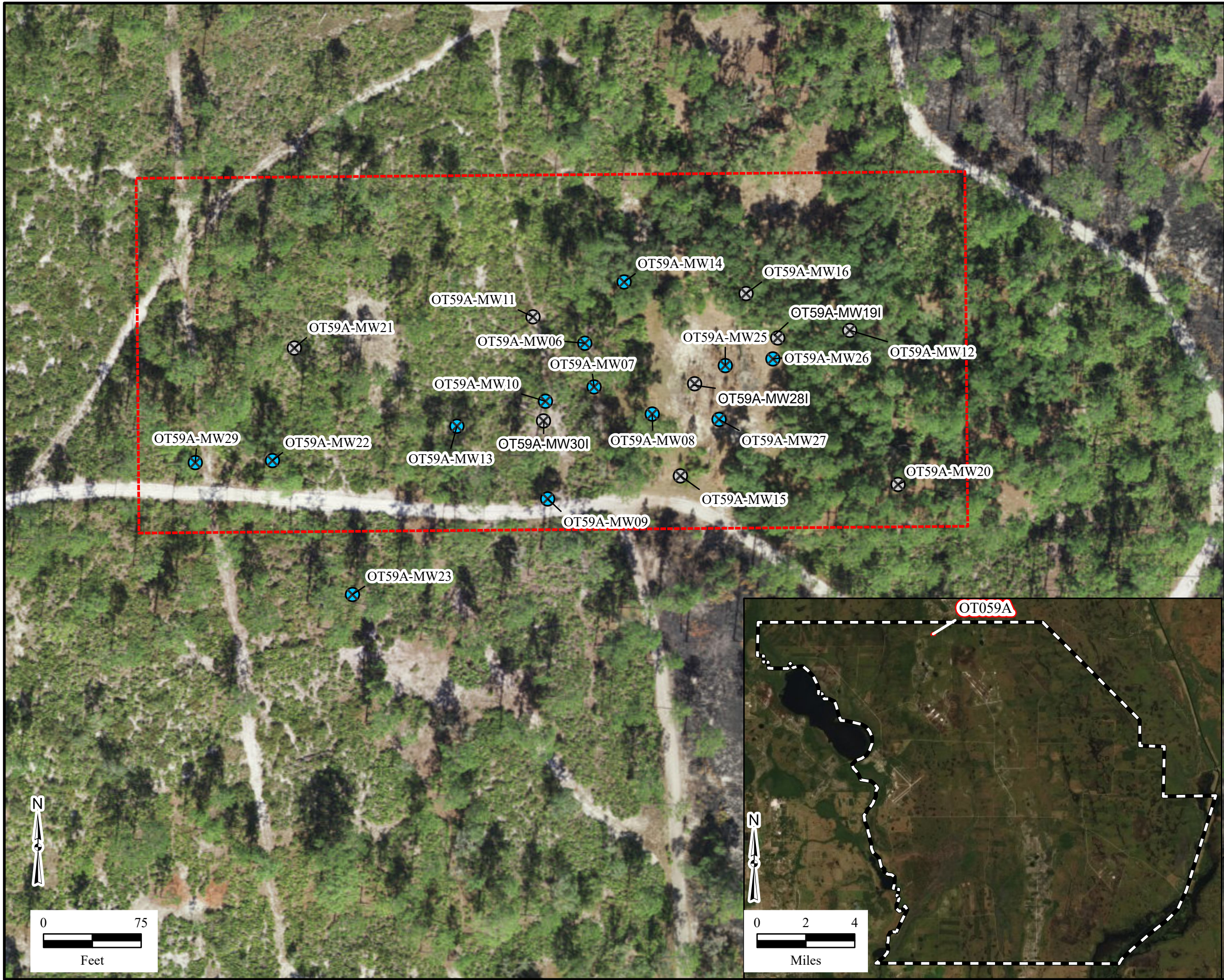
Figure 3
OT059A
Cattle Dip Vat A
Avon Park Air Force Range
Florida

Legend

-  Monitoring Well
-  Monitoring Well To Be Abandoned
-  OT059A Boundary
-  Installation Boundary

Notes:

APAFR = Avon Park Air Force Range
ORC = Optimized Remediation Contract
UFP-QAPP = Uniform Federal Policy - Quality Assurance
Project Plan







12/15/2021 RO, MM
Source: Tanaq, Esri, State of Florida, Earthstar Geographics, Maxar,
Microsoft



This page was intentionally left blank.

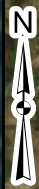
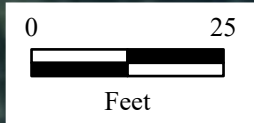
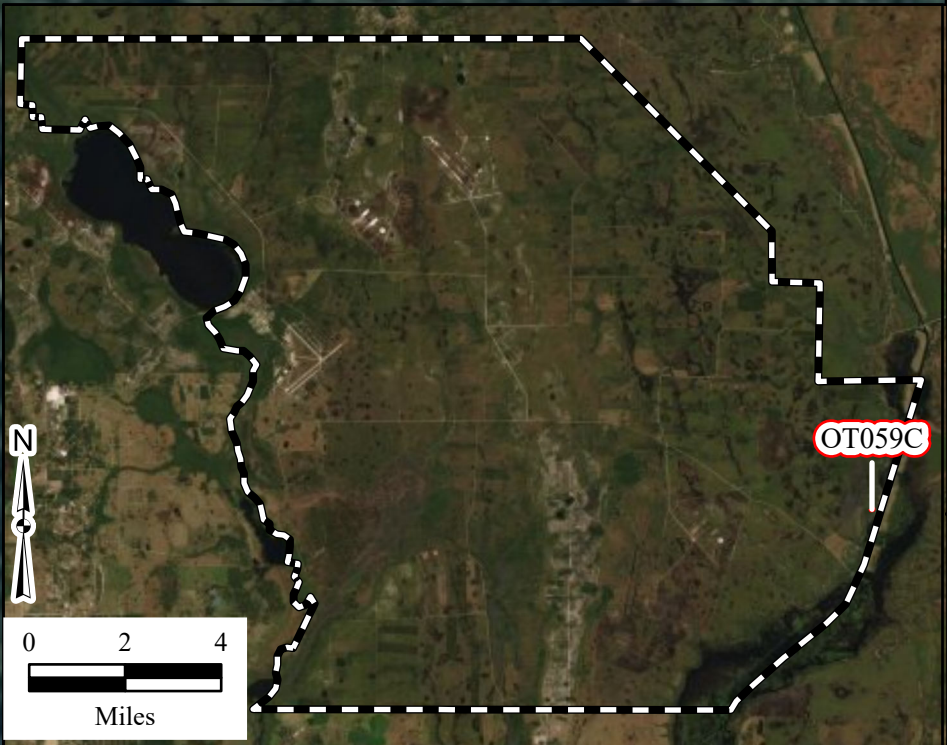
Figure 4
OT059C
Cattle Dip Vats
Avon Park Air Force Range
Florida

Legend

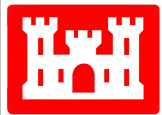
-  Monitoring Well
-  Monitoring Well To Be Abandoned
-  OT059C Boundary
-  Installation Boundary

Notes:

APAFR = Avon Park Air Force Range
ORC = Optimized Remediation Contract
UFP-QAPP = Uniform Federal Policy - Quality Assurance
Project Plan







12/15/2021 RO, MM
Source: Tanaq, Esri, State of Florida, Earthstar Geographics, Maxar,
Microsoft



This page was intentionally left blank.

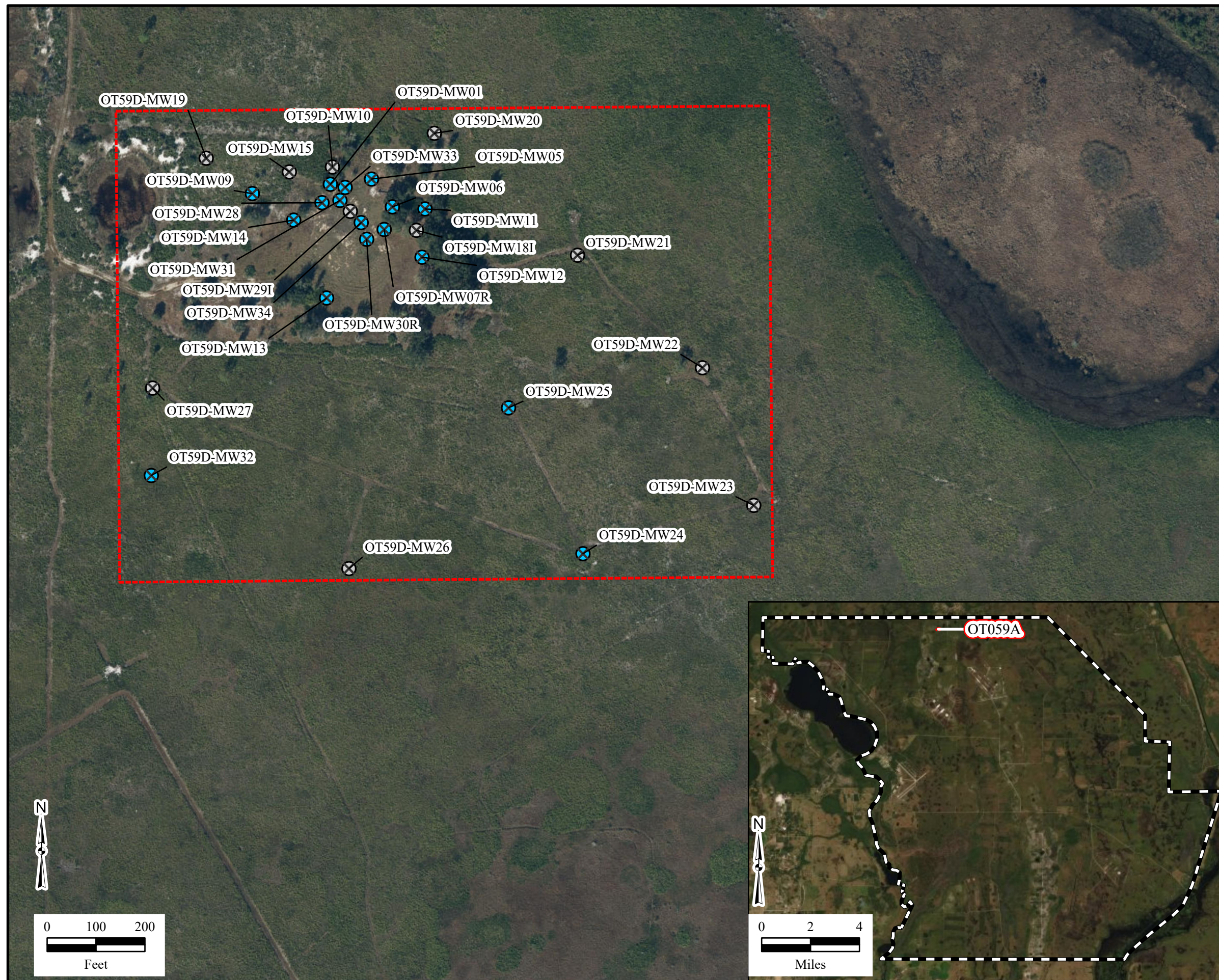
Figure 5
OT059D
Cattle Dip Vats
Avon Park Air Force Range
Florida

Legend

-  Monitoring Well
-  Monitoring Well To Be Abandoned
-  OT059D Boundary
-  Installation Boundary

Notes:

APAFR = Avon Park Air Force Range
ORC = Optimized Remediation Contract
UFP-QAPP = Uniform Federal Policy - Quality Assurance
Project Plan



This page was intentionally left blank.

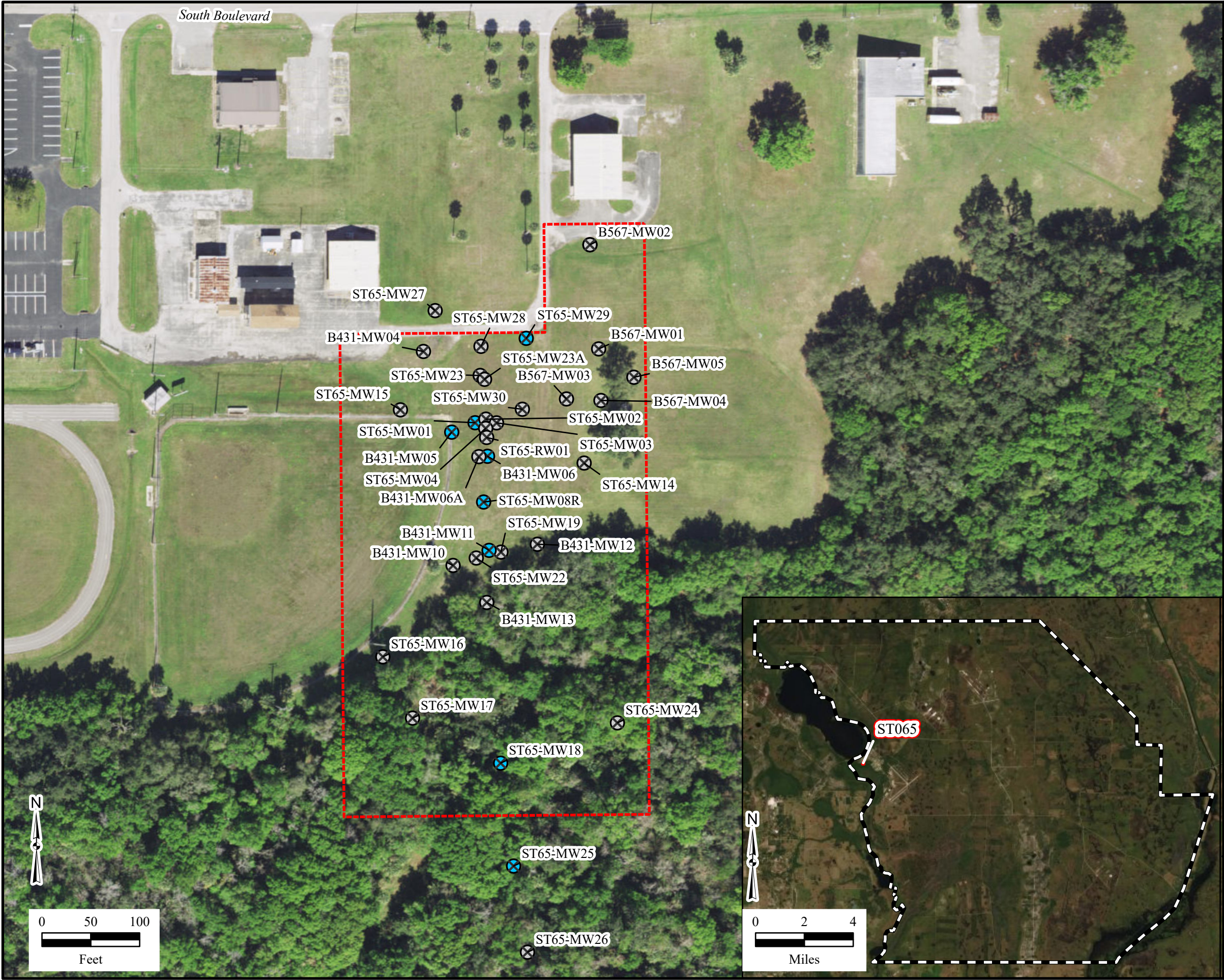


Figure 6
ST065
Former Government Vehicle
Refueling Area
Avon Park Air Force Range
Florida

Legend

- Monitoring Well
- Monitoring Well To Be Abandoned
- ST065 Boundary
- Installation Boundary

Notes:
APAFR = Avon Park Air Force Range
ORC = Optimized Remediation Contract
UFP-QAPP = Uniform Federal Policy - Quality Assurance
Project Plan



This page was intentionally left blank.

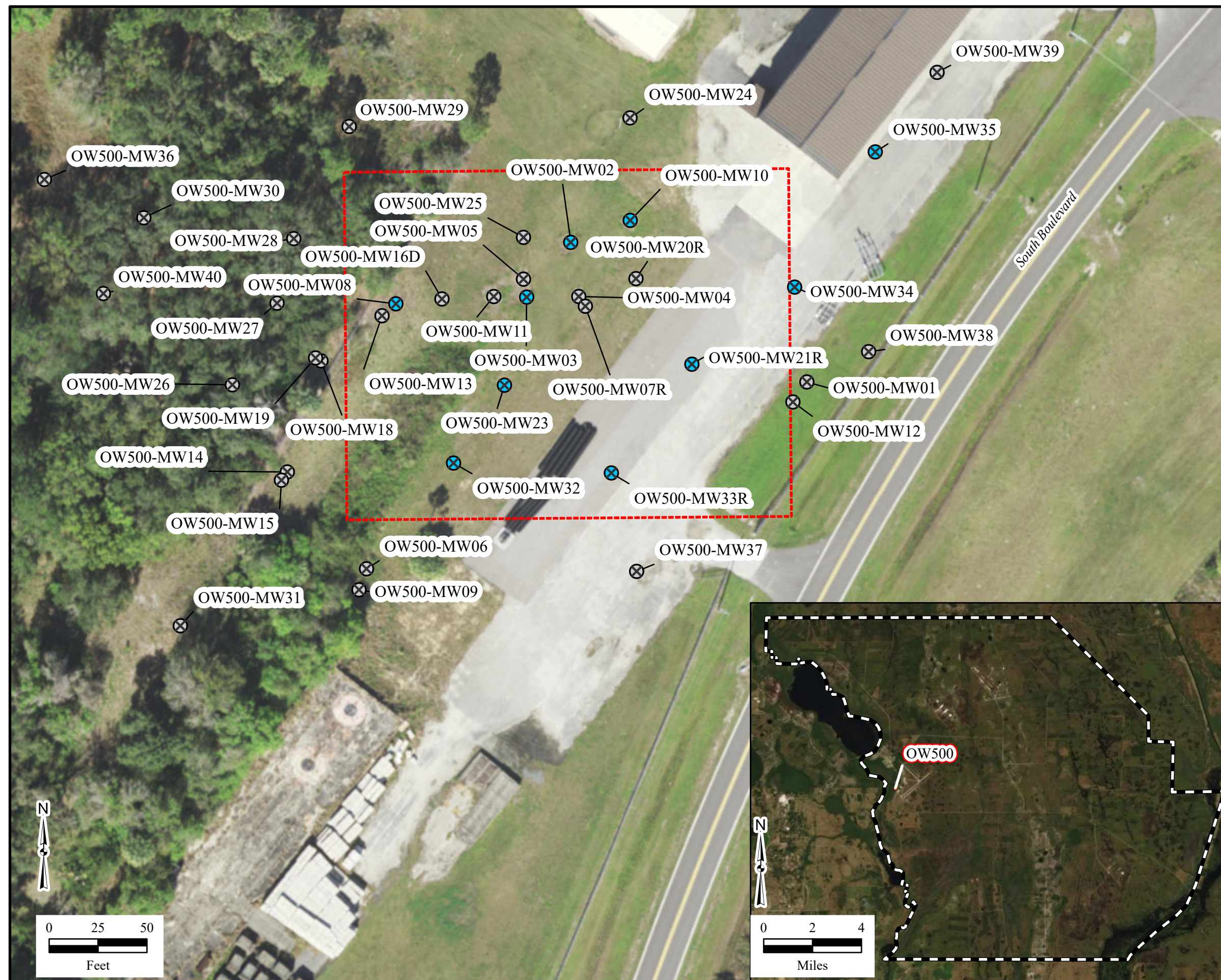
Figure 7
OW500 - Building 73 OWS
Pesticide and Hazardous Waste
Storage Site
Avon Park Air Force Range
Florida

Legend

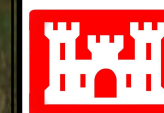
- Monitoring Well
- Monitoring Well To Be Abandoned
- OW500 Boundary
- Installation Boundary

Notes:

APAFR = Avon Park Air Force Range
ORC = Optimized Remediation Contract
OWS = Oil Water Separator
UFP-QAPP = Uniform Federal Policy - Quality Assurance
Project Plan



12/15/2021 RO, MM
Source: Tanaq, Esri, Earthstar Geographics, State of Florida, Maxar,
Microsoft



This page was intentionally left blank.

APPENDIX A: DATA MANAGEMENT AND VALIDATION

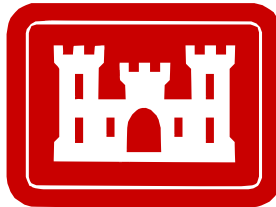
This page was intentionally left blank.

DATA MANAGEMENT AND VALIDATION, UPDATE 1

Optimized Remediation Contract
at
Avon Park Air Force Range, Florida

December 2023 - Revision 1

Prepared for:



**U.S. Army Corps of Engineers
Mobile District
109 St. Joseph St
Mobile, AL 36602-0001**

In Accordance with:

**Contract No: W9127821D0063
Delivery Order No: W9127821F0305**

Prepared by:



**Tanaq Environmental, LLC
2480 West 26th Avenue, Suite B-26
Denver, Colorado 80211**

This page was intentionally left blank.

TABLE OF CONTENTS

Table of Contents	A-i
List of Acronyms	A-iii
1.0 Introduction	A-1-1
2.0 Laboratory Data Management Requirements	A-2-1
2.1 Data Reduction	A-2-1
2.2 Data Review	A-2-1
2.3 Laboratory Documentation	A-2-2
2.4 Laboratory Record-Keeping	A-2-3
2.5 Laboratory Accreditation	A-2-3
2.5.1 U.S. Department of Defense Requirements	A-2-3
2.5.2 State Requirements	A-2-3
2.5.3 Other Assessment and Audit Tasks	A-2-3
3.0 Subcontractor Data Management Requirements	A-2-1
3.1 Data Verification	A-3-1
3.1.1 Laboratory Report Verification	A-3-1
3.1.2 Electronic Data Verification	A-3-1
3.2 Data Validation	A-3-2

This page was intentionally left blank.

LIST OF ACRONYMS

AFCEC	Air Force Civil Engineer Center
CCB	continuing calibration blank
CCV	continuing calibration verification
CL	control limit
DL	detection limit
DoD	U.S. Department of Defense
EDD	electronic database deliverable
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ERPIMS	Environmental Restoration Program Information Management System
Florida DEP	Florida Department of Environmental Protection
ICB	initial calibration blank
ICV	initial calibration verification
IS	internal standard
LCL	lower control limit
LCS	laboratory control sample
LOD	limits of detection
LOQ	limit of quantitation
MS	matrix spike
MSD	matrix spike duplicate
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
QSM	Quality Systems Manual
RPD	relative percent difference
SEDD	Staged Electronic Data Deliverable
UCL	upper control limit

This page was intentionally left blank.

1.0 INTRODUCTION

After sample collection and analysis, the data must be reviewed, reported, and validated. The procedures described in this appendix are to be followed to ensure that the data are collected and obtained in accordance with this basewide quality assurance project plan (QAPP), site-specific QAPPs, applicable guidance documents, and good practices. The overall goal is to ensure that the data quality requirements of the project are met.

This page was intentionally left blank.

2.0 LABORATORY DATA MANAGEMENT REQUIREMENTS

Each project laboratory is responsible for providing complete and correct data for all requested analyses. The QAPP addresses the project-specific requirements for analyses in Worksheet Nos. 12, 15, 24, and 28. Following analysis of the samples, the laboratory will perform a series of steps to deliver acceptable final data reports.

2.1 Data Reduction

Data reduction is the process for collecting and transforming measurements, through mathematical and/or statistical formulas, into final reportable measurements. The calculations may be performed manually or electronically. Data reduction is performed by the analyst and consists of calculating concentrations in samples from the raw data. The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (for example, extractions, dilutions, instrument readings, and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in calculating final reportable values. Calculations and data reduction steps for various methods are summarized in the respective laboratory standard operating procedures (SOPs) or program requirements.

Copies of all raw data and the calculations used to generate the final results, such as bound laboratory notebooks, strip-charts, chromatograms, spreadsheets, and computer record files, are retained on file as specified in this QAPP. Should the Tanaq Environmental, LLC (Tanaq) Team determine that the laboratory's data reduction processes require an in-depth review, these calculations and the associated raw data will be provided by the laboratory upon request.

2.2 Data Review

Data review is performed to assess whether the quality control (QC) requirements are met. All project laboratories will perform data review on 100 percent of the data deliverables. No data will be released to the Tanaq Team without the appropriate analyst and supervisory review being performed and documented.

The individual analyst continually reviews the quality of data through evaluating the results of calibration checks, QC samples, and performance evaluation samples. The analyst performs data review during, immediately following, and after the completed analysis. The laboratory supervisor, analyst, or data specialist performs a secondary review of the data. The data reviewer is trained by the quality assurance (QA) manager or section leader to perform the data review.

The analytical laboratory data reviewer, who has the initial responsibility for the correctness and completeness of the data, will conduct the first level of review; this first level review may contain multiple sublevels of all project-related data. Data reduction, QA review, and reporting by the laboratory will be completed as follows:

- Raw data produced by the analyst is processed and reviewed for attainment of QC criteria as outlined in the SOPs, laboratory QA manual, and established U.S. Environmental Protection Agency (EPA) methods, as well as for overall reasonableness. These general QC criteria are

modified by the requirements of this QAPP and the *DoD Quality Systems Manual (QSM) for Environmental Laboratories*, version 5.4.

- After entry into the laboratory information management system, a computerized report is generated and sent to the laboratory data reviewer.
- The data reviewer will decide whether any sample reanalysis is required.
- Upon acceptance of the preliminary reports by the data reviewer, final reports will be generated.

The laboratory data reviewer will evaluate the quality of the work based on an established set of laboratory guidelines. This person will review the data package to ensure the following:

- Sample preparation information is correct and complete;
- Analysis information is correct and complete;
- The appropriate SOPs have been followed;
- Analytical results are correct and complete;
- QC samples are within project-specific control limits; and
- Special sample preparation and analytical requirements have been met.

Documentation is complete when all anomalies in the preparation and analysis have been documented.

The laboratory will perform the in-house analytical data reduction and QA review under the direction of the laboratory QA director. The QA director or designee is responsible for assessing data quality and advising the project manager of any data that was rated “preliminary” or “unacceptable,” or other notations that would caution the data user of possible unreliability.

2.3 Laboratory Documentation

Analytical reports transmit final results, methods of analysis, levels of reporting, associated QC data, and method performance data. Laboratory data will be transmitted as full data reports, including raw data and analyst logs, unless the Tanaq Team has specified that a more streamlined report format is acceptable for a specific data set. In addition, issues affecting the analytical process will be noted in the case narrative included in each report. The number of significant figures reported will be consistent with the limits of uncertainty inherent in the analytical method. Consequently, most analytical results will be reported to no more than two or three significant figures.

Data is normally reported in units commonly used for the analyses performed. Concentrations in liquids are expressed in terms of weight or activity per unit volume (for example, micrograms per liter [$\mu\text{g/L}$] or milligrams per liter [mg/L]). Concentrations in solid or semisolid matrices are expressed in terms of weight or activity per unit weight of sample (for example, micrograms per kilogram [$\mu\text{g/kg}$] or milligrams per kilogram [mg/kg]). Solid and semisolid matrices will also be reported on a dry weight basis. The sample-specific sensitivity limits (detection limits [DLs], limits of detection [LODs], and limits of quantitation [LOQs]) are reported adjusted for subsample size and percent moisture, as well as all appropriate concentration, dilution, and extraction factors.

If analytical anomalies are encountered during the analyses (for example, an out-of-control matrix duplicate), they will be documented in a case narrative. Copies of the sample discrepancy reports, or corrective action reports must be included in the laboratory data reports. Flagging criteria identified in Appendix B of the DoD/DoE QSM, Version 5.4, will be used to flag data. Flags used by the laboratory will be those listed in Section 5.10.3.1.1 of the QSM.

2.4 Laboratory Record-Keeping

At a minimum, the laboratory will retain all data related to sample preparation, analysis, and general observations in appropriate hardbound laboratory notebooks or files. Laboratory notebook pages must be reviewed, signed, and dated by the author and receive an independent secondary review by a peer or supervisor who signs/initials and dates the data pages.

Corrections to notebook entries are made by drawing a single line through the erroneous entry and writing the correct entry next to the one that is crossed out. All corrections are initialed and dated by the individual performing the correction.

After delivering acceptable hard copy and/or electronic data deliverables, the laboratory will store the original project data for at least 5 years unless otherwise specified in the subcontract agreement.

2.5 Laboratory Accreditation

2.5.1 U.S. Department of Defense Requirements

Laboratories supporting this project must be accredited under the U.S. Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP). This accreditation must be maintained and renewed as necessary during the lifetime of the project. DoD ELAP accreditation involves an on-site audit by an auditing firm contracted by DoD, evaluating sample results, and performing an extensive review of the laboratory's facilities and procedures to ensure compliance with the requirements of the QSM.

2.5.2 State Requirements

Florida DEP maintains an accreditation program for laboratories that analyze environmental samples. Laboratories performing analyses for samples collected from the Avon Park Air Force Range site will be required to meet the state laboratory accreditation requirements are presented in F.A.C. 64E-1 for all analyses performed, if available. Appropriate state accreditation must be maintained and renewed as necessary during the lifetime of the project.

2.5.3 Other Assessment and Audit Tasks

No subcontractor laboratory technical system audits are currently planned for this project; however, an audit may be performed at any time during this program at the Tanaq Team's discretion or at client direction. If laboratory performance does not meet QAPP requirements or significant data quality issues arise, the Tanaq Team reserves the right to perform additional system or project audit at any time throughout the program.

This page was intentionally left blank.

3.0 SUBCONTRACTOR DATA MANAGEMENT REQUIREMENTS

After a laboratory data package and the associated electronic database deliverables (EDDs) are received, the Tanaq Team will perform data management tasks required to ensure that all analyses were performed in accordance with project requirements. The data management requirements include conducting data verification and data validation to determine the usability of the data for the original project objectives. A list of the data verification and validation inputs is located in Worksheet No. 34. Data verification, data evaluation, and data validation are each separate levels of review that can be performed by themselves or in conjunction with each other. Evaluation activities will be documented in the QA reports listed in Worksheet No. 29 and will be used to assess the usability of project data in levels of detail ranging from an analyte- and sample-specific basis to the overall dataset for each sampling event.

3.1 Data Verification

Initially, laboratory deliverables are received at the Tanaq Team in both PDF (laboratory data report) and EDD formats, as discussed previously. When the data verification process described below is complete, laboratory data reports and EDDs will be transmitted to staff chemists or the data validation subcontractor who will perform data validation. Worksheet No. 35 summarizes the data verification procedure associated with this site.

3.1.1 Laboratory Report Verification

The Tanaq Team will perform data verification on every report submitted by a laboratory. Upon receipt of the laboratory deliverables, a data management staff member will perform the following actions:

- The deliverable will be inspected to verify that results were received for each requested analysis for each sample. If a result is missing, the staff member will determine whether the laboratory submitted a deficiency report that accounts for the missing data.
- The data deliverable will be inspected for completeness based on the requirements specified in this plan. Inspection will verify only that all required report elements are present, not that the data within the report is complete.

3.1.2 Electronic Data Verification

Laboratory analytical data will be delivered electronically in two database formats: 1) a format that complies with the current requirements of the Environmental Restoration Program Information Management System (ERPIMS), and 2) in a format that complies with the requirements of a Staged Electronic Data Deliverable (SEDD) Stage 2a. The SEDD Stage 2a deliverable will be made available to the validators to expedite the validation effort as applicable. Once it has been verified that each ERPIMS EDD meets format requirements, it will be loaded into the Tanaq Team's database as "unvalidated" for user access on the network. These analytical results will be considered preliminary until data validation is complete.

After the method-specific data validation reports for a sample delivery group have been generated, the data qualifiers assigned by the validator are applied to associated EDD files. The EDDs will be compared

to the PDF version of the laboratory data report and the data validation report by the Tanaq Team data management coordinators. This review will be performed on 10 percent of the electronic data results. If a discrepancy is identified, the laboratory will be required to correct the error. The laboratory also will be required to determine if the error was a simple mistake or was caused by a systematic problem in data reduction and reporting. If no discrepancies are found, the database will be updated with the final validation qualifiers.

In general, ERPIMS submissions will be performed on a quarterly basis, but due to the nature of work, the submission schedule may vary.

3.2 Data Validation

Data validation is a systematic process to ensure that all chemical analytical information meets uniform requirements and to determine that the usability and defensibility of the data are adequate for their intended use. A summary of data validation activities is provided in Worksheet No. 36. Data validation for this project can either be performed by qualified Tanaq Team project staff or by a subcontracted data validation firm. Validation of analytical results will be performed by a data validator and be reviewed by a project or senior chemist. Data validation will be performed on the results for environmental samples at the site-specific frequency and level of effort that are required to meet site-specific data quality objectives (DQOs). When only a screening level of data quality is required to support this project (for example, waste characterization), data validation will be limited to an evaluation of the sample handling system (such as sample delivery and condition and holding times) and an assessment of the performance of QC elements including field duplicates, laboratory duplicates, equipment blanks, surrogates, matrix spike (MS)/matrix spike duplicate (MSD) analyses, percent solids, method blanks, and laboratory control samples (LCSs). When a definitive level of data quality is required, validation also will include an evaluation of analytical system performance (such as instrument tuning, calibration, and method-specific instrument performance checks). The definitive data validation guidelines correspond to the components of a Stage 2B data validation, as described in *United States Department of Defense General Data Validation Guidelines, Environmental Data Quality Workgroup, November 2019*. As determined necessary by the project chemist, a Stage 4 validation process may be performed on a sample by sample basis.

The data will be validated against the method-specific criteria presented in Worksheet Nos. 12, 15, 24, and 28. These requirements are based on the requirements presented in Appendices B and C of the QSM, Version 5.4, as well as method-specific requirements listed in Modules 1-6 of the DoD Data Validation Guidelines. Qualifiers and reason codes applied to the data will be those defined in Section 4.8 and Appendix 7 of the DoD General Validation Guidelines.

Upon completion, the data validator will provide a data validation report and will provide an annotated EDD that contains all final data result qualifiers. These data qualifiers will then be uploaded into the project database, which will then be made accessible to the Tanaq Team and will be available for upload to ERPIMS.

Table A.1
Data Qualifier Codes Applied by Laboratory

In accordance with the DoD General Validation Guidelines, the following qualifiers will be used. If additional qualifiers are used, a complete explanation of those qualifiers should accompany the data validation report.

Qualifier	Definition
U	The analyte was not detected and was reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result was an estimated value with an unknown bias.
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result was an estimated quantity, but the result may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a "tentative identification."
NJ	The analyte has been "tentatively identified" or "presumptively" as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

This page was intentionally left blank.

APPENDIX B: USABILITY AND ASSESSMENT PROCEDURES

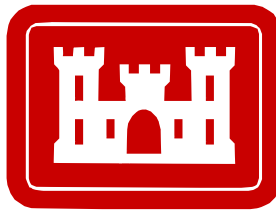
This page was intentionally left blank.

USABILITY AND ASSESSMENT PROCEDURES, UPDATE 1

Optimized Remediation Contract
at
Avon Park Air Force Range, Florida

December 2023 - Revision 1

Prepared for:



**U.S. Army Corps of Engineers
Mobile District
109 St. Joseph St
Mobile, AL 36602-0001**

In Accordance with:

**Contract No: W9127821D0063
Delivery Order No: W9127821F0305**

Prepared by:



**Tanaq Environmental, LLC
2480 West 26th Avenue, Suite B-26
Denver, Colorado 80211**

This page was intentionally left blank.

TABLE OF CONTENTS

Table of Contents.....	B-i
List of Acronyms.....	B-iii
1.0 Introduction	B-1-1
2.0 Interface with Validation Activities.....	B-2-1
3.0 Usability Assessment Procedures	B-3-1
3.1 Review of Sampling and Analysis Program	B-3-1
3.2 Achievement of DQIS.....	B-3-1
3.3 Rejected Results.....	B-3-1
3.4 Achievement of DQOS	B-3-2
4.0 Completeness	B-4-1

This page was intentionally left blank.

LIST OF ACRONYMS

DQI	data quality indicator
DQO	data quality objectives
EPA	U.S. Environmental Protection Agency
QAPP	quality assurance project plan
QC	quality control

This page was intentionally left blank.

1.0 INTRODUCTION

Assessment of the data usability is an important project component and will be performed as a preliminary step of the data interpretation phase. The assessment process summarized in Worksheet No. 37 is described in more detail in this attachment. Tanaq Environmental, LLC (Tanaq) has the primary responsibility for completing the data usability assessment process completed by the project manager, the project chemist, and the database manager.

The data usability assessment is considered the final step in the data evaluation process and can be performed only on data of known and documented quality. As described in Worksheet No. 36 and Appendix A, data generated for this project will undergo a formalized evaluation/validation process. Data usability goes beyond validation in that it evaluates the achievement of the data quality objectives (DQO) based on the comparison of the project data quality indicator (DQI) and individual study-specific work plans with the obtained results. The results of the data usability assessment, and particularly any changes to the DQOs necessitated by the data not meeting usability criteria, will be included in the final report.

This page was intentionally left blank.

2.0 INTERFACE WITH VALIDATION ACTIVITIES

Before performing the usability assessment, data verification, evaluation, and validation activities described in Appendix A (summarized in Worksheet Nos. 34 through 36) will be performed by the Tanaq data management teams to evaluate sampling team and laboratory compliance with the requirements in this quality assurance project plan (QAPP) and other project planning documents. When data validation is complete, the results of the validation will guide the usability assessment. The usability assessment will examine the performance of the quality control (QC) elements relating to precision, accuracy, representativeness, comparability, completeness (both sample collection and analytical), and sensitivity. The assessment also will identify the existence and impact of any data gaps resulting from sampling incompleteness (for example, a result of insufficient water in a well) or from rejected data.

This page was intentionally left blank.

3.0 USABILITY ASSESSMENT PROCEDURES

The assessment of data usability will primarily follow procedures described in appropriate U.S. Environmental Protection Agency (EPA) guidance documents, particularly *Guidance for Data Usability in Risk Assessment* (Publication No. 9285.7-05FS, September 1992), and will be conducted according to the process outlined below.

3.1 Review of Sampling and Analysis Program

The first step of the data usability assessment will include a review of the sampling and analysis activities in comparison to the requirements of the project planning documents (work plan and QAPP) and to the project-specific DQIs. Specific limitations to the data, such as the effect of results that are qualified as estimated (J/UJ) or rejected (R), will be determined and documented in the database.

3.2 Achievement of DQIS

The second part of data usability pertains to the achievement of the program-specific DQIs. The performance achieved for each data quality criterion will be evaluated against the expected and planned performance. In general, this comparison will follow from the DQIs used to define each DQO. This comparison is the most critical component of the assessment process. Any deviation from planned performance will be documented and evaluated to determine whether corrective action is advisable. Potential corrective actions will range from resampling and/or reanalysis of data, to qualification or exclusion of the data for use in the data interpretation. If corrective action is not possible, the limitations, if any, of the data regarding achieving the DQOs will be noted.

In conjunction with the DQI achievement review, the investigators will need to make decisions for the use of qualified values, which are a consequence of the formalized evaluation/validation process. Data qualifiers will be applied to individual data results. Data usability decisions will be made based on the assessment of the usability of each of these results for the intended purpose. The evaluation will describe the uncertainty (such as bias and imprecision) of the qualified results. Multiple discrepancies in DQIs may require technical judgment to determine the overall effect on the usability of the associated data. Decisions about usability of qualified data for use in risk assessment will be based on the EPA guidance, which allows for the use of estimated values. Finally, data users may choose to determine final data usability qualifiers as a result of this overall examination and decision process.

3.3 Rejected Results

The data validation protocols described in Table B.1 include instructions for rejecting (R-qualifying) results associated with severe non-conformances. Following data validation, a

critical component of the data usability process is the evaluation of all results qualified X (recommended for exclusion) during the data qualification process. The Tanaq Project Chemist and Project Manager, in consultation with the United States Army Corps of Engineers Project Chemist, will evaluate the impact of the identified QC discrepancies on the affected results and make a final determination as to whether each result is usable with respect to the DQOs even if severe technical discrepancies are associated with those results. In such cases where the affected result is determined to be usable, the X qualifier will be removed and replaced with an appropriate qualifier as determined by the data usability team. In cases in which the affected result is determined to be not usable, the X qualifier applied by the validator will be replaced by an R qualifier by the Project Chemist and Project Manager. The final decision to accept or reject such results will be documented in the appropriate data quality evaluation documents.

3.4 Achievement of DQOS

The third step in the data usability process concerns achievement of the DQOs. When the dataset has been assessed to be of known quality, data limitations have been documented, and overall result applicability/usability for its intended purpose has been determined, the final data assessment can be initiated by considering the answers to the following questions:

- Is the data adequate to determine the extent to which hazardous substances have migrated or to what extent they were expected to migrate from potential hazardous substance source areas?
- Does the data collected adequately characterize the nature and extent of potential hazardous substance source areas at the site?
- Is the data statistically adequate to evaluate on a per chemical and per medium basis?
- Does the data collected allow assessment of factors that may influence contaminant migration/distribution?
- Is the sample set sufficient to develop site-specific removal and disposal treatment methodologies?
- Has sufficient data been collected to evaluate how factors, including physical characteristics of the site and climate and water table fluctuations, affect contaminant fate and transport?
- Has sufficient data been collected to determine the toxicity, environmental fate, and other significant characteristics of each hazardous substance present?
- Is the dataset sufficient to evaluate the potential extent and risk of future releases of hazardous substances, which may remain as residual contamination at the source facility?

The study's principal investigators, in conjunction with the project team, will need to formulate solutions if data gaps are found as a result of problems, biases, trends, and so on, in the analytical data, or if conditions exist that were not anticipated in the development of the DQOs. It is particularly important that each data usability evaluation specifically address any limitations on the use of the data that may result from a failure to achieve the stipulated DQO. If the project scope changes, the DQOs will be expanded. The DQOs will address the specific action limits and measurable performance criteria to make appropriate decisions on the analytical data.

This page was intentionally left blank.

4.0 COMPLETENESS

Project-specific completeness goals account for all aspects of sample handling, from collection through data reporting. The level of completeness can be affected by loss or breakage of samples during transport, as well as external problems that prohibit collection of the sample.

The formula for sampling completeness is as follows:

$$\% \text{ Field Sampling Completeness} = \frac{\text{Number of data points collected}}{\text{Number of data points planned}} \times 100$$

The formula for analytical completeness is as follows:

$$\% \text{ Analytical Completeness} = \frac{\text{Number of usable results (not qualified R)}}{\text{Number of results reported}} \times 100$$

The ability to meet or exceed completeness objectives is dependent on field team performance, site conditions, the nature of samples submitted for analysis, and laboratory performance. The following table lists the completeness goals for this program. If the completeness goals are not met because of controllable circumstances, then the need for samples to be recollected and reanalyzed will be evaluated. If the completeness goals are not met because of uncontrollable circumstances, such as inaccessible sample points, matrix interferences, then the impact of the deficiency will be evaluated.

TASK	SUBTASK	COMPLETENESS GOAL
Sampling	Sample Collection	95%
Analytical Measurements	All Laboratory Analyses	95% of collected analytes (total)
		80% of each target analyte

It should be noted that an evaluation of completeness is a screening tool and that completeness alone does not determine whether a dataset is sufficient to meet project DQOs. The completeness determined for the investigations performed at each site can guide the data assessment process but is only a component of this process. Datasets that do not meet the overall completeness goals may still be determined to be usable without resampling or reanalysis, and datasets that do meet completeness goals may still be determined to have significant data gaps at critical data points or for critical target analytes that will require resampling or reanalysis.

Table B. 1
Florida DEP Data Qualifier Codes Applied by Reviewer

Qualifier	Definition
D	Measurement was made in the field (i.e., in situ). This applies to any value (except pH, specific conductance, dissolved oxygen, temperature, total residual chlorine, transparency, or salinity) that was obtained under field conditions using approved analytical methods. If the parameter code specifies a field measurement (e.g., "Field pH"), this code is not required.
E	Indicates that extra samples were taken at composite stations.
R	Significant rain in the past 48 hours. (Significant rain typically involves rain in excess of 1/2 inch within the past 48 hours.) This code shall be used when the rainfall might contribute to a lower than normal value.
!	Data deviate from historically established concentration ranges.
U	The analyte was not detected and was reported as less than the LOD
J	The reported result was an estimated value with an unknown bias
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result was an estimated quantity, but the result may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a "tentative identification."
NJ	The analyte has been "tentatively identified" or "presumptively" as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD. However, the associated numerical value is approximate
R	The result has been rejected by the Project Team after review of X qualifers from the data validation process.

APPENDIX C: LABORATORY CERTIFICATION AND STANDARD OPERATING PROCEDURES

This page was intentionally left blank.



CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

SGS North America Inc. - Orlando
4405 Vineland Road, Suite C-15
Orlando, FL 32811

Fulfills the requirements of

ISO/IEC 17025:2017

and

U.S. Department of Defense (DoD) Quality Systems Manual
for Environmental Laboratories (DoD QSM V 5.4)

In the field of

TESTING

This certificate is valid only when accompanied by a current scope of accreditation document.
The current scope of accreditation can be verified at www.anab.org.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 15 December 2024
Certificate Number: L2229



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory
quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

AND

U.S. Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (DoD QSM V 5.4)

SGS North America Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Svetlana Izosimova, Ph. D., QA Officer

407-425-6700

TESTING

Valid to: **December 15, 2024**

Certificate Number: **L2229**

Environmental

Drinking Water		
Technology	Method	Analyte
LC/MS/MS	EPA 537 rev. 1.1	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorononanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 rev. 1.1	N-Ethyl perfluorooctanesulfonamidoacetic acid

Drinking Water		
Technology	Method	Analyte
LC/MS/MS	EPA 537.1	Perfluorohexanoic Acid
LC/MS/MS	EPA 537.1	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537.1	Perfluorooctanoic Acid
LC/MS/MS	EPA 537.1	Perfluorononanoic Acid
LC/MS/MS	EPA 537.1	Perfluorodecanoic Acid
LC/MS/MS	EPA 537.1	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorododecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537.1	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537.1	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537.1	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537.1	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537.1	ADONA
LC/MS/MS	EPA 537.1	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	EPA 537.1	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	EPA 537.1	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)
LC/MS/MS	EPA 533	Perfluorobutanoic acid
LC/MS/MS	EPA 533	Perfluoropentanoic acid
LC/MS/MS	EPA 533	Perfluorohexanoic acid
LC/MS/MS	EPA 533	Perfluoroheptanoic acid
LC/MS/MS	EPA 533	Perfluorooctanoic acid
LC/MS/MS	EPA 533	Perfluorononanoic acid

Drinking Water		
Technology	Method	Analyte
LC/MS/MS	EPA 533	Perfluorodecanoic acid
LC/MS/MS	EPA 533	Perfluoroundecanoic acid
LC/MS/MS	EPA 533	Perfluorododecanoic acid
LC/MS/MS	EPA 533	Perfluorobutanesulfonic acid
LC/MS/MS	EPA 533	Perfluoropentanesulfonic acid
LC/MS/MS	EPA 533	Perfluorohexanesulfonic acid
LC/MS/MS	EPA 533	Perfluoroheptanesulfonic acid
LC/MS/MS	EPA 533	Perfluorooctanesulfonic acid
LC/MS/MS	EPA 533	4:2 Fluorotelomer sulfonate
LC/MS/MS	EPA 533	6:2 Fluorotelomer sulfonate
LC/MS/MS	EPA 533	8:2 Fluorotelomer sulfonate
LC/MS/MS	EPA 533	Perfluoro-3-methoxypropanoic acid
LC/MS/MS	EPA 533	Perfluoro-4-methoxybutanoic acid
LC/MS/MS	EPA 533	Nonafluoro-3,6-dioxahheptanoic acid
LC/MS/MS	EPA 533	Perfluoro(2-ethoxyethane)sulfonic acid
LC/MS/MS	EPA 533	Hexafluoropropylene oxide dimer acid
LC/MS/MS	EPA 533	4,8-Dioxa-3H-perfluorononanoic acid
LC/MS/MS	EPA 533	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid
LC/MS/MS	EPA 533	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid

Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2-Dibromoethane (EDB)
GC/ECD	EPA 504.1	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2,3-Trichloropropane (1,2,3-TCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)

Non-Potable Water		
Technology	Method	Analyte
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/ECD	EPA 608.3; EPA 8081B	4,4'-DDD
GC/ECD	EPA 608.3; EPA 8081B	4,4'-DDE
GC/ECD	EPA 608.3; EPA 8081B	4,4'-DDT
GC/ECD	EPA 608.3; EPA 8081B	Aldrin
GC/ECD	EPA 608.3; EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	delta-BHC
GC/ECD	EPA 608.3; EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 608.3; EPA 8081B	alpha-Chlordane
GC/ECD	EPA 608.3; EPA 8081B	gamma-Chlordane
GC/ECD	EPA 608.3; EPA 8081B	Dieldrin
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan I
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan II
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 608.3; EPA 8081B	Endrin
GC/ECD	EPA 608.3; EPA 8081B	Endrin aldehyde
GC/ECD	EPA 608.3; EPA 8081B	Endrin ketone
GC/ECD	EPA 608.3; EPA 8081B	Heptachlor
GC/ECD	EPA 608.3; EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 608.3; EPA 8081B	Methoxychlor
GC/ECD	EPA 608.3; EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 608.3; EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 608.3; EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 608.3; EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 608.3; EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 608.3; EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 608.3; EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 608.3; EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/ECD	EPA 8082A	Total PCB

Non-Potable Water		
Technology	Method	Analyte
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Demeton
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D

Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	RSK-175	Acetylene
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/FID	RSK-175	Propane
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	WI-DRO	Diesel range organics (DRO)
GC/FID	KS LRH	Low-Range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,1,1,2-Tetrachloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,1,1-Trichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,1,2-Trichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,1-Dichloroethane

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,1-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,1-Dichloropropene
GC/MS	EPA 624.1; EPA 8260C/D	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,2,3-Trichlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,2,3-Trichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,2,4-Trichlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,2,4-Trimethylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,2-Dichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,2-Dichloroethene (total)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,2-Dichloropropane
GC/MS	EPA 8260C/D	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,3,5-Trimethylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,3-Dichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260C	1-Chlorohexane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	2,2-Dichloropropane

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 624.1; EPA 8260C/D	2-Chloroethyl vinyl ether
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	2-Chlorotoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	2-Hexanone
GC/MS	EPA 8260C	2-Nitropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	4-Chlorotoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Acetone
GC/MS	EPA 8260C/D	Acetonitrile
GC/MS	EPA 624.1; EPA 8260C/D	Acrolein (Propenal)
GC/MS	EPA 624.1; EPA 8260C/D	Acrylonitrile
GC/MS	EPA 8260C/D	Allyl chloride (3-Chloropropene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Benzene
GC/MS	EPA 8260C/D	Benzyl Chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Bromobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Bromochloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Bromodichloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Bromoform
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	n-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	sec-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	tert-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Carbon disulfide
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Carbon tetrachloride

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Chlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Chloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Chloroform
GC/MS	EPA 8260C/D	Chloroprene
GC/MS	EPA 624.1; EPA 8260C/D	Cyclohexane
GC/MS	EPA 8260C/D	Cyclohexanone
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	cis-1,2-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	trans-1,2-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	cis-1,3-Dichloropropene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	trans-1,3-Dichloropropylene
GC/MS	EPA 8260C/D	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260C/D	trans-1,4-Dichloro-2-butene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Di-isopropylether (DIPE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Dibromochloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Dibromomethane (Methylene Bromide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Dichlorodifluoromethane
GC/MS	EPA 8260C/D	Diethyl ether
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D; EPA 8260C/D SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260C/D	Ethyl acetate
GC/MS	EPA 8260C/D	Ethyl methacrylate
GC/MS	EPA 8260C	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Ethylbenzene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Hexachlorobutadiene
GC/MS	EPA 8260C/D	Hexane
GC/MS	EPA 8260C/D	Iodomethane (Methyl iodide)
GC/MS	EPA 8260C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	p-Isopropyltoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Isopropylbenzene
GC/MS	EPA 8260C/D	Methacrylonitrile
GC/MS	EPA 624.1; EPA 8260C/D	Methyl Acetate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Methyl bromide (Bromomethane)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Methyl chloride (Chloromethane)
GC/MS	EPA 624.1; EPA 8260C/D	Methylcyclohexane
GC/MS	EPA 8260C/D	Methyl methacrylate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Methylene chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Naphthalene
GC/MS	EPA 8260C/D	Pentachloroethane
GC/MS	EPA 8260C/D	Propionitrile (Ethyl cyanide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	n-Propylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Styrene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	tert-Amyl alcohol (TAA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	tert-Amyl methyl ether (TAME)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	tert-Butyl alcohol (TBA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	tert-Butyl formate (TBF)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Tetrachloroethylene (Perchloroethylene)

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260C/D	Tetrahydrofuran
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Toluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Trichloroethene (Trichloroethylene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Trichlorofluoromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Vinyl acetate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Vinyl chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	Xylene (total)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	m,p-Xylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260C/D	o-Xylene
GC/MS	EPA 625.1; EPA 8270D/E	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 625.1; EPA 8270D/E	1,2,4-Trichlorobenzene
GC/MS	EPA 625.1; EPA 8270D/E	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 625.1; EPA 8270D/E	1,2-Diphenylhydrazine
GC/MS	EPA 8270D/E	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 625.1; EPA 8270D/E	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 625.1; EPA 8270D/E	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,4-Naphthoquinone
GC/MS	EPA 8270D/E	1,4-Phenylenediamine
GC/MS	EPA 8270D/E	1-Chloronaphthalene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	1-Methylnaphthalene
GC/MS	EPA 8270D/E	1-Naphthylamine
GC/MS	EPA 625.1; EPA 8270D/E	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4,5-Trichlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4,6-Trichlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4-Dichlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4-Dimethylphenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4-Dinitrophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4-Dinitrotoluene (2,4-DNT)

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270D/E	2,6-Dichlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D/E	2-Acetylaminofluorene
GC/MS	EPA 625.1; EPA 8270D/E	2-Chloronaphthalene
GC/MS	EPA 625.1; EPA 8270D/E	2-Chlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	2-Methylnaphthalene
GC/MS	EPA 625.1; EPA 8270D/E	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D/E	2-Naphthylamine
GC/MS	EPA 625.1; EPA 8270D/E	2-Nitroaniline
GC/MS	EPA 625.1; EPA 8270D/E	2-Nitrophenol
GC/MS	EPA 8270D/E	2-Picoline (2-Methylpyridine)
GC/MS	EPA 625.1; EPA 8270D/E	3,3'-Dichlorobenzidine
GC/MS	EPA 8270D/E	3,3'-Dimethylbenzidine
GC/MS	EPA 8270D/E	3-Methylcholanthrene
GC/MS	EPA 625.1; EPA 8270D/E	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 625.1; EPA 8270D/E	3-Nitroaniline
GC/MS	EPA 8270D/E	4-Aminobiphenyl
GC/MS	EPA 625.1; EPA 8270D/E	4-Bromophenyl phenyl ether
GC/MS	EPA 625.1; EPA 8270D/E	4-Chloro-3-methylphenol
GC/MS	EPA 625.1; EPA 8270D/E	4-Chloroaniline
GC/MS	EPA 625.1; EPA 8270D/E	4-Chlorophenyl phenylether
GC/MS	EPA 8270D/E	4-Dimethyl aminoazobenzene
GC/MS	EPA 625.1; EPA 8270D/E	4-Nitroaniline
GC/MS	EPA 625.1; EPA 8270D/E	4-Nitrophenol
GC/MS	EPA 8270D/E	5-Nitro-o-toluidine
GC/MS	EPA 8270D/E	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Acenaphthene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Acenaphthylene
GC/MS	EPA 625.1; EPA 8270D/E	Acetophenone
GC/MS	EPA 625.1; EPA 8270D/E	Aniline
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Anthracene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270D/E	Aramite
GC/MS	EPA 625.1; EPA 8270D/E	Atrazine
GC/MS	EPA 625.1; EPA 8270D/E	Benzaldehyde
GC/MS	EPA 625.1; EPA 8270D/E	Benzidine
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(a)anthracene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(a)pyrene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(b)fluoranthene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(g,h,i)perylene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(k)fluoranthene
GC/MS	EPA 625.1; EPA 8270D/E	Benzoic acid
GC/MS	EPA 625.1; EPA 8270D/E	Benzyl alcohol
GC/MS	EPA 625.1; EPA 8270D/E	Biphenyl(1,1'-Biphenyl)
GC/MS	EPA 625.1; EPA 8270D/E	bis(2-Chloroethoxy)methane
GC/MS	EPA 625.1; EPA 8270D/E	bis(2-Chloroethyl) ether
GC/MS	EPA 625.1; EPA 8270D/E	bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))
GC/MS	EPA 625.1; EPA 8270D/E	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625.1; EPA 8270D/E	Butyl benzyl phthalate
GC/MS	EPA 625.1; EPA 8270D/E	Carbazole
GC/MS	EPA 625.1; EPA 8270D/E	Caprolactam
GC/MS	EPA 8270D/E	Chlorobenzilate
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Chrysene
GC/MS	EPA 8270D/E	Diallate
GC/MS	EPA 625.1; EPA 8270D/E	Di-n-butyl phthalate
GC/MS	EPA 625.1; EPA 8270D/E	Di-n-octyl phthalate
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D/E	Dibenz(a,j)acridine
GC/MS	EPA 625.1; EPA 8270D/E	Dibenzofuran
GC/MS	EPA 625.1; EPA 8270D/E	Diethyl phthalate
GC/MS	EPA 625.1; EPA 8270D/E	Dimethyl phthalate

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270D/E	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D/E	Diphenyl Ether
GC/MS	EPA 8270D/E EPA 8270D/E SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D/E	Ethyl methanesulfonate
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Fluoranthene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Fluorene
GC/MS	EPA 625.1; EPA 8270D/E	Hexachlorobenzene
GC/MS	EPA 625.1; EPA 8270D/E	Hexachlorobutadiene
GC/MS	EPA 625.1; EPA 8270D/E	Hexachlorocyclopentadiene
GC/MS	EPA 625.1; EPA 8270D/E	Hexachloroethane
GC/MS	EPA 8270D/E	Hexachlorophene
GC/MS	EPA 8270D/E	Hexachloropropene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 625.1; EPA 8270D/E	Isophorone
GC/MS	EPA 8270D/E	Isosafrole
GC/MS	EPA 8270D/E	Kepone
GC/MS	EPA 8270D/E	Methapyrilene
GC/MS	EPA 8270D/E	Methyl methanesulfonate
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Naphthalene
GC/MS	EPA 625.1; EPA 8270D/E	Nitrobenzene
GC/MS	EPA 8270D/E	Nitroquinoline-1-oxide
GC/MS	EPA 8270D/E	n-Nitroso-di-n-butylamine
GC/MS	EPA 625.1; EPA 8270D/E	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D/E	n-Nitrosodiethylamine
GC/MS	EPA 625.1; EPA 8270D/E	n-Nitrosodimethylamine
GC/MS	EPA 625.1; EPA 8270D/E	n-Nitrosodiphenylamine
GC/MS	EPA 8270D/E	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D/E	n-Nitrosomethylethylamine
GC/MS	EPA 8270D/E	n-Nitrosomorpholine
GC/MS	EPA 8270D/E	n-Nitrosopiperidine

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270D/E	n-Nitrosopyrrolidine
GC/MS	EPA 8270D/E	Pentachlorobenzene
GC/MS	EPA 8270D/E	Pentachloroethane
GC/MS	EPA 8270D/E	Pentachloronitrobenzene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Pentachlorophenol
GC/MS	EPA 8270D/E	Phenacetin
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Phenanthrene
GC/MS	EPA 625.1; EPA 8270D/E	Phenol
GC/MS	EPA 8270D/E	Pronamide (Kerb)
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Pyrene
GC/MS	EPA 625.1; EPA 8270D/E	Pyridine
GC/MS	EPA 8270D/E	Safrole
GC/MS	EPA 8270D/E	Simazine
GC/MS	EPA 8270D/E	Thionazin (Zinophos)
GC/MS	EPA 8270D/E	o-Toluidine
GC/MS	EPA 8270D/E	Dimethoate
GC/MS	EPA 8270D/E	Disulfoton
GC/MS	EPA 8270D/E	Famphur
GC/MS	EPA 8270D/E	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D/E	Parathion ethyl
GC/MS	EPA 8270D/E	Phorate
GC/MS	EPA 8270D/E	O,O,O-Triethyl phosphorothioate
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene

Non-Potable Water		
Technology	Method	Analyte
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A/B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A/B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorononanoic Acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorododecanoic Acid (PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorotridecanoic Acid (PFTTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorobutanesulfonic Acid (PFBS)

Non-Potable Water		
Technology	Method	Analyte
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorohexanesulfonic Acid (PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctanesulfonic Acid (PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorononanesulfonic Acid (PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorodecanesulfonic Acid (PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoroheptanesulfonic Acid (PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoropentanesulfonic Acid (PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	6:2 Fluorotelomer Sulfonate (FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	ADONA
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	11-Chloroeicosafuoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	3:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	5:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	7:3 Fluorotelomer carboxylate

Non-Potable Water		
Technology	Method	Analyte
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	10:2 Fluorotelomer sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorododecanesulfonic acid
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorohexadecanoic acid (PFHxDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctadecanoic acid (PFOcDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	4-PFecHS (Perfluoro-4-ethylcyclohexanesulfonate)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorononanoic Acid (PFNA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorodecanoic Acid (PFDA)

Non-Potable Water		
Technology	Method	Analyte
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorododecanoic Acid (PFDoA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorotridecanoic Acid (PFTTrDA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorohexanesulfonic Acid (PFHxS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorooctanesulfonic Acid (PFOS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorononanesulfonic Acid (PFNS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorodecanesulfonic Acid (PFDS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoroheptanesulfonic acid (PFHpS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoropentanesulfonic Acid (PFPeS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorododecanesulfonic Acid (PFDoS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid (FTS 4:2)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid (FTS 6:2)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid (FTS 8:2)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	3-Perfluoropropyl propanoic acid (3:3 FTCA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	2H,2H,3H,3H-Perfluorooctanoic acid (5:3 FTCA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	3-Perfluoroheptyl propanoic acid (7:3 FTCA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorooctanesulfonamide (PFOSA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	N-Methyl perfluorooctanesulfonamide (NMeFOSA)

Non-Potable Water		
Technology	Method	Analyte
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	N-Ethyl perfluorooctanesulfonamide (NEtFOSA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	N-Methyl perfluorooctane sulfonamidoethanol (NMeFOSE)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	N-Ethyl perfluorooctane sulfonamidoethanol (NEtFOSE)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Hexafluoropropylene oxide dimer acid (HFPO-DA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)
ICP	EPA 200.7; EPA 6010C/D	Aluminum
ICP	EPA 200.7; EPA 6010C/D	Antimony
ICP	EPA 200.7; EPA 6010C/D	Arsenic
ICP	EPA 200.7; EPA 6010C/D	Barium
ICP	EPA 200.7; EPA 6010C/D	Beryllium
ICP	EPA 200.7; EPA 6010C/D	Cadmium
ICP	EPA 200.7; EPA 6010C/D	Calcium
ICP	EPA 200.7; EPA 6010C/D	Chromium
ICP	EPA 200.7; EPA 6010C/D	Cobalt
ICP	EPA 200.7; EPA 6010C/D	Copper
ICP	EPA 200.7; EPA 6010C/D	Iron
ICP	EPA 200.7; EPA 6010C/D	Lead

Non-Potable Water		
Technology	Method	Analyte
ICP	EPA 200.7; EPA 6010C/D	Magnesium
ICP	EPA 200.7; EPA 6010C/D	Manganese
ICP	EPA 200.7; EPA 6010C/D	Molybdenum
ICP	EPA 200.7; EPA 6010C/D	Nickel
ICP	EPA 200.7; EPA 6010C/D	Potassium
ICP	EPA 200.7; EPA 6010C/D	Selenium
ICP	EPA 200.7; EPA 6010C/D	Silver
ICP	EPA 200.7; EPA 6010C/D	Sodium
ICP	EPA 200.7; EPA 6010C/D	Strontium
ICP	EPA 200.7; EPA 6010C/D	Thallium
ICP	EPA 200.7; EPA 6010C/D	Tin
ICP	EPA 200.7; EPA 6010C/D	Titanium
ICP	EPA 200.7; EPA 6010C/D	Vanadium
ICP	EPA 200.7; EPA 6010C/D	Zinc
ICP/MS	EPA 200.8; EPA 6020A/B	Aluminum
ICP/MS	EPA 200.8; EPA 6020A/B	Antimony
ICP/MS	EPA 200.8; EPA 6020A/B	Arsenic
ICP/MS	EPA 200.8; EPA 6020A/B	Barium
ICP/MS	EPA 200.8; EPA 6020A/B	Beryllium
ICP/MS	EPA 200.8; EPA 6020A/B	Cadmium
ICP/MS	EPA 200.8; EPA 6020A/B	Calcium
ICP/MS	EPA 200.8; EPA 6020A/B	Chromium
ICP/MS	EPA 200.8; EPA 6020A/B	Cobalt
ICP/MS	EPA 200.8; EPA 6020A/B	Copper
ICP/MS	EPA 200.8; EPA 6020A/B	Iron
ICP/MS	EPA 200.8; EPA 6020A/B	Lead
ICP/MS	EPA 200.8; EPA 6020A/B	Magnesium
ICP/MS	EPA 200.8; EPA 6020A/B	Manganese
ICP/MS	EPA 200.8; EPA 6020A/B	Molybdenum
ICP/MS	EPA 200.8; EPA 6020A/B	Nickel
ICP/MS	EPA 200.8; EPA 6020A/B	Potassium
ICP/MS	EPA 200.8; EPA 6020A/B	Selenium
ICP/MS	EPA 200.8; EPA 6020A/B	Silver
ICP/MS	EPA 200.8; EPA 6020A/B	Sodium
ICP/MS	EPA 200.8; EPA 6020A/B	Strontium
ICP/MS	EPA 200.8; EPA 6020A/B	Thallium

Non-Potable Water		
Technology	Method	Analyte
ICP/MS	EPA 200.8; EPA 6020A/B	Tin
ICP/MS	EPA 200.8; EPA 6020A/B	Titanium
ICP/MS	EPA 200.8; EPA 6020A/B	Vanadium
ICP/MS	EPA 200.8; EPA 6020A/B	Zinc
CVAA	EPA 7470A	Mercury
CVAA	EPA 245.1	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 300; EPA 9056A	Bromide
IC	EPA 300; EPA 9056A	Chloride
IC	EPA 300; EPA 9056A	Fluoride
IC	EPA 300; EPA 9056A	Nitrate
IC	EPA 300; EPA 9056A	Nitrite
IC	EPA 300; EPA 9056A	Sulfate
IC	EPA 300; EPA 9056A	Total nitrate-nitrite
IC	EPA 300; EPA 9056A	Orthophosphate
Automated Colorimetry	EPA 350.1	Ammonia
Automated Colorimetry	EPA 350.1	Ammonia, Gas Diffusion Option
Automated Colorimetry	EPA 351.2	Total Kjeldahl Nitrogen
Automated Colorimetry	EPA 353.2	Nitrate
Automated Colorimetry	EPA 353.2	Nitrite
Automated Colorimetry	EPA 353.2	Nitrate + Nitrite
Manual Colorimetry	EPA 365.4	Orthophosphate
Automated Colorimetry	EPA 365.1	Orthophosphate
Automated Colorimetry	EPA 365.1	Total Phosphorus
Manual Colorimetry	EPA 365.4	Total Phosphorus
Titrimetric	SM 2320B-11	Alkalinity, Total
Titrimetric	SM 4500-S2 F-11	Sulfide, Iodometric
Gravimetric Methods	EPA 1664A; EPA 1664B; EPA 9070A	Oil and Grease
Gravimetric Methods	SM 2540B-11	Total Residue (Total Solids)
Gravimetric Methods	SM 2540C-11	Filterable Residue (Total Dissolved Solids)
Gravimetric Methods	SM 2540D-11	Non-Filterable Residue (Total Suspended Solids)
Electrometric Methods	SM 4500H+B-11; EPA 9040C	Hydrogen Ion (Ph)

Non-Potable Water		
Technology	Method	Analyte
Electrometric Methods	EPA 120.1	Specific conductivity
Combustion	EPA 9060A	Total Organic Carbon
Combustion	SM 5310B-11	Total Organic Carbon
Ignitability	EPA 1020B/ASTM D3278-78	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	Method	Type
Organic Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction
Organic Preparation	EPA 3511	Micro-extraction
Organic Preparation	EPA 3535A; EPA 3535A MOD	Solid Phase Extraction
Organic Preparation	EPA 8151A	Chlorinated Herbicides, Liquid-Liquid Extraction
Organic Preparation	EPA 608; EPA 625	Separatory Funnel Liquid-Liquid Extraction
Volatile Organic Preparation	SW836 5030B	Closed System Purge and Trap
Volatile Organic Preparation	EPA 624	Closed System Purge and Trap
Volatile Organic Preparation	SM 6200B-11	Closed System Purge and Trap
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup

Solid and Chemical Materials		
Technology	Method	Analyte
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/ECD	EPA 8081B	4,4'-DDD

Solid and Chemical Materials		
Technology	Method	Analyte
GC/ECD	EPA 8081B	4,4'-DDE
GC/ECD	EPA 8081B	4,4'-DDT
GC/ECD	EPA 8081B	Aldrin
GC/ECD	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 8081B	alpha-Chlordane
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/ECD	EPA 8082A	Total PCB
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion

Solid and Chemical Materials		
Technology	Method	Analyte
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Demeton
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba

Solid and Chemical Materials		
Technology	Method	Analyte
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	KS LRH	Low-range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 8260C/D	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C/D	1,1,1-Trichloroethane
GC/MS	EPA 8260C/D	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C/D	1,1,2-Trichloroethane
GC/MS	EPA 8260C/D	1,1-Dichloroethane
GC/MS	EPA 8260C/D	1,1-Dichloroethylene
GC/MS	EPA 8260C/D	1,1-Dichloropropene
GC/MS	EPA 8260C/D	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 8260C/D	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C/D	1,2,3-Trichloropropane
GC/MS	EPA 8260C/D	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C/D	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C/D	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260C/D	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260C/D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8260C/D	1,2-Dichloroethane

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8260C/D	1,2-Dichloroethene (total)
GC/MS	EPA 8260C/D	1,2-Dichloropropane
GC/MS	EPA 8260C/D	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260C/D	1,3,5-Trimethylbenzene
GC/MS	EPA 8260C/D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8260C/D	1,3-Dichloropropane
GC/MS	EPA 8260C/D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260C/D	1-Chlorohexane
GC/MS	EPA 8260C/D	2,2-Dichloropropane
GC/MS	EPA 8260C/D	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260C/D	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C/D	2-Chlorotoluene
GC/MS	EPA 8260C/D	2-Hexanone
GC/MS	EPA 8260C/D	2-Nitropropane
GC/MS	EPA 8260C/D	4-Chlorotoluene
GC/MS	EPA 8260C/D	4-Methyl-2-pentanone (MBK)
GC/MS	EPA 8260C/D	Acetone
GC/MS	EPA 8260C/D	Acetonitrile
GC/MS	EPA 8260C/D	Acrolein (Propenal)
GC/MS	EPA 8260C/D	Acrylonitrile
GC/MS	EPA 8260C/D	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260C/D	Benzene
GC/MS	EPA 8260C/D	Benzyl Chloride
GC/MS	EPA 8260C/D	Bromobenzene
GC/MS	EPA 8260C/D	Bromochloromethane
GC/MS	EPA 8260C/D	Bromodichloromethane
GC/MS	EPA 8260C/D	Bromoform
GC/MS	EPA 8260C/D	n-Butylbenzene
GC/MS	EPA 8260C/D	sec-Butylbenzene
GC/MS	EPA 8260C/D	tert-Butylbenzene
GC/MS	EPA 8260C/D	Carbon disulfide
GC/MS	EPA 8260C/D	Carbon tetrachloride
GC/MS	EPA 8260C/D	Chlorobenzene
GC/MS	EPA 8260C/D	Chloroethane
GC/MS	EPA 8260C/D	Chloroform
GC/MS	EPA 8260C/D	Chloroprene

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8260C/D	Cyclohexane
GC/MS	EPA 8260C/D	Cyclohexanone
GC/MS	EPA 8260C/D	cis-1,2-Dichloroethylene
GC/MS	EPA 8260C/D	trans-1,2-Dichloroethylene
GC/MS	EPA 8260C/D	cis-1,3-Dichloropropene
GC/MS	EPA 8260C/D	trans-1,3-Dichloropropylene
GC/MS	EPA 8260C/D	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260C/D	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C/D	Di-isopropylether (DIPE)
GC/MS	EPA 8260C/D	Dibromochloromethane
GC/MS	EPA 8260C/D	Dibromomethane (Methylene Bromide)
GC/MS	EPA 8260C/D	Dichlorodifluoromethane
GC/MS	EPA 8260C/D	Diethyl ether
GC/MS	EPA 8260C/D; EPA 8260C/D SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8260C/D	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260C/D	Ethyl acetate
GC/MS	EPA 8260C/D	Ethyl methacrylate
GC/MS	EPA 8260C/D	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 8260C/D	Ethyl tert-butyl ether (ETBE)
GC/MS	PA 8260C/D	Ethylbenzene
GC/MS	EPA 8260C/D	Ethylene Oxide
GC/MS	EPA 8260C/D	Hexachlorobutadiene
GC/MS	EPA 8260C/D	Hexane
GC/MS	EPA 8260C/D	Iodomethane (Methyl iodide)
GC/MS	EPA 8260C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260C/D	p-Isopropyltoluene
GC/MS	EPA 8260C/D	Isopropylbenzene
GC/MS	EPA 8260C/D	Methacrylonitrile
GC/MS	EPA 8260C/D	Methyl Acetate
GC/MS	EPA 8260C/D	Methyl bromide (Bromomethane)
GC/MS	EPA 8260C/D	Methyl chloride (Chloromethane)
GC/MS	EPA 8260C/D	Methylcyclohexane
GC/MS	EPA 8260C/D	Methyl methacrylate
GC/MS	EPA 8260C/D	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260C/D	Methylene chloride
GC/MS	EPA 8260C/D	Naphthalene

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8260C/D	Pentachloroethane
GC/MS	EPA 8260C/D	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260C/D	n-Propylbenzene
GC/MS	EPA 8260C/D	Styrene
GC/MS	EPA 8260C/D	tert-Amyl alcohol (TAA)
GC/MS	EPA 8260C/D	tert-Amyl methyl ether (TAME)
GC/MS	EPA 8260C/D	tert-Butyl alcohol (TBA)
GC/MS	EPA 8260C/D	tert-Butyl formate (TBF)
GC/MS	EPA 8260C/D	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260C/D	Tetrahydrofuran
GC/MS	EPA 8260C/D	Toluene
GC/MS	EPA 8260C/D	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260C/D	Trichlorofluoromethane
GC/MS	EPA 8260C/D	Vinyl acetate
GC/MS	EPA 8260C/D	Vinyl chloride
GC/MS	EPA 8260C/D	Xylene (total)
GC/MS	EPA 8260C/D	m,p-Xylene
GC/MS	EPA 8260C/D	o-Xylene
GC/MS	EPA 8270D/E	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D/E	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D/E	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,2-Diphenylhydrazine
GC/MS	EPA 8270D/E	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 8270D/E	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 8270D/E	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,4-Naphthoquinone
GC/MS	EPA 8270D/E	1,4-Phenylenediamine
GC/MS	EPA 8270D/E	1-Chloronaphthalene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	1-Methylnaphthalene
GC/MS	EPA 8270D/E	1-Naphthylamine
GC/MS	EPA 8270D/E	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D/E	2,4,5-Trichlorophenol
GC/MS	EPA 8270D/E	2,4,6-Trichlorophenol
GC/MS	EPA 8270D/E	2,4-Dichlorophenol
GC/MS	EPA 8270D/E	2,4-Dimethylphenol

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270D/E	2,4-Dinitrophenol
GC/MS	EPA 8270D/E	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D/E	2,6-Dichlorophenol
GC/MS	EPA 8270D/E	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D/E	2-Acetylaminofluorene
GC/MS	EPA 8270D/E	2-Chloronaphthalene
GC/MS	EPA 8270D/E	2-Chlorophenol
GC/MS	EPA 8270D/E	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	2-Methylnaphthalene
GC/MS	EPA 8270D/E	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D/E	2-Naphthylamine
GC/MS	EPA 8270D/E	2-Nitroaniline
GC/MS	EPA 8270D/E	2-Nitrophenol
GC/MS	EPA 8270D/E	2-Picoline (2-Methylpyridine)
GC/MS	EPA 8270D/E	3,3'-Dichlorobenzidine
GC/MS	EPA 8270D/E	3,3'-Dimethylbenzidine
GC/MS	EPA 8270D/E	3-Methylcholanthrene
GC/MS	EPA 8270D/E	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 8270D/E	3-Nitroaniline
GC/MS	EPA 8270D/E	4-Aminobiphenyl
GC/MS	EPA 8270D/E	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D/E	4-Chloro-3-methylphenol
GC/MS	EPA 8270D/E	4-Chloroaniline
GC/MS	EPA 8270D/E	4-Chlorophenyl phenylether
GC/MS	EPA 8270D/E	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270D/E	4-Nitroaniline
GC/MS	EPA 8270D/E	4-Nitrophenol
GC/MS	EPA 8270D/E	5-Nitro-o-toluidine
GC/MS	EPA 8270D/E	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Acenaphthene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Acenaphthylene
GC/MS	EPA 8270D/E	Acetophenone
GC/MS	EPA 8270D/E	Aniline
GC/MS	EPA 8270D; EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D/E	Aramite

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270D/E	Atrazine
GC/MS	EPA 8270D/E	Benzaldehyde
GC/MS	EPA 8270D/E	Benzidine
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(a)anthracene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(a)pyrene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D/E	Benzoic acid
GC/MS	EPA 8270D/E	Benzyl alcohol
GC/MS	EPA 8270D/E	Biphenyl (1,1'-Biphenyl)
GC/MS	EPA 8270D/E	bis(2-Chloroethoxy) methane
GC/MS	EPA 8270D/E	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D/E	bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))
GC/MS	EPA 8270D/E	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D/E	Butyl benzyl phthalate
GC/MS	EPA 8270D/E	Carbazole
GC/MS	EPA 8270D/E	Caprolactam
GC/MS	EPA 8270D/E	Chlorobenzilate
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Chrysene
GC/MS	EPA 8270D/E	Diallate
GC/MS	EPA 8270D/E	Di-n-butyl phthalate
GC/MS	EPA 8270D/E	Di-n-octyl phthalate
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D/E	Dibenz(a,j)acridine
GC/MS	EPA 8270D/E	Dibenzofuran
GC/MS	EPA 8270D/E	Diethyl phthalate
GC/MS	EPA 8270D/E	Dimethyl phthalate
GC/MS	EPA 8270D/E	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D/E	Diphenyl Ether
GC/MS	EPA 8270D/E EPA 8270D/E SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D/E	Ethyl methanesulfonate
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Fluoranthene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Fluorene

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270D/E	Hexachlorobenzene
GC/MS	EPA 8270D/E	Hexachlorobutadiene
GC/MS	EPA 8270D/E	Hexachlorocyclopentadiene
GC/MS	EPA 8270D/E	Hexachloroethane
GC/MS	EPA 8270D/E	Hexachlorophene
GC/MS	EPA 8270D/E	Hexachloropropene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D/E	Isodrin
GC/MS	EPA 8270D/E	Isophorone
GC/MS	EPA 8270D/E	Isosafrole
GC/MS	EPA 8270D/E	Kepone
GC/MS	EPA 8270D/E	Methapyrilene
GC/MS	EPA 8270D/E	Methyl methanesulfonate
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Naphthalene
GC/MS	EPA 8270D/E	Nitrobenzene
GC/MS	EPA 8270D/E	Nitroquinoline-1-oxide
GC/MS	EPA 8270D/E	n-Nitroso-di-n-butylamine
GC/MS	EPA 8270D/E	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D/E	n-Nitrosodiethylamine
GC/MS	EPA 8270D/E	n-Nitrosodimethylamine
GC/MS	EPA 8270D/E	n-Nitrosodiphenylamine
GC/MS	EPA 8270D/E	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D/E	n-Nitrosomethylethylamine
GC/MS	EPA 8270D/E	n-Nitrosomorpholine
GC/MS	EPA 8270D/E	n-Nitrosopiperidine
GC/MS	EPA 8270D/E	n-Nitrosopyrrolidine
GC/MS	EPA 8270D/E	Pentachlorobenzene
GC/MS	EPA 8270D/E	Pentachloroethane
GC/MS	EPA 8270D/E	Pentachloronitrobenzene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Pentachlorophenol
GC/MS	EPA 8270D/E	Phenacetin
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Phenanthrene
GC/MS	EPA 8270D/E	Phenol
GC/MS	EPA 8270D/E	Pronamide (Kerb)
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Pyrene

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270D/E	Pyridine
GC/MS	EPA 8270D/E	Safrole
GC/MS	EPA 8270D/E	Simazine
GC/MS	EPA 8270D/E	o-Toluidine
GC/MS	EPA 8270D/E	Dimethoate
GC/MS	EPA 8270D/E	Disulfoton
GC/MS	EPA 8270D/E	Famphur
GC/MS	EPA 8270D/E	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D/E	Parathion ethyl
GC/MS	EPA 8270D/E	Phorate
GC/MS	EPA 8270D/E	Sulfotepp
GC/MS	EPA 8270D/E	Thionazin (Zinophos)
GC/MS	EPA 8270D/E	O,O,O-Triethyl phosphorothioate
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX

Solid and Chemical Materials		
Technology	Method	Analyte
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorononanoic Acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorododecanoic Acid (PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorohexanesulfonic Acid (PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctanesulfonic Acid (PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorononanesulfonic Acid (PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorodecanesulfonic Acid (PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoroheptanesulfonic Acid (PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoropentanesulfonic Acid (PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctane sulfonamide (PFOSA)

Solid and Chemical Materials		
Technology	Method	Analyte
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	6:2 Fluorotelomer Sulfonate (FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	ADONA
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	11-Chloroeicosafuoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	3:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	5:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	7:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	10:2 Fluorotelomer sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorododecanesulfonic acid
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorohexadecanoic acid (PFHxDA)

Solid and Chemical Materials		
Technology	Method	Analyte
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	Perfluorooctadecanoic acid (PFOcDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	4-PFecHS (Perfluoro-4-ethylcyclohexanesulfonate)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.4 Table B-15	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorononanoic Acid (PFNA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorododecanoic Acid (PFDcA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorotridecanoic Acid (PFTTrDA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorohexanesulfonic Acid (PFHxS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorooctanesulfonic Acid (PFOS)

Solid and Chemical Materials		
Technology	Method	Analyte
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorononanesulfonic Acid (PFNS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorodecanesulfonic Acid (PFDS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoroheptanesulfonic acid (PFHpS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoropentanesulfonic Acid (PFPeS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorododecanesulfonic Acid (PFDoS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	1H,1H, 2H, 2H-Perfluorohexane sulfonic acid (FTS 4:2)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	1H,1H, 2H, 2H-Perfluorooctane sulfonic acid (FTS 6:2)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	1H,1H, 2H, 2H-Perfluorodecane sulfonic acid (FTS 8:2)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	3-Perfluoropropyl propanoic acid (3:3 FTCA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	2H,2H,3H,3H-Perfluorooctanoic acid (5:3 FTCA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	3-Perfluoroheptyl propanoic acid (7:3 FTCA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluorooctanesulfonamide (PFOSA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	N-Methyl perfluorooctanesulfonamide (NMeFOSA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	N-Ethyl perfluorooctanesulfonamide (NEtFOSA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	N-Methyl perfluorooctane sulfonamidoethanol (NMeFOSE)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	N-Ethyl perfluorooctane sulfonamidoethanol (NEtFOSE)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)


Solid and Chemical Materials		
Technology	Method	Analyte
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Hexafluoropropylene oxide dimer acid (HFPO-DA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	EPA Draft Method 1633 Compliant with QSM 5.4 Table B-24	Perfluoro (2-ethoxyethane) sulfonic acid (PFEEESA)
ICP	EPA 6010C/D	Aluminum
ICP	EPA 6010C/D	Antimony
ICP	EPA 6010C/D	Arsenic
ICP	EPA 6010C/D	Barium
ICP	EPA 6010C/D	Beryllium
ICP	EPA 6010C/D	Cadmium
ICP	EPA 6010C/D	Calcium
ICP	EPA 6010C/D	Chromium
ICP	EPA 6010C/D	Cobalt
ICP	EPA 6010C/D	Copper
ICP	EPA 6010C/D	Iron
ICP	EPA 6010C/D	Lead
ICP	EPA 6010C/D	Magnesium
ICP	EPA 6010C/D	Manganese
ICP	EPA 6010C/D	Molybdenum
ICP	EPA 6010C/D	Nickel
ICP	EPA 6010C/D	Potassium
ICP	EPA 6010C/D	Selenium
ICP	EPA 6010C/D	Silver
ICP	EPA 6010C/D	Sodium
ICP	EPA 6010C/D	Strontium
ICP	EPA 6010C/D	Thallium
ICP	EPA 6010C/D	Tin
ICP	EPA 6010C/D	Titanium
ICP	EPA 6010C/D	Vanadium

Solid and Chemical Materials		
Technology	Method	Analyte
ICP	EPA 6010C/D	Zinc
ICP/MS	EPA 6020A/B	Aluminum
ICP/MS	EPA 6020A/B	Antimony
ICP/MS	EPA 6020A/B	Arsenic
ICP/MS	EPA 6020A/B	Barium
ICP/MS	EPA 6020A/B	Beryllium
ICP/MS	EPA 6020A/B	Cadmium
ICP/MS	EPA 6020A/B	Calcium
ICP/MS	EPA 6020A/B	Chromium
ICP/MS	EPA 6020A/B	Cobalt
ICP/MS	EPA 6020A/B	Copper
ICP/MS	EPA 6020A/B	Iron
ICP/MS	EPA 6020A/B	Lead
ICP/MS	EPA 6020A/B	Magnesium
ICP/MS	EPA 6020A/B	Manganese
ICP/MS	EPA 6020A/B	Molybdenum
ICP/MS	EPA 6020A/B	Nickel
ICP/MS	EPA 6020A/B	Potassium
ICP/MS	EPA 6020A/B	Selenium
ICP/MS	EPA 6020A/B	Silver
ICP/MS	EPA 6020A/B	Sodium
ICP/MS	EPA 6020A/B	Strontium
ICP/MS	EPA 6020A/B	Thallium
ICP/MS	EPA 6020A/B	Tin
ICP/MS	EPA 6020A/B	Titanium
ICP/MS	EPA 6020A/B	Vanadium
ICP/MS	EPA 6020A/B	Zinc
CVAA	EPA 7471B	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate

Solid and Chemical Materials		
Technology	Method	Analyte
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Total nitrate-nitrite
Gravimetric Methods	SM 2540G	% solids
Electrometric Methods	EPA 9045D	Hydrogen Ion (pH)
Ignitability	EPA 1020B MOD	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	Method	Type
Organics Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction; Leachates
TCLP Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
SPLP Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure
Organics Preparation	EPA 8011	Microextraction
Organics Preparation	EPA 3546	Microwave Extraction
Organics Preparation	EPA 3550C	Ultrasonic Extraction
Organics Preparation	EPA 3580A	Waste Dilution for Extractable Organics
Organics Preparation	EPA 8330A; EPA 8332	Ultrasonic Extraction
Organics Preparation	EPA 8330B	Shaker Table Extraction
Volatile Organics Preparation	EPA 3585	Waste Dilution for Volatile Organics
Volatile Organics Preparation	EPA 5030A	Closed System Purge and Trap; Bulk Soils
Volatile Organics Preparation	EPA 5030B	Closed System Purge and Trap; Leachates and Methanol Extracts
Volatile Organics Preparation	EPA 5035; EPA 5035A	Closed System Purge and Trap
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 3050B	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 3060A	Alkaline Digestion, Cr6+
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 7471B	CVAA Digestion by Hotblock

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. L2229.



R. Douglas Leonard Jr., VP, PILR SBU





State of Florida
Department of Health, Bureau of Public Health Laboratories
This is to certify that



E83510

SGS NORTH AMERICA, INC. - ORLANDO
4405 VINELAND ROAD, SUITE C-15
ORLANDO, FL 32811

has complied with Florida Administrative Code 64E-1,
for the examination of environmental samples in the following categories

DRINKING WATER - GROUP III UNREGULATED CONTAMINANTS, DRINKING WATER - SECONDARY INORGANIC CONTAMINANTS, DRINKING WATER - SYNTHETIC ORGANIC CONTAMINANTS, NON-POTABLE WATER - EXTRACTABLE ORGANICS, NON-POTABLE WATER - GENERAL CHEMISTRY, NON-POTABLE WATER - METALS, NON-POTABLE WATER - PESTICIDES-HERBICIDES-PCB'S, NON-POTABLE WATER - VOLATILE ORGANICS, SOLID AND CHEMICAL MATERIALS - EXTRACTABLE ORGANICS, SOLID AND CHEMICAL MATERIALS - GENERAL CHEMISTRY, SOLID AND CHEMICAL MATERIALS - METALS, SOLID AND CHEMICAL MATERIALS - PESTICIDES-HERBICIDES-PCB'S, SOLID AND CHEMICAL MATERIALS - VOLATILE ORGANICS, AIR AND EMISSIONS - VOLATILE ORGANICS

Continued certification is contingent upon successful on-going compliance with the NELAC Standards and FAC Rule 64E-1 regulations. Specific methods and analytes certified are cited on the Laboratory Scope of Accreditation for this laboratory and are on file at the Bureau of Public Health Laboratories, P. O. Box 210, Jacksonville, Florida 32231. Clients and customers are urged to verify with this agency the laboratory's certification status in Florida for particular methods and analytes.

Date Issued: January 24, 2023 Expiration Date: June 30, 2023



Susanne Crowe, MHA
Interim Chief Bureau of Public Health Laboratories
DH Form 1697, 7/04
NON-TRANSFERABLE E83510-68-01/24/2023
Supersedes all previously issued certificates



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Drinking Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Perfluorooctane sulfonic acid (PFOS)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluorooctane sulfonic acid (PFOS)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504.1	Synthetic Organic Contaminants	NELAP	9/6/2002
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504.1	Synthetic Organic Contaminants	NELAP	9/6/2002
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic Acid (11-CIPF3OUdS)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic Acid (11-CIPF3OUdS)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2 Fluorotelomersulfonate, 8:2 FTS)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 Fluorotelomersulfonate, 4:2 FTS)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
1H,1H,2H,2H-Perfluoro-octanesulfonic Acid (6:2 Fluorotelomersulfonate, 6:2 FTS)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid	EPA 537	Group III Unregulated Contaminants	NELAP	10/19/2016
2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
2-(N-Methyl-perfluorooctane sulfonamido) acetic acid	EPA 537	Group III Unregulated Contaminants	NELAP	10/19/2016
2-(N-Methyl-perfluorooctane sulfonamido) acetic acid	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
4,8-Dioxa-3H-perfluorononanoic Acid (ADONA)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
4,8-Dioxa-3H-perfluorononanoic Acid (ADONA)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic Acid (9-CIPF3ONS)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic Acid (9-CIPF3ONS)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA, GenX)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA, GenX)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
Lithium	EPA 200.7	Secondary Inorganic Contaminants	NELAP	8/10/2022
Nonafluoro-3,6-dioxaheptanoic Acid (NFDHA)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluoro(2-ethoxyethane) Sulfonic Acid (PFEEA)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluoro-3-methoxypropanoic Acid (PFMPA)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluoro-4-methoxybutanoic Acid (PFMBA)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluorobutane Sulfonate (PFBS, Perfluorobutane Sulfonic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluorobutane Sulfonate (PFBS, Perfluorobutane Sulfonic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	11/24/2014
Perfluorobutane Sulfonate (PFBS, Perfluorobutane Sulfonic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
Perfluorobutanoate (PFBA, Perfluorobutanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Drinking Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Perfluorodecanoate (PFDA, Perfluorodecanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluorodecanoate (PFDA, Perfluorodecanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	11/24/2014
Perfluorodecanoate (PFDA, Perfluorodecanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
Perfluorododecanoate (PFDoA, Perfluorododecanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluorododecanoate (PFDoA, Perfluorododecanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	11/24/2014
Perfluorododecanoate (PFDoA, Perfluorododecanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
Perfluoroheptane Sulfonate (PFHpS, Perfluoroheptane Sulfonic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluoroheptanoate (PFHpA, Perfluoroheptanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluoroheptanoate (PFHpA, Perfluoroheptanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	11/24/2014
Perfluoroheptanoate (PFHpA, Perfluoroheptanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
Perfluorohexane Sulfonic Acid (PFHxS, Perfluorohexane Sulfonate)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluorohexane Sulfonic Acid (PFHxS, Perfluorohexane Sulfonate)	EPA 537	Group III Unregulated Contaminants	NELAP	11/24/2014
Perfluorohexane Sulfonic Acid (PFHxS, Perfluorohexane Sulfonate)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
Perfluorohexanoate (PFHxA, Perfluorohexanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluorohexanoate (PFHxA, Perfluorohexanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	11/24/2014
Perfluorohexanoate (PFHxA, Perfluorohexanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
Perfluorononanoate (PFNA, Perfluorononanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluorononanoate (PFNA, Perfluorononanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	11/24/2014
Perfluorononanoate (PFNA, Perfluorononanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
Perfluorooctane sulfonate (PFOS, Perfluoro-octane Sulfonic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	11/24/2014
Perfluoro-octanoate (PFOA, Perfluoro-octanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluoro-octanoate (PFOA, Perfluoro-octanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	11/24/2014
Perfluoro-octanoate (PFOA, Perfluoro-octanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
Perfluoropentane Sulfonic Acid (PFPeS, Perfluoropentane Sulfonate)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluoropentanoate (PFPeA, Perfluoropentanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Drinking Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Perfluorotetradecanoate (PFTeDA, perfluorotetradecanoic acid)	EPA 537	Group III Unregulated Contaminants	NELAP	11/24/2014
Perfluorotetradecanoate (PFTeDA, perfluorotetradecanoic acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
Perfluorotridecanoate (PFTriA, perfluorotridecanoic acid)	EPA 537	Group III Unregulated Contaminants	NELAP	11/24/2014
Perfluorotridecanoate (PFTriA, perfluorotridecanoic acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019
Perfluoroundecanoate (PFUnA, Perfluoroundecanoic Acid)	EPA 533	Group III Unregulated Contaminants	NELAP	7/7/2020
Perfluoroundecanoate (PFUnA, Perfluoroundecanoic Acid)	EPA 537	Group III Unregulated Contaminants	NELAP	11/24/2014
Perfluoroundecanoate (PFUnA, Perfluoroundecanoic Acid)	EPA 537.1	Group III Unregulated Contaminants	NELAP	6/5/2019



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Perfluorooctane sulfonic acid (PFOS)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
1,1,1,2-Tetrachloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1,1-Trichloroethane	EPA 624.1	Volatile Organics	NELAP	8/22/2018
1,1,1-Trichloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1,2,2-Tetrachloroethane	EPA 624.1	Volatile Organics	NELAP	8/22/2018
1,1,2,2-Tetrachloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1,2-Trichloroethane	EPA 624.1	Volatile Organics	NELAP	8/22/2018
1,1,2-Trichloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1-Dichloroethane	EPA 624.1	Volatile Organics	NELAP	8/22/2018
1,1-Dichloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1-Dichloroethylene	EPA 624.1	Volatile Organics	NELAP	8/22/2018
1,1-Dichloroethylene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1-Dichloropropene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2,3-Trichlorobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2,3-Trichloropropane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2,3-Trimethylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2,4,5-Tetrachlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,2,4-Trichlorobenzene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
1,2,4-Trichlorobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2,4-Trichlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,2,4-Trimethylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504.1	Volatile Organics	NELAP	6/20/2007
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011	Volatile Organics	NELAP	7/1/2003
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504.1	Volatile Organics	NELAP	11/16/2020
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8011	Volatile Organics	NELAP	11/16/2020
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2-Dichlorobenzene	EPA 624.1	Volatile Organics	NELAP	8/22/2018
1,2-Dichlorobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2-Dichlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,2-Dichloroethane	EPA 624.1	Volatile Organics	NELAP	8/22/2018
1,2-Dichloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2-Dichloropropane	EPA 624.1	Volatile Organics	NELAP	8/22/2018
1,2-Dichloropropane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2-Diphenylhydrazine	EPA 8270E	Extractable Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Page 5 of 42

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,3,5-Trimethylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
1,3-Dichlorobenzene	EPA 624.1	Volatile Organics	NELAP	8/22/2018
1,3-Dichlorobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,3-Dichlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,3-Dichloropropane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,3-Dinitrobenzene (1,3-DNB)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
1,4-Dichlorobenzene	EPA 624.1	Volatile Organics	NELAP	8/22/2018
1,4-Dichlorobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,4-Dichlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,4-Naphthoquinone	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,4-Phenylenediamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
11-Chloroeicosafuoro-3-oxaundecane-1-sulfonic Acid (11-CIPF3OUdS)	ALS MS 014	Extractable Organics	NELAP	6/5/2019
11-Chloroeicosafuoro-3-oxaundecane-1-sulfonic Acid (11-CIPF3OUdS)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
1-Chlorohexane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1-Chloronaphthalene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2 Fluorotelomersulfonate, 8:2 FTS)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2 Fluorotelomersulfonate, 8:2 FTS)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
1H,1H,2H,2H-Perfluorohexane Sulfonate (4:2 Fluorotelomersulfonic acid, 4:2 FTS)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 Fluorotelomersulfonate, 4:2 FTS)	ALS MS 014	Extractable Organics	NELAP	12/4/2018
1H,1H,2H,2H-Perfluoro-octanesulfonic Acid (6:2 Fluorotelomersulfonate, 6:2 FTS)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
1H,1H,2H,2H-Perfluoro-octanesulfonic Acid (6:2 Fluorotelomersulfonate, 6:2 FTS)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
1-Methylnaphthalene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
1-Methylnaphthalene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1-Naphthylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid	ALS MS 014	Extractable Organics	NELAP	3/22/2016

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
2-(N-Methyl-perfluorooctane sulfonamido) acetic acid	ALS MS 014	Extractable Organics	NELAP	3/22/2016
2-(N-Methyl-perfluorooctane sulfonamido) acetic acid	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
2,2-Dichloropropane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
2,2'-Oxybis(1-chloropropane),bis(2-Chloro-1-methylethyl)ether (fka bis(2-Chloroisopropyl) ether	EPA 625.1	Extractable Organics	NELAP	8/22/2018
2,2'-Oxybis(1-chloropropane),bis(2-Chloro-1-methylethyl)ether (fka bis(2-Chloroisopropyl) ether	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,3,4,6-Tetrachlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,4,5-T	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
2,4,5-Trichlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,4,6-Trichlorophenol	EPA 625.1	Extractable Organics	NELAP	8/22/2018
2,4,6-Trichlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
2,4-D	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
2,4-DB	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
2,4-Dichlorophenol	EPA 625.1	Extractable Organics	NELAP	8/22/2018
2,4-Dichlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,4-Dimethylphenol	EPA 625.1	Extractable Organics	NELAP	8/22/2018
2,4-Dimethylphenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,4-Dinitrophenol	EPA 625.1	Extractable Organics	NELAP	8/22/2018
2,4-Dinitrophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,4-Dinitrotoluene (2,4-DNT)	EPA 625.1	Extractable Organics	NELAP	8/22/2018
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
2,6-Dichlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,6-Dinitrotoluene (2,6-DNT)	EPA 625.1	Extractable Organics	NELAP	8/22/2018
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
2-Acetylaminofluorene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260D	Volatile Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2-Chloroethyl vinyl ether	EPA 624.1	Volatile Organics	NELAP	8/22/2018
2-Chloroethyl vinyl ether	EPA 8260D	Volatile Organics	NELAP	12/22/2022
2-Chloronaphthalene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
2-Chloronaphthalene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Chlorophenol	EPA 625.1	Extractable Organics	NELAP	8/22/2018
2-Chlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Chlorotoluene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
2H,2H,3H,3H-Perfluoro-octanoic Acid (5:3 FTCA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
2H,2H,3H,3H-Perfluoro-octanoic Acid (5:3 FTCA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
2-Hexanone	EPA 8260D	Volatile Organics	NELAP	12/22/2022
2-Methyl-4,6-dinitrophenol	EPA 625.1	Extractable Organics	NELAP	8/22/2018
2-Methyl-4,6-dinitrophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Methylnaphthalene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
2-Methylnaphthalene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Methylphenol (o-Cresol)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Naphthylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Nitroaniline	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Nitrophenol	EPA 625.1	Extractable Organics	NELAP	8/22/2018
2-Nitrophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Nitropropane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
2-Nitrotoluene	EPA 8330A	Extractable Organics	NELAP	12/22/2022
2-Nitrotoluene	EPA 8330B	Extractable Organics	NELAP	1/24/2023
2-Picoline (2-Methylpyridine)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
3,3'-Dichlorobenzidine	EPA 625.1	Extractable Organics	NELAP	8/22/2018
3,3'-Dichlorobenzidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
3,3-Dimethyl-1-butanol	EPA 8260D	Volatile Organics	NELAP	12/22/2022
3,3'-Dimethylbenzidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
3,5-Dinitroaniline	EPA 8330	Extractable Organics	NELAP	8/1/2008
3,5-Dinitroaniline	EPA 8330B	Extractable Organics	NELAP	1/24/2023
3/4-Methylphenols (m/p-Cresols)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
3-Methylcholanthrene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
3-Methylphenol (m-Cresol)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
3-Nitroaniline	EPA 8270E	Extractable Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
3-Nitrotoluene	EPA 8330A	Extractable Organics	NELAP	12/22/2022
3-Nitrotoluene	EPA 8330B	Extractable Organics	NELAP	1/24/2023
4,4,5,5,6,6,6-Heptafluorohexanoic Acid (3:3 FTCA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
4,4,5,5,6,6,6-Heptafluorohexanoic Acid (3:3 FTCA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
4,4'-DDD	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
4,4'-DDD	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
4,4'-DDE	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
4,4'-DDE	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
4,4'-DDT	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
4,4'-DDT	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
4,8-Dioxa-3H-perfluorononanoic Acid (ADONA)	ALS MS 014	Extractable Organics	NELAP	6/5/2019
4,8-Dioxa-3H-perfluorononanoic Acid (ADONA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
4-Aminobiphenyl	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Bromophenyl phenyl ether	EPA 625.1	Extractable Organics	NELAP	8/22/2018
4-Bromophenyl phenyl ether	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Chloro-3-methylphenol	EPA 625.1	Extractable Organics	NELAP	8/22/2018
4-Chloro-3-methylphenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Chloroaniline	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Chlorophenyl phenylether	EPA 625.1	Extractable Organics	NELAP	8/22/2018
4-Chlorophenyl phenylether	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Chlorotoluene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
4-Dimethyl aminoazobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Methyl-2-pentanone (MIBK)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
4-Methylphenol (p-Cresol)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Nitroaniline	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Nitrophenol	EPA 625.1	Extractable Organics	NELAP	8/22/2018
4-Nitrophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Nitroquinoline 1-oxide	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Nitrotoluene	EPA 8330A	Extractable Organics	NELAP	12/22/2022
4-Nitrotoluene	EPA 8330B	Extractable Organics	NELAP	1/24/2023
5-Nitro-o-toluidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
6-Methylchrysene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
7,12-Dimethylbenz(a) anthracene	EPA 8270E	Extractable Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic Acid (9-CIPF3ONS)	ALS MS 014	Extractable Organics	NELAP	6/5/2019
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic Acid (9-CIPF3ONS)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
a,a-Dimethylphenethylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Acenaphthene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Acenaphthene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Acenaphthylene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Acenaphthylene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Acetone	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Acetonitrile	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Acetophenone	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Acetylene	RSK-175	Volatile Organics	NELAP	4/7/2010
Acrolein (Propenal)	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Acrolein (Propenal)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Acrylamide	EPA 8316	Volatile Organics	NELAP	10/7/2011
Acrylonitrile	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Acrylonitrile	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Aldrin	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Aldrin	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Alkalinity as CaCO ₃	SM 2320 B	General Chemistry	NELAP	11/19/2009
Allyl chloride (3-Chloropropene)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
alpha-Chlordane	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aluminum	EPA 200.7	Metals	NELAP	4/10/2002
Aluminum	EPA 200.8	Metals	NELAP	11/24/2014
Aluminum	EPA 6010D	Metals	NELAP	12/22/2022
Aluminum	EPA 6020B	Metals	NELAP	12/22/2022
Ammonia as N	EPA 350.1	General Chemistry	NELAP	6/20/2007
Aniline	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Anthracene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Anthracene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Antimony	EPA 200.7	Metals	NELAP	4/10/2002
Antimony	EPA 200.8	Metals	NELAP	11/24/2014
Antimony	EPA 6010D	Metals	NELAP	12/22/2022
Antimony	EPA 6020B	Metals	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Aramite	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Aroclor-1016 (PCB-1016)	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Aroclor-1016 (PCB-1016)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1221 (PCB-1221)	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Aroclor-1221 (PCB-1221)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1232 (PCB-1232)	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Aroclor-1232 (PCB-1232)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1242 (PCB-1242)	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Aroclor-1242 (PCB-1242)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1248 (PCB-1248)	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Aroclor-1248 (PCB-1248)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1254 (PCB-1254)	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Aroclor-1254 (PCB-1254)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1260 (PCB-1260)	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Aroclor-1260 (PCB-1260)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1262 (PCB-1262)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1268 (PCB-1268)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Arsenic	EPA 200.7	Metals	NELAP	4/10/2002
Arsenic	EPA 200.8	Metals	NELAP	11/24/2014
Arsenic	EPA 6010D	Metals	NELAP	12/22/2022
Arsenic	EPA 6020B	Metals	NELAP	12/22/2022
Atrazine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Azinphos-methyl (Guthion)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Barium	EPA 200.7	Metals	NELAP	4/10/2002
Barium	EPA 200.8	Metals	NELAP	11/24/2014
Barium	EPA 6010D	Metals	NELAP	12/22/2022
Barium	EPA 6020B	Metals	NELAP	12/22/2022
Benzaldehyde	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzene	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Benzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Benzidine	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Benzidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzo(a)anthracene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Benzo(a)anthracene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzo(a)pyrene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Benzo(a)pyrene	EPA 8270E	Extractable Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Benzo(b)fluoranthene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Benzo(b)fluoranthene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzo(g,h,i)perylene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Benzo(g,h,i)perylene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzo(k)fluoranthene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Benzo(k)fluoranthene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzoic acid	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzyl alcohol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Beryllium	EPA 200.7	Metals	NELAP	4/10/2002
Beryllium	EPA 200.8	Metals	NELAP	11/24/2014
Beryllium	EPA 6010D	Metals	NELAP	12/22/2022
Beryllium	EPA 6020B	Metals	NELAP	12/22/2022
beta-BHC (beta-Hexachlorocyclohexane)	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Biochemical oxygen demand	SM 5210 B	General Chemistry	NELAP	6/20/2007
Biphenyl (1,1-Biphenyl, BZ 0)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
bis(2-Chloroethoxy)methane	EPA 625.1	Extractable Organics	NELAP	8/22/2018
bis(2-Chloroethoxy)methane	EPA 8270E	Extractable Organics	NELAP	12/22/2022
bis(2-Chloroethyl) ether	EPA 625.1	Extractable Organics	NELAP	8/22/2018
bis(2-Chloroethyl) ether	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Bolstar (Sulprofos)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Bromide	EPA 300.0	General Chemistry	NELAP	4/10/2002
Bromide	EPA 9056A	General Chemistry	NELAP	12/22/2022
Bromobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Bromochloromethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Bromodichloromethane	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Bromodichloromethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Bromoform	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Bromoform	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Butyl benzyl phthalate	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Butyl benzyl phthalate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Cadmium	EPA 200.7	Metals	NELAP	4/10/2002
Cadmium	EPA 200.8	Metals	NELAP	11/24/2014
Cadmium	EPA 6010D	Metals	NELAP	12/22/2022
Cadmium	EPA 6020B	Metals	NELAP	12/22/2022
Calcium	EPA 200.7	Metals	NELAP	4/10/2002

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Calcium	EPA 200.8	Metals	NELAP	11/24/2014
Calcium	EPA 6010D	Metals	NELAP	12/22/2022
Calcium	EPA 6020B	Metals	NELAP	12/22/2022
Caprolactam	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Carbazole	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Carbon disulfide	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Carbon tetrachloride	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Carbon tetrachloride	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Carbonaceous BOD (CBOD)	SM 5210 B	General Chemistry	NELAP	4/10/2002
Carbophenothion	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Carbophenothion	EPA 8270E	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Chemical oxygen demand	SM 5220 C	General Chemistry	NELAP	6/20/2007
Chlordane (tech.)	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Chlordane (tech.)	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Chloride	EPA 300.0	General Chemistry	NELAP	4/10/2002
Chloride	EPA 9056A	General Chemistry	NELAP	12/22/2022
Chlorobenzene	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Chlorobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Chlorobenzilate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Chloroethane	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Chloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Chloroform	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Chloroform	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Chloroprene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Chlorpyrifos	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Chromium	EPA 200.7	Metals	NELAP	4/10/2002
Chromium	EPA 200.8	Metals	NELAP	11/24/2014
Chromium	EPA 6010D	Metals	NELAP	12/22/2022
Chromium	EPA 6020B	Metals	NELAP	12/22/2022
Chromium VI	EPA 7196A	Metals	NELAP	12/22/2022
Chrysene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Chrysene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
cis-1,2-Dichloroethylene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
cis-1,3-Dichloropropene	EPA 624.1	Volatile Organics	NELAP	8/22/2018
cis-1,3-Dichloropropene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
cis-1,4-Dichloro-2-butene	EPA 8260D	Volatile Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Cobalt	EPA 200.7	Metals	NELAP	4/10/2002
Cobalt	EPA 200.8	Metals	NELAP	11/24/2014
Cobalt	EPA 6010D	Metals	NELAP	12/22/2022
Cobalt	EPA 6020B	Metals	NELAP	12/22/2022
Color	SM 2120 B	General Chemistry	NELAP	6/20/2007
Conductivity	EPA 120.1	General Chemistry	NELAP	5/2/2005
Copper	EPA 200.7	Metals	NELAP	4/10/2002
Copper	EPA 200.8	Metals	NELAP	11/24/2014
Copper	EPA 6010D	Metals	NELAP	12/22/2022
Copper	EPA 6020B	Metals	NELAP	12/22/2022
Coumaphos	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Dalapon	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
delta-BHC	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
delta-BHC	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Demeton-o	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Demeton-s	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Di(2-ethylhexyl) phthalate (DEHP)	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Di(2-ethylhexyl) phthalate (DEHP)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Diallate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Diazinon	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Dibenz(a,h)acridine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Dibenz(a,h)anthracene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Dibenz(a,h)anthracene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Dibenz(a,j)acridine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Dibenzofuran	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Dibromochloromethane	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Dibromochloromethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Dibromomethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Dicamba	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Dichlorodifluoromethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Dichloroprop (Dichlorprop)	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Dichlorovos (DDVP, Dichlorvos)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Dieldrin	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Dieldrin	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Diesel range organics (DRO)	EPA 8015C	Volatile Organics	NELAP	12/22/2022
Diesel range organics (DRO)	EPA 8015D	Extractable Organics	NELAP	1/24/2023

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Diesel range organics (DRO)	MADEP-EPH (MA-EPH)	Extractable Organics	NELAP	7/1/2003
Diesel range organics (DRO)	OA-2	Extractable Organics	NELAP	4/1/2005
Diesel range organics (DRO)	TN-EPH	Extractable Organics	NELAP	6/20/2007
Diesel range organics (DRO)	WI(95) DRO	Extractable Organics	NELAP	4/1/2005
Diethyl ether	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Diethyl phthalate	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Diethyl phthalate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Di-isopropylether (DIPE)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Dimethoate	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Dimethoate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Dimethyl phthalate	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Dimethyl phthalate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Di-n-butyl phthalate	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Di-n-butyl phthalate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Di-n-octyl phthalate	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Di-n-octyl phthalate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Diphenyl ether	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Dissolved organic carbon (DOC)	EPA 9060A	General Chemistry	NELAP	12/22/2022
Dissolved organic carbon (DOC)	SM 5310 B	General Chemistry	NELAP	7/30/2012
Disulfoton	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Disulfoton	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Endosulfan I	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Endosulfan I	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Endosulfan II	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Endosulfan II	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Endosulfan sulfate	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Endosulfan sulfate	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Endrin	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Endrin	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Endrin aldehyde	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Endrin aldehyde	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Endrin ketone	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
EPN	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Ethane	RSK-175	Volatile Organics	NELAP	4/1/2005
Ethanol	EPA 8015C	Volatile Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Ethanol	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Ethion	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Ethoprop	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Ethyl acetate	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Ethyl methacrylate	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Ethyl methanesulfonate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Ethylbenzene	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Ethylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Ethylene	RSK-175	Volatile Organics	NELAP	4/1/2005
Ethyl-t-butylether (ETBE)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Famphur	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Famphur	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Fensulfothion	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Fenthion	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Fluoranthene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Fluoranthene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Fluorene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Fluorene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Fluoride	EPA 300.0	General Chemistry	NELAP	4/10/2002
Fluoride	EPA 9056A	General Chemistry	NELAP	12/22/2022
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
gamma-Chlordane	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Gasoline range organics (GRO)	EPA 8015C	Volatile Organics	NELAP	12/22/2022
Gasoline range organics (GRO)	EPA 8015D	Volatile Organics	NELAP	1/24/2023
Gasoline range organics (GRO)	MADEP-VPH (MA-VPH)	Extractable Organics	NELAP	7/1/2003
Gasoline range organics (GRO)	OA-1	Extractable Organics	NELAP	4/1/2005
Gasoline range organics (GRO)	TN-GRO	Extractable Organics	NELAP	4/1/2005
Hardness	SM 2340 B	Metals	NELAP	1/24/2003
Heptachlor	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Heptachlor	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Heptachlor epoxide	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Heptachlor epoxide	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Hexachlorobenzene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Hexachlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Hexachlorobutadiene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Hexachlorobutadiene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Hexachlorobutadiene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Hexachlorocyclopentadiene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Hexachlorocyclopentadiene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Hexachloroethane	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Hexachloroethane	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Hexachlorophene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Hexachloropropene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA, GenX)	ALS MS 014	Extractable Organics	NELAP	7/7/2020
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA, GenX)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Ignitability	ASTM D3278-78	General Chemistry	NELAP	12/31/2019
Ignitability	EPA 1010B	General Chemistry	NELAP	12/22/2022
Ignitability	EPA 1020B	General Chemistry	NELAP	1/24/2023
Ignitability	EPA 1020C	General Chemistry	NELAP	12/22/2022
Indene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Indeno(1,2,3-cd)pyrene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Indeno(1,2,3-cd)pyrene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Iodomethane (Methyl iodide)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Iron	EPA 200.7	Metals	NELAP	4/10/2002
Iron	EPA 200.8	Metals	NELAP	11/24/2014
Iron	EPA 6010D	Metals	NELAP	12/22/2022
Iron	EPA 6020B	Metals	NELAP	12/22/2022
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8015C	Volatile Organics	NELAP	12/22/2022
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Isodrin	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Isophorone	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Isophorone	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Isopropyl alcohol (2-Propanol)	EPA 8015C	Volatile Organics	NELAP	12/22/2022
Isopropyl alcohol (2-Propanol)	EPA 8260	Volatile Organics	NELAP	10/19/2016
Isopropylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Isosafrole	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Kepone	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Kjeldahl nitrogen - total	EPA 351.2	General Chemistry	NELAP	6/20/2007
Lead	EPA 200.7	Metals	NELAP	4/10/2002

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Lead	EPA 200.8	Metals	NELAP	11/24/2014
Lead	EPA 6010D	Metals	NELAP	12/22/2022
Lead	EPA 6020B	Metals	NELAP	12/22/2022
m+p-Xylenes	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Magnesium	EPA 200.7	Metals	NELAP	4/10/2002
Magnesium	EPA 200.8	Metals	NELAP	11/24/2014
Magnesium	EPA 6010D	Metals	NELAP	12/22/2022
Magnesium	EPA 6020B	Metals	NELAP	12/22/2022
Malathion	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Manganese	EPA 200.7	Metals	NELAP	4/10/2002
Manganese	EPA 200.8	Metals	NELAP	11/24/2014
Manganese	EPA 6010D	Metals	NELAP	12/22/2022
Manganese	EPA 6020B	Metals	NELAP	12/22/2022
MCPA	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
MCPP	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Mercury	EPA 245.1	Metals	NELAP	4/10/2002
Mercury	EPA 7470A	Metals	NELAP	12/22/2022
Merphos	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Methacrylonitrile	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Methane	RSK-175	Volatile Organics	NELAP	4/1/2005
Methanol	EPA 8015C	Volatile Organics	NELAP	12/22/2022
Methapyrilene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Methoxychlor	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Methyl bromide (Bromomethane)	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Methyl bromide (Bromomethane)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Methyl chloride (Chloromethane)	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Methyl chloride (Chloromethane)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Methyl methacrylate	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Methyl methanesulfonate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Methyl parathion (Parathion, methyl)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Methyl parathion (Parathion, methyl)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Methyl tert-butyl ether (MTBE)	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Methyl tert-butyl ether (MTBE)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Methyl-2,4,6-trinitrophenylnitramine (tetryl)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
Methyl-2,4,6-trinitrophenylnitramine (tetryl)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
Methylene chloride	EPA 624.1	Volatile Organics	NELAP	8/22/2018

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Methylene chloride	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Mevinphos	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Molybdenum	EPA 200.7	Metals	NELAP	4/10/2002
Molybdenum	EPA 200.8	Metals	NELAP	11/24/2014
Molybdenum	EPA 6010D	Metals	NELAP	12/22/2022
Molybdenum	EPA 6020B	Metals	NELAP	12/22/2022
Monocrotophos	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Naled	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Naphthalene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Naphthalene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Naphthalene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Butyl alcohol	EPA 8015C	Volatile Organics	NELAP	12/22/2022
n-Butyl alcohol	EPA 8260D	Volatile Organics	NELAP	12/22/2022
n-Butylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
N-ethylperfluoro-octane sulfonamido ethanol (EtFOSE)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
N-ethylperfluoro-octane sulfonamido ethanol (EtFOSE)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Nickel	EPA 200.7	Metals	NELAP	4/10/2002
Nickel	EPA 200.8	Metals	NELAP	11/24/2014
Nickel	EPA 6010D	Metals	NELAP	12/22/2022
Nickel	EPA 6020B	Metals	NELAP	12/22/2022
Nitrate	EPA 9056A	General Chemistry	NELAP	12/22/2022
Nitrate as N	EPA 300.0	General Chemistry	NELAP	4/10/2002
Nitrate as N	EPA 353.2	General Chemistry	NELAP	7/30/2012
Nitrate-nitrite	EPA 300.0	General Chemistry	NELAP	4/10/2002
Nitrate-nitrite	EPA 353.2	General Chemistry	NELAP	7/30/2012
Nitrite	EPA 9056A	General Chemistry	NELAP	12/22/2022
Nitrite as N	EPA 300.0	General Chemistry	NELAP	4/10/2002
Nitrite as N	EPA 353.2	General Chemistry	NELAP	7/30/2012
Nitrobenzene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Nitrobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Nitrobenzene	EPA 8330A	Extractable Organics	NELAP	12/22/2022
Nitrobenzene	EPA 8330B	Extractable Organics	NELAP	1/24/2023
Nitroglycerin	EPA 8330	Extractable Organics	NELAP	8/1/2008

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Nitroglycerin	EPA 8330B	Extractable Organics	NELAP	1/24/2023
N-Methylperfluorooctane sulfonamide (MeFOSA)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
N-Methylperfluorooctane sulfonamide (MeFOSA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
N-Methylperfluoro-octane sulfonamido ethanol (MeFOSE)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
N-Methylperfluoro-octane sulfonamido ethanol (MeFOSE)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
n-Nitrosodiethylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosodimethylamine	EPA 625.1	Extractable Organics	NELAP	8/22/2018
n-Nitrosodimethylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitroso-di-n-butylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosodi-n-propylamine	EPA 625.1	Extractable Organics	NELAP	8/22/2018
n-Nitrosodi-n-propylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosodiphenylamine	EPA 625.1	Extractable Organics	NELAP	8/22/2018
n-Nitrosodiphenylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
N-Nitrosodiphenylamine / Diphenylamine (analyte pair)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosomethylethylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosomorpholine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosopiperidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosopyrrolidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Nonafluoro-3,6-dioxaheptanoic Acid (NFDHA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Nonafluoro-3,6-dioxaheptanoic Acid (NFDHA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
n-Propanol	EPA 8015C	Volatile Organics	NELAP	12/22/2022
n-Propylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
o,o,o-Triethyl phosphorothioate	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
o,o,o-Triethyl phosphorothioate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
Oil & Grease	EPA 1664A	General Chemistry	NELAP	9/8/2003
Oil & Grease	EPA 9070A	General Chemistry	NELAP	12/22/2022
Organic nitrogen	EPA 351.2 - EPA 350.1	General Chemistry	NELAP	6/20/2007
Orthophosphate as P	EPA 300.0	General Chemistry	NELAP	12/31/2019
Orthophosphate as P	EPA 365.1	General Chemistry	NELAP	12/31/2019
Orthophosphate as P	EPA 365.3	General Chemistry	NELAP	4/10/2002
Orthophosphate as P	EPA 9056A	General Chemistry	NELAP	12/22/2022
o-Toluidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
o-Xylene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Parathion, ethyl	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Parathion, ethyl	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Pentachlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Pentachloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Pentachloroethane	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Pentachloronitrobenzene (Quintozone)	EPA 8270E	Extractable Organics	NELAP	2/22/2023
Pentachlorophenol	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Pentachlorophenol	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Pentachlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Pentaerythritoltetranitrate (PETN)	EPA 8330	Extractable Organics	NELAP	8/1/2008
Pentaerythritoltetranitrate (PETN)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
Perchlorate	EPA 6850	General Chemistry	NELAP	7/30/2012
Perfluoro(2-ethoxyethane) Sulfonic Acid (PFEEA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Perfluoro(2-ethoxyethane) Sulfonic Acid (PFEEA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoro-3-methoxypropanoic Acid (PFMPA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Perfluoro-3-methoxypropanoic Acid (PFMPA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoro-4-methoxybutanoic Acid (PFMBA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Perfluoro-4-methoxybutanoic Acid (PFMBA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorobutane Sulfonate (PFBS, Perfluorobutane Sulfonic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorobutane Sulfonic Acid (PFBS, perfluorobutane sulfonate)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorobutanoate (PFBA, Perfluorobutanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorobutanoate (PFBA, Perfluorobutanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorodecane sulfonate (PFDS, perfluorodecane sulfonic acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorodecane sulfonate (PFDS, perfluorodecane sulfonic acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorodecanoate (PFDA, Perfluorodecanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorodecanoate (PFDA, Perfluorodecanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorododecane Sulfonate (PFDoS)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorododecane Sulfonic Acid (PFDoS)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Perfluorododecanoate (PFDoA, Perfluorododecanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorododecanoate (PFDoA, Perfluorododecanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Perfluoroheptane Sulfonate (PFHpS, Perfluoroheptane Sulfonic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoroheptane Sulfonate (PFHpS, perfluorosulfonic acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoroheptanoate (PFHpA, Perfluoroheptanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoroheptanoate (PFHpA, Perfluoroheptanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorohexadecanoate (PFHxDA, Perfluorohexadecanoic acid)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Perfluorohexane Sulfonic Acid (PFHxS, Perfluorohexane Sulfonate)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorohexane Sulfonic Acid (PFHxS, Perfluorohexane Sulfonate)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorohexanoate (PFHxA, Perfluorohexanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorohexanoate (PFHxA, Perfluorohexanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorononane Sulfonic Acid (PFNS, Perfluorononane Sulfonate)	ALS MS 014	Extractable Organics	NELAP	12/4/2018
Perfluorononane Sulfonic Acid (PFNS, Perfluorononane Sulfonate)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorononanoate (PFNA, Perfluorononanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorononanoate (PFNA, Perfluorononanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoro-octadecanoate (PFODA, Perfluoro-octadecanoic Acid)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Perfluorooctane sulfonamide (PFOSA)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoro-octane Sulfonamide (PFOSA)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoro-octane Sulfonamide (PFOSA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorooctane sulfonate (PFOS, Perfluoro-octane Sulfonic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoro-octanoate (PFOA, Perfluoro-octanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoro-octanoate (PFOA, Perfluoro-octanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoropentane Sulfonic Acid (PFPeS, Perfluoropentane Sulfonate)	ALS MS 014	Extractable Organics	NELAP	12/4/2018
Perfluoropentane Sulfonic Acid (PFPeS, Perfluoropentane Sulfonate)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoropentanoate (PFPeA, Perfluoropentanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoropentanoate (PFPeA, Perfluoropentanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorotetradecanoate (PFTeDA, perfluorotetradecanoic acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorotetradecanoate (PFTeDA, perfluorotetradecanoic acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Perfluorotridecanoate (PFTriA, perfluorotridecanoic acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorotridecanoate (PFTriA, perfluorotridecanoic acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoroundecanoate (PFUnA, Perfluoroundecanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoroundecanoate (PFUnA, Perfluoroundecanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
pH	EPA 9040C	General Chemistry	NELAP	12/22/2022
pH	SM 4500-H+-B	General Chemistry	NELAP	6/20/2007
Phenacetin	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Phenanthrene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Phenanthrene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Phenol	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Phenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Phorate	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Phorate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Phosphorus, total	EPA 365.1	General Chemistry	NELAP	12/31/2019
Phosphorus, total	EPA 365.3	General Chemistry	NELAP	5/21/2007
p-Isopropyltoluene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Potassium	EPA 200.7	Metals	NELAP	4/10/2002
Potassium	EPA 200.8	Metals	NELAP	11/24/2014
Potassium	EPA 6010D	Metals	NELAP	12/22/2022
Potassium	EPA 6020B	Metals	NELAP	12/22/2022
Pronamide (Kerb)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Propane	RSK-175	Volatile Organics	NELAP	4/7/2010
Propionitrile (Ethyl cyanide)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Pyrene	EPA 625.1	Extractable Organics	NELAP	8/22/2018
Pyrene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Pyridine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Quinoline	EPA 8270E	Extractable Organics	NELAP	12/22/2022
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
Reactive Cyanide	s.7.3 SW-846	General Chemistry	NELAP	7/1/2003
Reactive sulfide	s.7.3 SW-846	General Chemistry	NELAP	7/1/2003
Residue-filterable (TDS)	SM 2540 C	General Chemistry	NELAP	6/20/2007
Residue-nonfilterable (TSS)	SM 2540 D	General Chemistry	NELAP	6/20/2007
Residue-total	SM 2540 B	General Chemistry	NELAP	6/20/2007

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Ronnel	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Safrole	EPA 8270E	Extractable Organics	NELAP	12/22/2022
sec-Butylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Selenium	EPA 200.7	Metals	NELAP	4/10/2002
Selenium	EPA 200.8	Metals	NELAP	11/24/2014
Selenium	EPA 6010D	Metals	NELAP	12/22/2022
Selenium	EPA 6020B	Metals	NELAP	12/22/2022
Silver	EPA 200.7	Metals	NELAP	4/10/2002
Silver	EPA 200.8	Metals	NELAP	11/24/2014
Silver	EPA 6010D	Metals	NELAP	12/22/2022
Silver	EPA 6020B	Metals	NELAP	12/22/2022
Silvex (2,4,5-TP)	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Simazine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Sodium	EPA 200.7	Metals	NELAP	4/10/2002
Sodium	EPA 200.8	Metals	NELAP	11/24/2014
Sodium	EPA 6010D	Metals	NELAP	12/22/2022
Sodium	EPA 6020B	Metals	NELAP	12/22/2022
Stirofos	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Strontium	EPA 200.7	Metals	NELAP	7/30/2012
Strontium	EPA 200.8	Metals	NELAP	11/24/2014
Strontium	EPA 6010D	Metals	NELAP	12/22/2022
Strontium	EPA 6020B	Metals	NELAP	12/22/2022
Styrene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Sulfate	EPA 300.0	General Chemistry	NELAP	4/10/2002
Sulfate	EPA 9056A	General Chemistry	NELAP	12/22/2022
Sulfide	SM 4500-S F (19th/20th/21st Ed.)/TITR	General Chemistry	NELAP	6/20/2007
Sulfotep	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Sulfotep	EPA 8270E	Extractable Organics	NELAP	12/22/2022
T-amylmethylether (TAME)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
tert-Amyl Alcohol	EPA 8260D	Volatile Organics	NELAP	12/22/2022
tert-Butyl alcohol (2-Methyl-2-propanol)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
tert-Butyl Formate	EPA 8260D	Volatile Organics	NELAP	12/22/2022
tert-Butylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Tetrachloroethylene (Perchloroethylene)	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Tetrachloroethylene (Perchloroethylene)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Tetraethyl pyrophosphate (TEPP)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Thallium	EPA 200.7	Metals	NELAP	4/10/2002
Thallium	EPA 200.8	Metals	NELAP	11/24/2014
Thallium	EPA 6010D	Metals	NELAP	12/22/2022
Thallium	EPA 6020B	Metals	NELAP	12/22/2022
Thionazin (Zinophos)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Thionazin (Zinophos)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Thiophenol (Benzenethiol)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Tin	EPA 200.7	Metals	NELAP	4/1/2005
Tin	EPA 200.8	Metals	NELAP	11/24/2014
Tin	EPA 6010D	Metals	NELAP	12/22/2022
Tin	EPA 6020B	Metals	NELAP	12/22/2022
Titanium	EPA 200.7	Metals	NELAP	7/30/2012
Titanium	EPA 200.8	Metals	NELAP	11/24/2014
Titanium	EPA 6010D	Metals	NELAP	12/22/2022
Titanium	EPA 6020B	Metals	NELAP	12/22/2022
Tokuthion (Prothiophos)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Toluene	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Toluene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Total cyanide	EPA 335.4	General Chemistry	NELAP	6/20/2007
Total cyanide	EPA 9012B	General Chemistry	NELAP	12/22/2022
Total nitrate-nitrite	EPA 9056A	General Chemistry	NELAP	12/22/2022
Total organic carbon	EPA 9060A	General Chemistry	NELAP	12/22/2022
Total organic carbon	SM 5310 B	General Chemistry	NELAP	6/20/2007
Total organic carbon	SM 5310 C	General Chemistry	NELAP	9/11/2002
Total Petroleum Hydrocarbons (TPH)	FL-PRO	Extractable Organics	NELAP	7/1/2003
Total phenolics	EPA 420.4	General Chemistry	NELAP	6/20/2007
Toxaphene (Chlorinated camphene)	EPA 608.3	Pesticides-Herbicides-PCB's	NELAP	8/22/2018
Toxaphene (Chlorinated camphene)	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
trans-1,2-Dichloroethylene	EPA 624.1	Volatile Organics	NELAP	8/22/2018
trans-1,2-Dichloroethylene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
trans-1,3-Dichloropropene	EPA 624.1	Volatile Organics	NELAP	8/22/2018
trans-1,3-Dichloropropene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
trans-1,4-Dichloro-2-butene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Trichloroethene (Trichloroethylene)	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Trichloroethene (Trichloroethylene)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Trichlorofluoromethane	EPA 624.1	Volatile Organics	NELAP	8/22/2018

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Trichlorofluoromethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Trichloronate	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Turbidity	EPA 180.1	General Chemistry	NELAP	4/10/2002
Un-Ionized Ammonia	DEP SOP 02/12/01	General Chemistry	NELAP	9/26/2021
Vanadium	EPA 200.7	Metals	NELAP	4/10/2002
Vanadium	EPA 200.8	Metals	NELAP	11/24/2014
Vanadium	EPA 6010D	Metals	NELAP	12/22/2022
Vanadium	EPA 6020B	Metals	NELAP	12/22/2022
Vinyl acetate	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Vinyl chloride	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Vinyl chloride	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Xylene (total)	EPA 624.1	Volatile Organics	NELAP	8/22/2018
Xylene (total)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Zinc	EPA 200.7	Metals	NELAP	4/10/2002
Zinc	EPA 200.8	Metals	NELAP	11/24/2014
Zinc	EPA 6010D	Metals	NELAP	12/22/2022
Zinc	EPA 6020B	Metals	NELAP	12/22/2022



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1,1-Trichloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1,2,2-Tetrachloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1,2-Trichloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1-Dichloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1-Dichloroethylene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,1-Dichloropropene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2,3-Trichlorobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2,3-Trichloropropane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2,4,5-Tetrachlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,2,4-Trichlorobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2,4-Trichlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,2,4-Trimethylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011	Volatile Organics	NELAP	4/15/2010
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8011	Volatile Organics	NELAP	4/15/2010
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2-Dichlorobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2-Dichlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,2-Dichloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2-Dichloropropane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,2-Diphenylhydrazine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,3,5-Trimethylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
1,3-Dichlorobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,3-Dichlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,3-Dichloropropane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,3-Dinitrobenzene (1,3-DNB)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
1,4-Dichlorobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1,4-Dichlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8260D	Volatile Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,4-Naphthoquinone	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1,4-Phenylenediamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
11-Chloroeicosafuoro-3-oxaundecane-1-sulfonic Acid (11-CIPF3OUdS)	ALS MS 014	Extractable Organics	NELAP	6/5/2019
11-Chloroeicosafuoro-3-oxaundecane-1-sulfonic Acid (11-CIPF3OUdS)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
1-Chlorohexane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
1-Chloronaphthalene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1H,1H,2H,2H-Perfluorodecane Sulfonate (8:2 Fluorotelomersulfonic acid, 8:2FTS)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2 Fluorotelomersulfonate, 8:2 FTS)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
1H,1H,2H,2H-Perfluorohexane Sulfonate (4:2 Fluorotelomersulfonic acid, 4:2 FTS)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 Fluorotelomersulfonate, 4:2 FTS)	ALS MS 014	Extractable Organics	NELAP	12/4/2018
1H,1H,2H,2H-Perfluoro-octane Sulfonate (6:2 Fluorotelomersulfonic acid, 6:2FTS)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
1H,1H,2H,2H-Perfluoro-octanesulfonic Acid (6:2 Fluorotelomersulfonate, 6:2 FTS)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
1-Methylnaphthalene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
1-Naphthylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid	ALS MS 014	Extractable Organics	NELAP	3/22/2016
2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
2-(N-Methyl-perfluorooctane sulfonamido) acetic acid	ALS MS 014	Extractable Organics	NELAP	3/22/2016
2-(N-Methyl-perfluorooctane sulfonamido) acetic acid	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
2,2-Dichloropropane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
2,2'-Oxybis(1-chloropropane),bis(2-Chloro-1-methylethyl)ether (fka bis(2-Chloroisopropyl) ether	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,3,4,6-Tetrachlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,4,5-T	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
2,4,5-Trichlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,4,6-Trichlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
2,4-D	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
2,4-DB	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
2,4-Dichlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,4-Dimethylphenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,4-Dinitrophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
2,6-Dichlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
2-Acetylaminofluorene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
2-Chloroethyl vinyl ether	EPA 8260D	Volatile Organics	NELAP	12/22/2022
2-Chloronaphthalene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Chlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Chlorotoluene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
2H,2H,3H,3H-Perfluoro-octanoic Acid (5:3 FTCA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
2H,2H,3H,3H-Perfluoro-octanoic Acid (5:3 FTCA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
2-Hexanone	EPA 8260D	Volatile Organics	NELAP	12/22/2022
2-Methyl-4,6-dinitrophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Methylnaphthalene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Methylphenol (o-Cresol)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Naphthylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Nitroaniline	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Nitrophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Nitropropane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
2-Nitrotoluene	EPA 8330A	Extractable Organics	NELAP	12/22/2022
2-Nitrotoluene	EPA 8330B	Extractable Organics	NELAP	1/24/2023
2-Picoline (2-Methylpyridine)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
2-Propanol	EPA 8260D	Volatile Organics	NELAP	12/22/2022
3,3'-Dichlorobenzidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
3,3'-Dimethylbenzidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
3,5-Dinitroaniline	EPA 8330	Extractable Organics	NELAP	8/1/2008
3,5-Dinitroaniline	EPA 8330B	Extractable Organics	NELAP	1/24/2023
3/4-Methylphenols (m/p-Cresols)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
3-Methylcholanthrene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
3-Methylphenol (m-Cresol)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
3-Nitroaniline	EPA 8270E	Extractable Organics	NELAP	12/22/2022
3-Nitrotoluene	EPA 8330A	Extractable Organics	NELAP	12/22/2022
3-Nitrotoluene	EPA 8330B	Extractable Organics	NELAP	1/24/2023
4,4,5,5,6,6,6-Heptafluorohexanoic Acid (3:3 FTCA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
4,4,5,5,6,6,6-Heptafluorohexanoic Acid (3:3 FTCA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
4,4'-DDD	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
4,4'-DDE	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
4,4'-DDT	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
4,8-Dioxa-3H-perfluorononanoic Acid (ADONA)	ALS MS 014	Extractable Organics	NELAP	6/5/2019
4,8-Dioxa-3H-perfluorononanoic Acid (ADONA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
4-Aminobiphenyl	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Bromophenyl phenyl ether	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Chloro-3-methylphenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Chloroaniline	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Chlorophenyl phenylether	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Chlorotoluene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
4-Dimethyl aminoazobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Methyl-2-pentanone (MIBK)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
4-Methylphenol (p-Cresol)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Nitroaniline	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Nitrophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Nitroquinoline 1-oxide	EPA 8270E	Extractable Organics	NELAP	12/22/2022
4-Nitrotoluene	EPA 8330A	Extractable Organics	NELAP	12/22/2022
4-Nitrotoluene	EPA 8330B	Extractable Organics	NELAP	1/24/2023
5-Nitro-o-toluidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
6-Methylchrysene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
7,12-Dimethylbenz(a) anthracene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic Acid (9-CIPF3ONS)	ALS MS 014	Extractable Organics	NELAP	6/5/2019

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic Acid (9-CIPF3ONS)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
a,a-Dimethylphenethylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Acenaphthene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Acenaphthylene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Acetone	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Acetonitrile	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Acetophenone	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Acrolein (Propenal)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Acrylamide	EPA 8316	Volatile Organics	NELAP	10/7/2011
Acrylonitrile	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Aldrin	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Allyl chloride (3-Chloropropene)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
alpha-Chlordane	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aluminum	EPA 6010D	Metals	NELAP	12/22/2022
Aluminum	EPA 6020B	Metals	NELAP	12/22/2022
Ammonia as N	EPA 350.1	General Chemistry	NELAP	6/20/2007
Aniline	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Anthracene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Antimony	EPA 6010D	Metals	NELAP	12/22/2022
Antimony	EPA 6020B	Metals	NELAP	12/22/2022
Aramite	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Aroclor-1016 (PCB-1016)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1221 (PCB-1221)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1232 (PCB-1232)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1242 (PCB-1242)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1248 (PCB-1248)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1254 (PCB-1254)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1260 (PCB-1260)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1262 (PCB-1262)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Aroclor-1268 (PCB-1268)	EPA 8082A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Arsenic	EPA 6010D	Metals	NELAP	12/22/2022
Arsenic	EPA 6020B	Metals	NELAP	12/22/2022
Atrazine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Azinphos-methyl (Guthion)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Barium	EPA 6010D	Metals	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Barium	EPA 6020B	Metals	NELAP	12/22/2022
Benzaldehyde	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Benzidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzo(a)anthracene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzo(a)pyrene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzo(b)fluoranthene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzo(g,h,i)perylene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzo(k)fluoranthene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzoic acid	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Benzyl alcohol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Beryllium	EPA 6010D	Metals	NELAP	12/22/2022
Beryllium	EPA 6020B	Metals	NELAP	12/22/2022
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Biphenyl (1,1-Biphenyl, BZ 0)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
bis(2-Chloroethoxy)methane	EPA 8270E	Extractable Organics	NELAP	12/22/2022
bis(2-Chloroethyl) ether	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Bolstar (Sulprofos)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Bromide	EPA 9056A	General Chemistry	NELAP	12/22/2022
Bromobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Bromochloromethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Bromodichloromethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Bromoform	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Butyl benzyl phthalate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Cadmium	EPA 6010D	Metals	NELAP	12/22/2022
Cadmium	EPA 6020B	Metals	NELAP	12/22/2022
Calcium	EPA 6010D	Metals	NELAP	12/22/2022
Calcium	EPA 6020B	Metals	NELAP	12/22/2022
Caprolactam	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Carbazole	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Carbon disulfide	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Carbon tetrachloride	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Carbophenothion	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Chlordane (tech.)	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Chloride	EPA 9056A	General Chemistry	NELAP	12/22/2022
Chlorobenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Chlorobenzilate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Chloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Chloroform	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Chloroprene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Chlorpyrifos	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Chromium	EPA 6010D	Metals	NELAP	12/22/2022
Chromium	EPA 6020B	Metals	NELAP	12/22/2022
Chromium VI	EPA 7196A	General Chemistry	NELAP	12/22/2022
Chrysene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
cis-1,2-Dichloroethylene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
cis-1,3-Dichloropropene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
cis-1,4-Dichloro-2-butene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Cobalt	EPA 6010D	Metals	NELAP	12/22/2022
Cobalt	EPA 6020B	Metals	NELAP	12/22/2022
Copper	EPA 6010D	Metals	NELAP	12/22/2022
Copper	EPA 6020B	Metals	NELAP	12/22/2022
Coumaphos	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Dalapon	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
delta-BHC	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Demeton-o	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Demeton-s	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Di(2-ethylhexyl) phthalate (DEHP)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Diallate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Diazinon	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Dibenz(a,h)acridine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Dibenz(a,h)anthracene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Dibenz(a,j)acridine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Dibenzofuran	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Dibromochloromethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Dibromomethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Dicamba	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Dichlorodifluoromethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Dichloroprop (Dichlorprop)	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Dichlorovos (DDVP, Dichlorvos)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Dieldrin	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Diesel range organics (DRO)	EPA 8015C	Volatile Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Diesel range organics (DRO)	EPA 8015D	Extractable Organics	NELAP	1/24/2023
Diesel range organics (DRO)	MADEP-EPH (MA-EPH)	Extractable Organics	NELAP	2/3/2003
Diesel range organics (DRO)	OA-2	Extractable Organics	NELAP	4/1/2005
Diesel range organics (DRO)	TN-EPH	Extractable Organics	NELAP	6/20/2007
Diethyl ether	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Diethyl phthalate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Di-isopropylether (DIPE)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Dimethoate	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Dimethoate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Dimethyl phthalate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Di-n-butyl phthalate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Di-n-octyl phthalate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Diphenyl ether	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Disulfoton	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Disulfoton	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Endosulfan I	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Endosulfan II	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Endosulfan sulfate	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Endrin	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Endrin aldehyde	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Endrin ketone	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
EPN	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Ethanol	EPA 8015C	Volatile Organics	NELAP	12/22/2022
Ethion	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Ethoprop	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Ethyl acetate	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Ethyl methacrylate	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Ethyl methanesulfonate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Ethylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Ethyl-t-butylether (ETBE)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Famphur	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Famphur	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Fensulfothion	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Fenthion	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Fluoranthene	EPA 8270E	Extractable Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Fluorene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Fluoride	EPA 9056A	General Chemistry	NELAP	12/22/2022
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
gamma-Chlordane	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Gasoline range organics (GRO)	EPA 8015C	Volatile Organics	NELAP	12/22/2022
Gasoline range organics (GRO)	EPA 8015D	Volatile Organics	NELAP	1/24/2023
Gasoline range organics (GRO)	MADEP-VPH (MA-VPH)	Extractable Organics	NELAP	2/3/2003
Gasoline range organics (GRO)	OA-1	Volatile Organics	NELAP	4/1/2005
Gasoline range organics (GRO)	TN-GRO	Extractable Organics	NELAP	4/1/2005
Heptachlor	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Heptachlor epoxide	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Hexachlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Hexachlorobutadiene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Hexachlorobutadiene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Hexachlorocyclopentadiene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Hexachloroethane	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Hexachlorophene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Hexachloropropene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA, GenX)	ALS MS 014	Extractable Organics	NELAP	7/7/2020
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA, GenX)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Ignitability	EPA 1010	General Chemistry	NELAP	12/22/2022
Ignitability	EPA 1010B	General Chemistry	NELAP	12/22/2022
Ignitability	EPA 1020B	General Chemistry	NELAP	1/24/2023
Ignitability	EPA 1020C	General Chemistry	NELAP	12/22/2022
Indene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Indeno(1,2,3-cd)pyrene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Iodomethane (Methyl iodide)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Iron	EPA 6010D	Metals	NELAP	12/22/2022
Iron	EPA 6020B	Metals	NELAP	12/22/2022
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8015C	Volatile Organics	NELAP	12/22/2022
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Isodrin	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Isophorone	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Isopropyl alcohol (2-Propanol)	EPA 8015C	Volatile Organics	NELAP	12/22/2022
Isopropylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Isosafrole	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Kepone	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Kjeldahl nitrogen - total	EPA 351.2	General Chemistry	NELAP	6/20/2007
Lead	EPA 6010D	Metals	NELAP	12/22/2022
Lead	EPA 6020B	Metals	NELAP	12/22/2022
m+p-Xylenes	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Magnesium	EPA 6010D	Metals	NELAP	12/22/2022
Magnesium	EPA 6020B	Metals	NELAP	12/22/2022
Malathion	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Manganese	EPA 6010D	Metals	NELAP	12/22/2022
Manganese	EPA 6020B	Metals	NELAP	12/22/2022
MCPA	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
MCPP	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Mercury	EPA 7471B	Metals	NELAP	12/22/2022
Merphos	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Methacrylonitrile	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Methanol	EPA 8015C	Volatile Organics	NELAP	12/22/2022
Methapyrilene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Methoxychlor	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Methyl bromide (Bromomethane)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Methyl chloride (Chloromethane)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Methyl methacrylate	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Methyl methanesulfonate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Methyl parathion (Parathion, methyl)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Methyl parathion (Parathion, methyl)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Methyl tert-butyl ether (MTBE)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Methyl-2,4,6-trinitrophenylnitramine (tetra)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
Methyl-2,4,6-trinitrophenylnitramine (tetra)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
Methylene chloride	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Mevinphos	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Molybdenum	EPA 6010D	Metals	NELAP	12/22/2022
Molybdenum	EPA 6020B	Metals	NELAP	12/22/2022
Monocrotophos	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Naled	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Naphthalene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Naphthalene	EPA 8270E	Extractable Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
n-Butyl alcohol	EPA 8015C	Volatile Organics	NELAP	12/22/2022
n-Butyl alcohol	EPA 8260D	Volatile Organics	NELAP	12/22/2022
n-Butylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
N-Ethylperfluorooctane sulfonamide (N-EtFOSA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
N-ethylperfluoro-octane sulfonamido ethanol (EtFOSE)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
N-ethylperfluoro-octane sulfonamido ethanol (EtFOSE)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Nickel	EPA 6010D	Metals	NELAP	12/22/2022
Nickel	EPA 6020B	Metals	NELAP	12/22/2022
Nitrate	EPA 9056A	General Chemistry	NELAP	12/22/2022
Nitrite	EPA 9056A	General Chemistry	NELAP	12/22/2022
Nitrobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Nitrobenzene	EPA 8330A	Extractable Organics	NELAP	12/22/2022
Nitrobenzene	EPA 8330B	Extractable Organics	NELAP	1/24/2023
Nitroglycerin	EPA 8330	Extractable Organics	NELAP	8/1/2008
Nitroglycerin	EPA 8330B	Extractable Organics	NELAP	1/24/2023
N-Methylperfluorooctane sulfonamide (MeFOSA)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
N-Methylperfluorooctane sulfonamide (MeFOSA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
N-Methylperfluorooctane sulfonamido ethanol (MeFOSE)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
N-Methylperfluoro-octane sulfonamido ethanol (MeFOSE)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
n-Nitrosodiethylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosodimethylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitroso-di-n-butylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosodi-n-propylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosodiphenylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
N-Nitrosodiphenylamine / Diphenylamine (analyte pair)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosomethylethylamine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosomorpholine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosopiperidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
n-Nitrosopyrrolidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Nonafluoro-3,6-dioxaheptanoic Acid (NFDHA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Nonafluoro-3,6-dioxaheptanoic Acid (NFDHA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
n-Propanol	EPA 8015C	Volatile Organics	NELAP	12/22/2022
n-Propylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
o,o,o-Triethyl phosphorothioate	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
o,o,o-Triethyl phosphorothioate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
Oil & Grease	EPA 9071B	General Chemistry	NELAP	12/22/2022
o-Toluidine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
o-Xylene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Parathion, ethyl	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Parathion, ethyl	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Pentachlorobenzene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Pentachloroethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Pentachloroethane	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Pentachloronitrobenzene (Quintozone)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Pentachlorophenol	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Pentachlorophenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Pentaerythritoltetranitrate (PETN)	EPA 8330	Extractable Organics	NELAP	8/1/2008
Pentaerythritoltetranitrate (PETN)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
Perchlorate	EPA 6850	General Chemistry	NELAP	7/30/2012
Perfluoro(2-ethoxyethane) Sulfonic Acid (PFEEA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Perfluoro(2-ethoxyethane) Sulfonic Acid (PFEEA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoro-3-methoxypropanoic Acid (PFMPA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Perfluoro-3-methoxypropanoic Acid (PFMPA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoro-4-methoxybutanoic Acid (PFMBA)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Perfluoro-4-methoxybutanoic Acid (PFMBA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorobutane Sulfonate (PFBS, Perfluorobutane Sulfonic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorobutane Sulfonic Acid (PFBS, perfluorobutane sulfonate)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorobutanoate (PFBA, Perfluorobutanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorobutanoate (PFBA, Perfluorobutanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorodecane sulfonate (PFDS, perfluorodecane sulfonic acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorodecane sulfonate (PFDS, perfluorodecane sulfonic acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorodecanoate (PFDA, Perfluorodecanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Perfluorodecanoate (PFDA, Perfluorodecanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorododecane Sulfonate (PFDoS)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorododecane Sulfonic Acid (PFDoS)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Perfluorododecanoate (PFDoA, Perfluorododecanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorododecanoate (PFDoA, Perfluorododecanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoroheptane Sulfonate (PFHpS, Perfluoroheptane Sulfonic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoroheptane Sulfonate (PFHpS, perfluorosulfonic acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoroheptanoate (PFHpA, Perfluoroheptanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoroheptanoate (PFHpA, Perfluoroheptanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorohexadecanoate (PFHxDA, Perfluorohexadecanoic acid)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Perfluorohexane Sulfonic Acid (PFHxS, Perfluorohexane Sulfonate)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorohexane Sulfonic Acid (PFHxS, Perfluorohexane Sulfonate)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorohexanoate (PFHxA, Perfluorohexanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorohexanoate (PFHxA, Perfluorohexanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorononane Sulfonic Acid (PFNS, Perfluorononane Sulfonate)	ALS MS 014	Extractable Organics	NELAP	12/4/2018
Perfluorononane Sulfonic Acid (PFNS, Perfluorononane Sulfonate)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorononanoate (PFNA, Perfluorononanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorononanoate (PFNA, Perfluorononanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoro-octadecanoate (PFODA, Perfluoro-octadecanoic Acid)	ALS MS 014	Extractable Organics	NELAP	9/26/2021
Perfluorooctane sulfonamide (PFOSA)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoro-octane Sulfonamide (PFOSA)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorooctane sulfonate (PFOS, Perfluoro-octane Sulfonic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorooctane sulfonate (PFOS, Perfluoro-octane Sulfonic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoro-octanoate (PFOA, Perfluoro-octanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoro-octanoate (PFOA, Perfluoro-octanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoropentane Sulfonic Acid (PFPeS, Perfluoropentane Sulfonate)	ALS MS 014	Extractable Organics	NELAP	12/4/2018

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Perfluoropentane Sulfonic Acid (PFPeS, Perfluoropentane Sulfonate)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoropentanoate (PFPeA, Perfluoropentanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoropentanoate (PFPeA, Perfluoropentanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorotetradecanoate (PFTeDA, perfluorotetradecanoic acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorotetradecanoate (PFTeDA, perfluorotetradecanoic acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluorotridecanoate (PFTriA, perfluorotridecanoic acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluorotridecanoate (PFTriA, perfluorotridecanoic acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
Perfluoroundecanoate (PFUnA, Perfluoroundecanoic Acid)	ALS MS 014	Extractable Organics	NELAP	3/22/2016
Perfluoroundecanoate (PFUnA, Perfluoroundecanoic Acid)	EPA 1633 (Draft)	Extractable Organics	NELAP	6/29/2022
pH	EPA 9045D	General Chemistry	NELAP	12/22/2022
Phenacetin	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Phenanthrene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Phenol	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Phorate	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Phorate	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Phosphorus, total	EPA 365.3	General Chemistry	NELAP	6/20/2007
p-Isopropyltoluene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Potassium	EPA 6010D	Metals	NELAP	12/22/2022
Potassium	EPA 6020B	Metals	NELAP	12/22/2022
Pronamide (Kerb)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Propionitrile (Ethyl cyanide)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Pyrene	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Pyridine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Quinoline	EPA 8270E	Extractable Organics	NELAP	12/22/2022
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330A	Extractable Organics	NELAP	12/22/2022
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330B	Extractable Organics	NELAP	1/24/2023
Reactive Cyanide	s.7.3 SW-846	General Chemistry	NELAP	4/10/2002
Reactive sulfide	s.7.3 SW-846	General Chemistry	NELAP	4/10/2002
Ronnel	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Safrole	EPA 8270E	Extractable Organics	NELAP	12/22/2022
sec-Butylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Selenium	EPA 6010D	Metals	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Selenium	EPA 6020B	Metals	NELAP	12/22/2022
Silver	EPA 6010D	Metals	NELAP	12/22/2022
Silver	EPA 6020B	Metals	NELAP	12/22/2022
Silvex (2,4,5-TP)	EPA 8151A	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Simazine	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Sodium	EPA 6010D	Metals	NELAP	12/22/2022
Sodium	EPA 6020B	Metals	NELAP	12/22/2022
Stirofos	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Strontium	EPA 6010D	Metals	NELAP	12/22/2022
Strontium	EPA 6020B	Metals	NELAP	12/22/2022
Styrene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Sulfate	EPA 9056A	General Chemistry	NELAP	12/22/2022
Sulfotep	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Sulfotep	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312	General Chemistry	NELAP	4/10/2002
T-amylmethylether (TAME)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
tert-Butyl alcohol (2-Methyl-2-propanol)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
tert-Butylbenzene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Tetrachloroethylene (Perchloroethylene)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Tetraethyl pyrophosphate (TEPP)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Thallium	EPA 6010D	Metals	NELAP	12/22/2022
Thallium	EPA 6020B	Metals	NELAP	12/22/2022
Thionazin (Zinophos)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Thionazin (Zinophos)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Thiophenol (Benzenethiol)	EPA 8270E	Extractable Organics	NELAP	12/22/2022
Tin	EPA 6010D	Metals	NELAP	12/22/2022
Tin	EPA 6020B	Metals	NELAP	12/22/2022
Titanium	EPA 6010D	Metals	NELAP	12/22/2022
Titanium	EPA 6020B	Metals	NELAP	12/22/2022
Tokuthion (Prothiophos)	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Toluene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Total cyanide	EPA 9012B	General Chemistry	NELAP	12/22/2022
Total nitrate-nitrite	EPA 9056A	General Chemistry	NELAP	12/22/2022
Total organic carbon	EPA 9060A	General Chemistry	NELAP	12/22/2022
Total Petroleum Hydrocarbons (TPH)	FL-PRO	Extractable Organics	NELAP	4/10/2002
Toxaphene (Chlorinated camphene)	EPA 8081B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program.

Issue Date: 1/24/2023

Expiration Date: 6/30/2023



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311	General Chemistry	NELAP	4/10/2002
trans-1,2-Dichloroethylene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
trans-1,3-Dichloropropene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
trans-1,4-Dichloro-2-butene	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Trichloroethene (Trichloroethylene)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Trichlorofluoromethane	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Trichloronate	EPA 8141B	Pesticides-Herbicides-PCB's	NELAP	12/22/2022
Vanadium	EPA 6010D	Metals	NELAP	12/22/2022
Vanadium	EPA 6020B	Metals	NELAP	12/22/2022
Vinyl acetate	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Vinyl chloride	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Xylene (total)	EPA 8260D	Volatile Organics	NELAP	12/22/2022
Zinc	EPA 6010D	Metals	NELAP	12/22/2022
Zinc	EPA 6020B	Metals	NELAP	12/22/2022



Laboratory Scope of Accreditation

Attachment to Certificate #: E83510-68, expiration date June 30, 2023. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E83510**

EPA Lab Code: **FL00946**

(407) 425-6700

E83510

SGS North America, Inc. - Orlando

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Matrix: **Air and Emissions**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Benzene	EPA TO-3	Volatile Organics	NELAP	7/1/2007
Ethylbenzene	EPA TO-3	Volatile Organics	NELAP	7/1/2007
Gasoline range organics (GRO)	EPA TO-3	Volatile Organics	NELAP	7/1/2007
Isopropylbenzene	EPA TO-3	Volatile Organics	NELAP	7/1/2007
Methyl tert-butyl ether (MTBE)	EPA TO-3	Volatile Organics	NELAP	7/1/2007
Toluene	EPA TO-3	Volatile Organics	NELAP	7/1/2007
Xylene (total)	EPA TO-3	Volatile Organics	NELAP	7/1/2007



ANALYSIS OF POLYCHLORINATED BIPHENYLS BY GAS CHROMATOGRAPHY, ELECTRON CAPTURE DETECTOR

Prepared by: Norm Farmer Date: 06/13/2022

Approved by: Naresh Jiawan Date: 06/15/2022

Annual Review

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Document Control

Issued to: QA Department - digital Date: 06/17/2022

Issued to: SVOC Department - digital Date: * 06/17/2022

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Effective 7 days after "*" date

**CONTROLLED COPY
DO NOT DUPLICATE**

TITLE: ANALYSIS OF POLYCHLORINATED BIPHENYLS BY GAS CHROMATOGRAPHY, ELECTRON CAPTURE DETECTOR

REFERENCES: SW846 8082A

REVISED SECTIONS: 1.1.7 and 12.0

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the polychlorinated biphenyl (PCB) concentrations in water, solid, and waste matrices utilizing a gas chromatograph equipped with an electron capture detector.

1.1.2 PCBs for this method are reported as Aroclors. Aroclors are multi-component mixtures consisting of various chlorinated biphenyl congeners. Quantitation is based on individual Aroclor standards. For the purpose of this SOP, the term Aroclor and PCB may be used interchangeably. The following compounds can be reported by this method:

Aroclor 1016	Aroclor 1221	Aroclor 1232
Aroclor 1242	Aroclor 1248	Aroclor 1254
Aroclor 1260	Aroclor 1262	Aroclor 1268

1.1.3 The Lower Limit of Quantitation (LLOQ) or Reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. LLOQs may vary depending on matrix complications and volumes. LLOQs for this method are in the range of 0.5 ug/l for aqueous samples, 33 ug/kg for solid samples, 1ug/wipe for surface wipe samples, and 10 mg/kg for oil samples. Solid matrices are reported on a dry weight basis.

1.1.4 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the LLOQ. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported LLOQ.

1.1.5 The LLOQ for each analyte is evaluated on an annual basis for each matrix and instrument. The LLOQ verifications are prepared by spiking a clean matrix at 0.5 to 2 times the current LLOQ level. This LLOQ verification is carried through the same preparation and analytical procedures as the samples. Recovery of the analytes should be within the established limits. The DOD QSM requirements for Limit of Detection (LOD) and Limit of Quantitation (LOQ) verifications are different. See SOP QA020 for complete requirements for MDL, LOD, LOQ, and LLOQ.

**CONTROLLED COPY
DO NOT DUPLICATE**

- 1.1.6 Compounds detected at concentrations between the LLOQ and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the LLOQ be reported.
- 1.1.7 For DOD projects refer to QSM 5.4 Table B-1 for additional method requirements and data qualifying guidance.

1.2 Summary

- 1.2.1 This method is adapted from SW846 method 8082A.
- 1.2.2 Samples are received, stored and extracted within the appropriate holding times.
- 1.2.3 Sample preparation is performed in accordance with SGS - Orlando SOP OP008, OP009, or OP033.
- 1.2.4 The extracts are analyzed on a gas chromatograph equipped with dual electron capture detectors.
- 1.2.5 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

- 2.1.1 Samples shall be collected in amber glass bottles with Teflon lined caps. One-liter or 250ml bottles are used for aqueous samples and 4oz jars are recommended for solid samples.
- 2.1.2 The samples must be protected from light and refrigerated at $\leq 6^{\circ}\text{C}$ from the time of collection until extraction. The extracts must be stored at $\leq 6^{\circ}\text{C}$ until analysis.

2.2 Holding Time

- 2.2.1 Aqueous samples must be extracted within 7 days of collection.
- 2.2.2 Solid and waste samples must be extracted within 14 days of collection.
- 2.2.3 Extracts must be analyzed within 40 days of extraction.

3.0 INTERFERENCES

- 3.1 Data from all blanks, samples, and spikes must be evaluated for interferences.
- 3.2 Method interferences may be caused by contaminants in solvents, reagents, or glassware. Interferences from phthalate esters can be eliminated by using plastic-free solvent containers and solvent rinsed glassware.
- 3.3 Other organic compounds, including chlorinated pesticides, chlorinated hydrocarbons, phenols, and phthalate esters may be co-extracted by this method. Many of these interferences can be removed by sulfuric acid cleanup.
- 3.4 Interferences from sulfur compounds can be eliminated using an activated copper powder cleanup. Regional samples are generally high in sulfur content; therefore, all sample extracts may be sulfur cleaned prior to analysis.
- 3.5 The DDT analogs (DDT, DDE, and DDD) are frequently co-extracted with the PCBs. A single point DDT analog standard must be analyzed periodically to show if any PCB peaks are subject to interference.

4.0 DEFINITIONS

- 4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.
- 4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).
- 4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all GC and HPLC methods, a CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.
- 4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.
- 4.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point must be at a level equal to or below the LLOQ.
- 4.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor must be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

- 4.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.
- 4.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.
- 4.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.
- 4.10 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.
- 4.11 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.
- 4.12 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 REAGENTS

- 5.1 Hexane – pesticide grade or equivalent
- 5.2 PCB Stock standards – Traceable to Certificate of Analysis
- 5.3 Surrogate standard – TCMX and Decachlorobiphenyl
- 5.4 DDT analogs standard – Mixture of 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD

6.0 APPARATUS

- 6.1 Gas Chromatograph – Agilent Technologies 6890 or 7890 with 7683 Autosampler

Suitable gas chromatograph equipped with a split-splitless injection port and electron capture detectors.

Autosampler allows for unattended sample and standard injection throughout the analytical run.

- 6.2 Data System – Agilent Technologies MS Chemstation rev. DA 03.0x or EA 02.0x.
 - 6.2.1 A computer system interfaced to the gas chromatograph that allows for the continuous acquisition and storage of all data obtained throughout the duration of the chromatographic program.
 - 6.2.2 Data is archived to a backup server for long term storage.
- 6.3 Dual CLP PEST/PEST2 or equivalent: 30m X 0.53mm X 0.50/0.42um
Dual MR1/MR2 or equivalent: 30m X 0.53mm X 0.5um
- 6.4 Gas-tight syringes and class “A” volumetric glassware for dilutions of standards and extracts.

7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified reference standards. All standards must be logged in the Semivolatile Standards Logbook. All standards shall be traceable to their original source. The standards must be stored at $\leq 6^{\circ}\text{C}$, or as recommended by the manufacturer. Calibration levels, spike and surrogate concentrations, preparation information, and vendor part numbers can be found in the GC STD Summary in the Active SOP directory.

7.1.1 Stock Standard Solutions

Stock standards are available from several commercial vendors. All vendors must supply a “Certificate of Analysis” with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor’s expiration date. Once opened, the hold time is reduced to one year or the vendor’s expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with hexane. The hold time for intermediate standards is six months or the vendor’s expiration date (whichever is shorter). Intermediate standards may need to be remade if comparison to other standards indicates analyte degradation or concentration changes.

7.1.3 Calibration Standards

Calibration standards for PCB 1016 and 1260 are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. The low standard is at a concentration at or below the LLOQ and the remaining standards define the working range of the detector.

Standards for the remaining PCBs are made at a single level near the low to mid-point of the curve. **NOTE:** Some projects may require that samples with positive detects for any of the remaining PCBs be reanalyzed and quantitated using a 5-point calibration.

Calibration standard concentrations for PCB 1016 and PCB 1260 are verified by the analysis of an initial calibration verification (ICV) standard. Additional ICV standards for the other PCBs may be required.

7.2 Gas Chromatograph Conditions

2ul autosampler injection Splitless or 2:1 split injection

Carrier gas – UHP Hydrogen (3.8 ml/min) or (8.0 ml/min)

Detector gas – UHP Nitrogen (45-90 ml/min)

Injection port temperature – 200 °C Detector temperature – 325 °C

Oven program – 125 °C for 0.5 minutes
 35 °C/min to 250 °C for 0 minutes
 25 °C/min to 310 °C for 3 minutes

GC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.3 Sample Preparation

7.3.1 Water Samples

A 250ml or 1000ml aliquot of sample is extracted with methylene chloride utilizing separatory funnel extraction. The extract is solvent exchanged into hexane, concentrated to 5.0ml, sulfur cleaned, and acid cleaned.

7.3.2 Solid Samples

A 15-gram aliquot of sample is extracted with hexane:acetone utilizing pulse sonication or microwave extraction. The extract is concentrated, adjusted to 5ml with hexane, sulfur cleaned, and acid cleaned.

7.3.3 Surface Wipe Samples

A wipe sample is extracted with hexane utilizing a wrist shaker. The extract may then be sulfur cleaned or acid cleaned.

7.3.4 Oil Samples

A one-gram aliquot of sample is diluted in hexane to 10ml. The extract may then be sulfur cleaned or acid cleaned.

**CONTROLLED COPY
DO NOT DUPLICATE**

7.4 Gas Chromatographic Analysis

Instrument calibration consists of three major sections:

Initial Calibration Procedures
Daily Calibration Procedures
Continuing Calibration Verification

7.4.1 Initial Calibration Procedures

Before samples can be run, the chromatographic system must be calibrated, retention time windows must be determined, pattern recognition standards must be analyzed, and DDT analogs interference check must be analyzed.

7.4.1.1 External Standard Calibration

Prime the GC by injecting a conditioning standard, this is a high-level PCB standard. This will aid in deactivating the injection port and column.

Quantitation for this method is based on the response of individual peaks in each individual PCB standard. Three to six major peaks from each Aroclor are used for quantitation purposes. Each individual PCB peak is assigned the concentration of the total PCB standard.

A minimum 5-point calibration curve is created for PCB 1016, PCB 1260, TCMX, and Decachlorobiphenyl. PCB 1016 and 1260 are used to establish linearity for all of the PCBs.

The remaining PCBs are calibrated at a single level in the low to mid-point range of the PCB 1016/1260 curve. The single point standards are also used for pattern recognition.

NOTE: DoD QSM projects require a 5-point calibration for all PCBs.

Historically, many analytical methods have relied on linear models of the calibration relationship, where the instrument response is directly proportional to the amount of a target compound. The linear model has many advantages including simplicity and ease of use. However, given the advent of new detection techniques and because many methods cannot be optimized for all the analytes to which they may be applied, the analyst is increasingly likely to encounter situations where the linear model neither applies nor is appropriate. The option of using non-linear calibration may be necessary to address specific instrumental techniques. However, it is not EPA's intent to allow non-linear calibration to compensate for detector saturation or avoid proper instrument maintenance.

NOTE: Because of this concern, select programs including SC DHEC do not support the use of non-linear regressions.

Calibration factors (CF) for PCBs are determined at each concentration by dividing the total area (or height) of the PCB (3 to 6 major peaks) by the concentration of the standard. Calibration factors for the surrogate are determined at each concentration by dividing the area (or height) of the peak by the concentration of the standard.

The mean CF and standard deviation of the CF are determined for each analyte. The percent relative standard deviation (%RSD) of the calibration factors is calculated for each analyte as follows:

$$\%RSD = (\text{Standard Deviation of CF} \times 100) / \text{Mean CF}$$

If the $\%RSD \leq 20\%$, linearity through the origin can be assumed and the mean CF can be used to quantitate target analytes in the samples. Alternatively, a calibration curve of response vs. amount can be plotted. This method allows for the use of average response factors, linear regressions, and non-linear regressions. Linear regressions may be unweighted or weighted as $1/x$ or $1/x^2$. If the correlation coefficient (r) is ≥ 0.995 ($r^2 \geq 0.990$) then the curve can be used to quantitate target analytes in the samples.

NOTE: If a non-linear calibration curve (quadratic) is used for PCB 1016 and/or 1260, then the remaining PCBs such as 1221, 1232, 1242, 1248, 1254, 1262, and 1268 must be calibrated using a multipoint technique.

Regardless of which calibration model is chosen, the laboratory should visually inspect the curve plots to see how the individual calibration points compare to the plot.

Alternatively, either of the two techniques described below may be used to determine whether the calibration function meets acceptable criteria. These involve refitting the calibration data back to the model. Both % Error and Relative Standard Error (RSE) evaluate the difference between the measured and the true amounts or concentrations used to create the model.

Calculation of the % Error

$$\% \text{ ERR} = (x_i - x'_i) / x_i \times 100$$

x'_i = Measured amount of analyte at calibration level i , in mass or concentration units.

x_i = True amount of analyte at calibration level i , in mass or concentration units.

CONTROLLED COPY
DO NOT DUPLICATE

Percent error between the calculated and expected amounts of an analyte should be $\leq 30\%$ for all standards. For some data uses, $\leq 50\%$ may be acceptable for the lowest calibration point.

Calculation of Relative Standard Error (%RSE)

$$RSE = 100 \times \sqrt{\sum_{i=1}^n \left[\frac{x'_i - x_i}{x_i} \right]^2 / (n - p)}$$

x'_i = Measured amount of analyte at calibration level i , in mass or concentration units.

x_i = True amount of analyte at calibration level i , in mass or concentration units.

p = Number of terms in the fitting equation.
(average = 1, linear = 2, quadratic = 3)

n = Number of calibration points.

The %RSE acceptance limit criterion is $\leq 20\%$.

7.4.1.2 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV must be prepared from a second source at a mid-range concentration.

The %D for all analytes of interest should be $\leq 20\%$. If the ICV does not meet this criteria, a second standard must be prepared. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, analyze an ICV prepared from a third source or lot. Determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

For any DoD QSM project, if samples must be analyzed with a target analyte having a %D $> 20\%$, then the data must be qualified accordingly.

7.4.1.3 Retention Time Windows

Retention time windows must be established whenever a new column is installed in an instrument or whenever a major change has been made to an instrument.

CONTROLLED COPY
DO NOT DUPLICATE

Individual PCB peaks must fall within the appropriate retention time windows; however, Aroclor identification is based primarily on individual peak ratios and pattern recognition.

Retention time windows are crucial to the identification of target compounds. Absolute retention times are used for compound identification in all GC and HPLC methods that do not employ internal standard calibration. Retention time windows are established to compensate for minor shifts in absolute retention times that result from normal chromatographic variability. The width of the retention time window should be carefully established to minimize the occurrence of both false positive and false negative results.

Retention time windows are established by injecting all standard mixes three times over the course of 72 hours. The width of the retention time window for each analyte, surrogate, and major constituent in multi-component analytes is defined as ± 3 times the standard deviation of the mean absolute retention time or 0.03 minutes, whichever is greater.

Establish the center of the retention time window for each analyte and surrogate by using the absolute retention time for each analyte and surrogate from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.

Peak identification is based on the retention time of a peak falling within the retention time window for a given analyte. Time reference peaks (surrogates) are used to correct for run-to-run variations in retention times due to temperature, flow, or injector fluctuations.

The retention time windows should be used as a guide for identifying compounds; however, the experience of the analyst should weigh heavily in the interpretation of the chromatograms. The analyst should monitor the retention times of known peaks (standards and surrogates) throughout an instrument run as an indication of instrument performance.

Because calculated retention time windows are generally very tight (less than ± 0.03 minutes), the retention time windows for the data processing method are generally set wider than the calculated window. This is done to ensure that the software does not miss any potential "hits". The analyst will then review these "hits" and determine if the retention times are close enough to the retention time of the target analyte to positively identify the peak or to require confirmation.

7.4.1.4 DDT Analogs Interference Check

Analyze a DDT analogs standard consisting of DDT, DDE, and DDD at a concentration near the midpoint of the PCB calibration curve. Overlay the DDT analogs standard with the mid-level PCB standard (and single point standards) and determine if there are any interferences. Note on the run log which PCB peaks co-elute with the DDT series. Instrument conditions should be optimized to minimize interferences.

The analyst must be aware of these co-eluting peaks when quantitating samples that may contain DDT series. It may be necessary to omit a co-eluting peak in order to obtain the most accurate value.

7.4.2 Daily Calibration Procedures

Prime the GC by injecting a conditioning standard, this is a high-level PCB standard. This will aid in deactivating the injection port and column.

Analyze a continuing calibration verification standard (section 7.4.3) for PCB 1016 and PCB 1260. Then analyze the PCBs that are calibrated at a single concentration level.

The single point standards must be analyzed every 24 hours; they do not have to be analyzed at the same frequency as the CCV standard. For DoD QSM projects the CCVs for the other PCBs should be analyzed at the same frequency as PCB 1016 and PCB 1260.

NOTE: DoD QSM projects require CCVs for each PCB to be analyzed throughout the sequence.

7.4.3 Continuing Calibration Verification (CCV)

Continuing calibration verification standards for PCB 1016 and PCB 1260 are prepared at various concentrations (CCV standards for other PCBs may be required); at least one CCV must be below the mid-point of the calibration curve. A continuing calibration standard must be analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally, a CCV must be analyzed after every 10 samples.

The percent difference (%D) for each analyte of interest will be monitored. The $|\%D|$ should be $\leq 20\%$ for each analyte.

If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated. If the second standard meets criteria, then the system is considered in control and results may be reported.

Rationale for second standard such as instrument maintenance, clipped column, remade standard, etc. must be documented in the run log or maintenance log. Reanalysis of second standard without valid rationale may require the analysis of a third standard (in which case both the second and third standard would have to pass).

NOTE: For any DoD QSM project, if the second standard meets criteria, then a third standard must be analyzed. If the third standard also meets criteria, then the system is considered in control and results may be reported.

If the $|\%D|$ is greater than 20%, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Under certain circumstances, the data may be reported. i.e. The CCV failed high, the associated QC passed, and the samples were ND.

NOTE: For any DoD QSM project, if samples must be reported with a target analyte having a $\%D > 20\%$, then the data must be qualified accordingly, regardless of whether the analyte was detected or not.

NOTE: Samples that are being reported to the State of California require that the $|\%D| \leq 15\%$ for each analyte.

NOTE: Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed, or the data must be qualified.

7.4.4 Sample Extract Analysis

7.4.4.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

- Conditioning Standard
- Initial Calibration Standards (or Initial CCV)
- Single Point Standards
- QC Extracts
- Sample Extracts
- CCV Standards

7.4.4.2 Two microliters (same amount as standards) of extract is injected into the GC by the autosampler. A splitless injection technique is used. The data system then records the resultant peak responses and retention times.

7.4.4.3 Tentative identification of an analyte occurs when the peaks from the sample extract fall within the established retention time windows for a calibrated compound on the primary column.

**CONTROLLED COPY
DO NOT DUPLICATE**

- 7.4.4.4 If the peaks of interest fall within the retention time windows on the confirmation column, the identification is confirmed. Quantitation of the analyte on the primary and confirmation column should agree within 40%. If the difference is greater than 40% and no obvious reason can be found, the higher result should be reported and flagged as “estimated”; otherwise, the result from the primary column should be reported.
- 7.4.4.5 Pattern comparisons should also be used to aid in the identification of the multipeak analytes.
- 7.4.4.6 If the compound identification does not confirm on a dissimilar column, then the result should be reported as ND or “U”.
- 7.4.4.7 If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.
- 7.4.4.8 If peak or pattern identification is prevented by the presence of interferences, further cleanup may be required, or the extract must be diluted so that the interference does not mask any analytes.

7.5 Maintenance and Trouble Shooting

- 7.5.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.
- 7.5.2 All instrument maintenance must be documented in the appropriate “Instrument Repair and Maintenance” log. The log will include such items as problem, action taken, correction verification, date, and analyst.
- 7.5.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.
- 7.5.4 PC and software changes must be documented in the “Instrument Repair and Maintenance” log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of surrogates and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD).

9.1 Surrogates

- 9.1.1 Tetrachloro-m-xylene (TCMX) and Decachlorobiphenyl are used as the surrogate standards to monitor the efficiency of the extraction and clean-up procedures.

A known amount of surrogate standard is added to each sample including the QC set prior to extraction. The percent recovery for each surrogate is calculated as follows:

$$\% \text{ Recovery} = (\text{Sample Amount} / \text{Amount Spiked}) \times 100$$

The percent recovery must fall within the established control limits for both surrogates for the results to be acceptable.

- 9.1.2 If the surrogate recoveries are not within the established control limits, the following are required.
- 9.1.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or surrogate solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.
- 9.1.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.
- 9.1.2.3 If no problem is found, reanalyze the sample. **NOTE: If the recoveries are high and the sample is non-detect, then re-extraction may not be necessary; however, the resulting data must be qualified accordingly.** If there is insufficient sample for re-extraction, reanalyze the sample and footnote this on the report.

- 9.1.2.4 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Surrogates from both sets of analysis must be reported on the final report.

9.2 Method Blank

- 9.2.1 The method blank is either de-ionized water or sodium sulfate (depending upon sample matrix) to which the surrogate standard has been added. The method blank is then extracted and taken through all cleanup procedures along with the other samples to determine any contamination from reagents, glassware, or high-level samples. The method blank must be free of any analytes of interest or interferences at $\frac{1}{2}$ the required LLOQ to be acceptable. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a "B" or "V" qualifier.
- 9.2.2 If the MB is contaminated but the samples are non-detect, then the source of contamination must be investigated and documented. The sample results can be reported without qualification. **NOTE: For samples reported to SC DHEC or DoD the associated sample results must still be reported with the B qualifier.**
- 9.2.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination must be investigated and documented. The samples results may be reported with the appropriate "B" or "V" qualifier. This must be approved by the department supervisor.
- 9.2.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination must be investigated and documented. The samples must be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

9.3 Blank Spike

- 9.3.1 The blank spike is either de-ionized water or sodium sulfate (depending upon sample matrix) to which the surrogate standard and spike standard have been added. The blank spike is then extracted and taken through all cleanup procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

$$\% \text{ Recovery} = (\text{Blank Spike Amount} / \text{Amount Spiked}) \times 100$$

The percent recovery for each analyte of interest should fall within the established control limits for the results to be acceptable.

NOTE: A secondary check against 70-130% limits must be performed for all analytes reported to SC DHEC.

- 9.3.2 If the blank spike recoveries are not within the established control limits, the following are required.
- 9.3.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.
 - 9.3.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.
 - 9.3.2.3 Check to see if the recoveries that are outside of control limits are analytes of concern. If the analytes are not being reported, additional corrective action is not necessary, and the sample results can be reported without qualification.
 - 9.3.2.4 **If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable; however, the resulting data must be qualified accordingly.**
 - 9.3.2.5 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.
 - 9.3.2.6 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

9.4 Matrix Spike and Matrix Spike Duplicate

- 9.4.1 Matrix spike and spike duplicates are replicate sample aliquots to which the surrogate standard and spike standard have been added. The matrix spike and spike duplicate are then extracted and taken through all cleanup procedures along with the other samples to monitor the precision and accuracy of the extraction procedure. The percent recovery for each analyte is calculated as follows:

$$\% \text{ Recovery} = [(\text{Spike Amount} - \text{Sample Amount}) / \text{Amount Spiked}] \times 100$$

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

9.4.2 If the matrix spike recoveries are not within the established control limits, the following are required.

- 9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.
- 9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.
- 9.4.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extract but are an indication of the sample matrix effects.

9.4.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

$$RPD = [| \text{MS Result} - \text{MSD Result} | / \text{Average Result}] \times 100$$

The RPD for each analyte should fall within the established control limits. If the RPDs fall outside of the established control limits, the MS and MSD should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

10.0 CALCULATIONS

The amount of the PCB in the samples is determined by averaging the concentration of the major peaks for each individual PCB. The MS Chemstation software will automatically sum and average the peaks used for each individual Aroclor.

The concentration of each individual PCB peak in the original sample is calculated as follows:

$$\text{PCB Water (ug/l)} = (\text{CONC}_{\text{inst}}) \times (V_F / V_I) \times \text{DF}$$

$$\text{PCB Soil (ug/kg)} = [(\text{CONC}_{\text{inst}}) \times (V_F / W_I) \times \text{DF}] / \% \text{solids}$$

$CONC_{inst}$	=	Instrument concentration calculated from the initial calibration using mean CF, curve fit, or single point
DF	=	Dilution Factor
V_F	=	Volume of final extract (ml)
V_I	=	Volume of sample extracted (ml)
W_I	=	Weight of sample extracted (g)
%solids	=	Dry weight determination in decimal form

All soils are reported on a dry weight basis.

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst should follow normal safety procedures as outlined in the SGS North America, Inc. Health and Safety Program and SGS Orlando SOP QA033 (Laboratory Safety Procedure), current revision. Safety glasses, lab coat, and appropriate gloves should be worn at all times when handling samples.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample must be treated as a potential health hazard. Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment must be used by all analysts.

11.2 Pollution Prevention

Waste solvents from the sample analysis and standards preparation are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

Sample Extracts are archived and stored for 60 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

SW846 Method 8000D Revision 4, July 2014

SW846 Method 8082A Revision 1, February 2007

DOD QSM 5.4, November 2021

ANALYSIS OF POLYCHLORINATED BIPHENYLS BY GAS CHROMATOGRAPHY, ELECTRON CAPTURE DETECTOR

SOP Acknowledgement Form

I have read and understand this SOP. I will not knowingly deviate from this approved SOP without approval of the Department Supervisor, QA Officer, or Technical Director. If I notice any discrepancies between this SOP and the routine procedure, I will notify the Department Supervisor so that either the SOP or procedure can be changed. Furthermore, I understand that this SOP is property of SGS North America Inc. – Orlando and may not be **printed** nor duplicated in any manner.

Internal SOPs referenced within this SOP: OP008, OP009, OP033, GC001, QA020, QA029, QA033

Print Name	Signature	Date

Print the SOP Acknowledgement Form, sign, and submit to the SGS Orlando QA department.

CONTROLLED COPY
DO NOT DUPLICATE



ANALYSIS OF ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY, ELECTRON CAPTURE DETECTOR

Prepared by: Norm Farmer Date: 06/13/2022

Approved by: Naresh Jiawan Date: 06/15/2022

Annual Review

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Document Control

Issued to: QA Department - digital Date: 06/17/2022

Issued to: SVOC Department - digital Date: * 06/17/2022

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Effective 7 days after "*" date

**CONTROLLED COPY
DO NOT DUPLICATE**

TITLE: ANALYSIS OF ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY, ELECTRON CAPTURE DETECTOR

REFERENCES: SW846 8081B

REVISED SECTIONS: 1.1.7 and 12.0

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of specific organochlorine pesticides in water and solid matrices utilizing a gas chromatograph equipped with an electron capture detector.

1.1.2 The following compounds can be reported by this method:

Aldrin	Dieldrin
Alpha-BHC	Endosulfan I
Beta-BHC	Endosulfan II
Delta-BHC	Endosulfan Sulfate
Gamma-BHC (Lindane)	Endrin
Chlordane (Technical)	Endrin Ketone
Alpha-chlordane	Endrin Aldehyde
Gamma-chlordane	Heptachlor
4,4'-DDD	Heptachlor Epoxide
4,4'-DDE	Methoxychlor
4,4'-DDT	Toxaphene

1.1.3 The Lower Limit of Quantitation (LLOQ) or Reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. LLOQs may vary depending on matrix complications and volumes. LLOQs for the single peak pesticides in this method are in the range of 0.05 to 0.10 ug/l for aqueous samples and 1.7 to 3.3 ug/kg for solid samples. Solid matrices are reported on a dry weight basis.

1.1.4 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the LLOQ. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported LLOQ.

**CONTROLLED COPY
DO NOT DUPLICATE**

- 1.1.5 The LLOQ for each analyte is evaluated on an annual basis for each matrix and instrument. The LLOQ verifications are prepared by spiking a clean matrix at 0.5 to 2 times the current LLOQ level. This LLOQ verification is carried through the same preparation and analytical procedures as the samples. Recovery of the analytes should be within the established limits. The DOD QSM requirements for Limit of Detection (LOD) and Limit of Quantitation (LOQ) verifications are different. See SOP QA020 for complete requirements for MDL, LOD, LOQ, and LLOQ.
- 1.1.6 Compounds detected at concentrations between the LLOQ and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the LLOQ be reported.
- 1.1.7 For DOD projects refer to QSM 5.4 Table B-1 for additional method requirements and data qualifying guidance.

1.2 Summary

- 1.2.1 This method is adapted from SW846 method 8081B.
- 1.2.2 Samples are received, stored and extracted within the appropriate holding times.
- 1.2.3 Sample preparation is performed in accordance with SGS - Orlando SOP OP008 and OP009.
- 1.2.4 The extracts are analyzed on a gas chromatograph equipped with dual electron capture detectors.
- 1.2.5 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

- 2.1.1 Samples shall be collected in amber glass bottles with Teflon lined caps. One-liter or 250ml bottles are used for aqueous samples and 4oz jars are recommended for solid samples.
- 2.1.2 The samples must be protected from light and refrigerated at $\leq 6^{\circ}\text{C}$ from the time of collection until extraction. The extracts must be stored at $\leq 6^{\circ}\text{C}$ until analysis.

2.2 Holding Time

- 2.2.1 Aqueous samples must be extracted within 7 days of collection.
- 2.2.2 Solid and waste samples must be extracted within 14 days of collection.
- 2.2.3 Extracts must be analyzed within 40 days of extraction.

CONTROLLED COPY
DO NOT DUPLICATE

3.0 INTERFERENCES

- 3.1 Data from all blanks, samples, and spikes must be evaluated for interferences.
- 3.2 Method interferences may be caused by contaminants in solvents, reagents, or glassware. Interferences from phthalate esters can be eliminated by using plastic-free solvent containers and solvent rinsed glassware.
- 3.3 Other organic compounds, including PCBs, chlorinated hydrocarbons, phenols, and phthalate esters may be co-extracted by this method.
- 3.4 Interferences from sulfur compounds can be eliminated using an activated copper powder cleanup. Regional samples are generally high in sulfur content; therefore, all sample extracts should be sulfur cleaned prior to analysis.

4.0 DEFINITIONS

- 4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.
- 4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).
- 4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all GC and HPLC methods, a CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.
- 4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.
- 4.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point must be at a level equal to or below the LLOQ.
- 4.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor must be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.
- 4.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

- 4.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.
- 4.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.
- 4.10 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.
- 4.11 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.
- 4.12 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 REAGENTS

- 5.1 Hexane – pesticide grade or equivalent
- 5.2 Pesticide stock standards – Traceable to Certificate of Analysis
- 5.3 Surrogate standard – TCMX and Decachlorobiphenyl

6.0 APPARATUS

- 6.1 Gas Chromatograph – Agilent Technologies 6890 or 7890 with 7683 Autosampler

Suitable gas chromatograph equipped with a split-splitless injection port and electron capture detectors.

Autosampler allows for unattended sample and standard injection throughout the analytical run.
- 6.2 Data System – Agilent Technologies MS Chemstation rev. DA 00.01, DA 03.0x or EA 02.0x.
 - 6.2.1 A computer system interfaced to the gas chromatograph that allows for the continuous acquisition and storage of all data obtained throughout the duration of the chromatographic program.
 - 6.2.2 Data is archived to a backup server for long term storage.

- 6.3 Dual MR1/MR2 (multiresidue) Column or equivalent: 30m X 0.53mm X 0.50um
Dual CLP/CLP2 Column or equivalent: 30m X 0.50mm X 0.5/0.42um
- 6.4 Gas-tight syringes and class "A" volumetric glassware for dilutions of standards and extracts.

7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified reference standards. All standards must be logged in the Semivolatiles Standards Logbook. All standards shall be traceable to their original source. The standards must be stored at $\leq 6^{\circ}\text{C}$, or as recommended by the manufacturer. Calibration levels, spike and surrogate concentrations, preparation information, and vendor part numbers can be found in the GC STD Summary in the Active SOP directory

7.1.1 Stock Standard Solutions

Stock standards are available from several commercial vendors. All vendors must supply a "Certificate of Analysis" with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor's expiration date. Once opened, the hold time is reduced to one year or the vendor's expiration date (whichever is shorter)

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with hexane. The hold time for intermediate standards is six months or the vendor's expiration date (whichever is shorter). Intermediate standards may need to be remade if comparison to other standards indicates analyte degradation or concentration changes.

7.1.3 Calibration Standards

Calibration standards for the single peak pesticides are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. The low standard is at a concentration at or below the LLOQ and the remaining standards define the working range of the detector.

Standards for the multippeak pesticides (Toxaphene and Technical Chlordane) are made at a single level near the RL. **NOTE:** Some projects may require that samples with positive detects for either toxaphene or technical chlordane be reanalyzed and quantitated using a 5-point calibration.

Calibration standard concentrations for the single peak pesticides are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 Gas Chromatograph Conditions

4ul autosampler injection Splitless or 2:1 split injection

Carrier gas – UHP Helium (5-10 ml/min ramped flow)

Detector gas – UHP Nitrogen (45 - 90 ml/min)

Injection port temperature – 190 - 200 °C Detector temperature – 325 - 350 °C

Oven program – 120 °C for 0 minutes
 45 °C/min to 200 °C
 12.5 °C/min to 230 °C
 20 °C/min to 320 °C for 2.0 minutes

Pressure Program – 5.0 ml/min for 1.0 minute
 1.0 ml/min to 10.0 ml/min for 0 minutes

GC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.3 Sample Preparation

7.3.1 Water Samples

A 250ml or 1000ml aliquot of sample is extracted with methylene chloride utilizing separatory funnel extraction. The extract is solvent exchanged into hexane, concentrated to 5.0ml, and sulfur cleaned.

7.3.2 Solid Samples

A 15-gram aliquot of sample is extracted with hexane:acetone utilizing pulse sonication or microwave extraction. The extract is concentrated, adjusted to 5.0ml with hexane, and sulfur cleaned.

7.4 Gas Chromatographic Analysis

Instrument calibration consists of three major sections:

Initial Calibration Procedures
Daily Calibration Procedures
Continuing Calibration Verification

7.4.1 Initial Calibration Procedures

Before samples can be run, injection port inertness must be verified, the chromatographic system must be calibrated, and retention time windows must be determined.

7.4.1.1 Breakdown Check

Prime the GC by injecting a conditioning standard; this is a pesticide standard that is approximately 20 times the concentration of the mid-level standard. This will aid in deactivating the injection port and column.

Endrin and DDT breakdown must be verified at the start of each 12-hour shift. Inject a DDT/Endrin standard that is at a concentration near the mid-point of the curve. Calculate the percent breakdown of each analyte as follows (height may be used instead of area):

$$\%DDT_{\text{BREAKDOWN}} = \frac{(\text{DDE Area} + \text{DDD Area}) \times 100}{(\text{DDE Area} + \text{DDD Area} + \text{DDT Area})}$$

$$\%\text{Endrin}_{\text{BREAKDOWN}} = \frac{(\text{Endrin ketone Area} + \text{Endrin aldehyde Area}) \times 100}{(\text{Endrin ketone Area} + \text{Endrin aldehyde Area} + \text{Endrin Area})}$$

The percent breakdown for both DDT and endrin must not exceed 15%. If breakdown exceeds 15%, instrument maintenance must be performed before any samples can be analyzed.

7.4.1.2 External Standard Calibration

A minimum 5-point calibration curve is created for the single peak pesticides, TCMX, and Decachlorobiphenyl. SGS Orlando routinely performs a 6-point calibration to maximize the calibration range.

The low point may be omitted from the calibration table for any compound with an LLOQ set at the level two standard. Additionally, the high point may be omitted for any compound that exhibits poor linearity at the upper end of the calibration range.

An entire level may be omitted provided that a minimum of 5 points remain. There must be technical justification to omit an entire level. This must be documented in the run log.

Toxaphene and chlordane (technical) are calibrated at a single level near the RL. **NOTE:** DoD QSM projects require at 5-point calibration for technical chlordane and toxaphene if they are being reported.

Historically, many analytical methods have relied on linear models of the calibration relationship, where the instrument response is directly proportional to the amount of a target compound. The linear model has many advantages including simplicity and ease of use. However, given the advent of new detection techniques and because many methods cannot be optimized for all the analytes to which they may be applied, the analyst is increasingly likely to encounter situations where the linear

model neither applies nor is appropriate. The option of using non-linear calibration may be necessary to address specific instrumental techniques. However, it is not EPA's intent to allow non-linear calibration to compensate for detector saturation or avoid proper instrument maintenance.

NOTE: Because of this concern, select programs including SC DHEC do not support the use of non-linear regressions.

Calibration factors (CF) for the single peak pesticides and surrogates are determined at each concentration by dividing the area (or height) of each compound by the concentration of the standard.

Quantitation for technical chlordane is based on the individual peaks in the chlordane standard. Three to six major peaks are used for quantitation purposes. Each individual chlordane peak is assigned the concentration of the total chlordane standard. Toxaphene may be quantitated by individual peaks (4 to 6 major peaks) or by total area. For the individual peak approach, each individual toxaphene peak is assigned the concentration of the total toxaphene standard. See method 8081B for additional information.

Calibration factor (CF) for chlordane is determined by dividing the total area (or height) of chlordane (3 to 6 major peaks) by the concentration of the standard. The calibration factor for the toxaphene is determined by dividing the total area (height cannot be used) of Toxaphene (4 to 6 major peaks) by the concentration of the standard.

The mean CF and standard deviation of the CF are determined for each analyte. The percent relative standard deviation (%RSD) of the calibration factors is calculated for each analyte as follows:

$$\%RSD = (\text{Standard Deviation of CF} \times 100) / \text{Mean CF}$$

If the $\%RSD \leq 20\%$, linearity through the origin can be assumed and the mean CF can be used to quantitate target analytes in the samples. Alternatively, a calibration curve of response vs. amount can be plotted. This method allows for the use of average response factors, linear regressions, and non-linear regressions. Linear regressions may be unweighted or weighted as $1/x$ or $1/x^2$. If the correlation coefficient (r) is ≥ 0.995 ($r^2 \geq 0.990$) then the curve can be used to quantitate target analytes in the samples. Regardless of which calibration model is chosen, the laboratory should visually inspect the curve plots to see how the individual calibration points compare to the plot.

Alternatively, either of the two techniques described below may be used to determine whether the calibration function meets acceptable criteria. These involve refitting the calibration data back to the model. Both % Error and Relative Standard Error (RSE) evaluate the difference

CONTROLLED COPY
DO NOT DUPLICATE

between the measured and the true amounts or concentrations used to create the model.

Calculation of the % Error

$$\% \text{ ERR} = (x_i - x'_i) / x_i * 100$$

x'_i = Measured amount of analyte at calibration level i, in mass or concentration units.

x_i = True amount of analyte at calibration level i, in mass or concentration units.

Percent error between the calculated and expected amounts of an analyte should be $\leq 30\%$ for all standards. For some data uses, $\leq 50\%$ may be acceptable for the lowest calibration point.

Calculation of Relative Standard Error (%RSE)

$$RSE = 100 \times \sqrt{\sum_{i=1}^n \left[\frac{x'_i - x_i}{x_i} \right]^2 / (n - p)}$$

x'_i = Measured amount of analyte at calibration level i, in mass or concentration units.

x_i = True amount of analyte at calibration level i, in mass or concentration units.

p = Number of terms in the fitting equation.
 (average = 1, linear = 2, quadratic = 3)

n = Number of calibration points.

The %RSE acceptance limit criterion is $\leq 20\%$.

7.4.1.3 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV must be prepared from a second source at a mid-range concentration.

The %D for all analytes of interest should be $\leq 20\%$. If the ICV does not meet this criteria, a second standard must be prepared. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, analyze an ICV prepared from a third source or lot.

**CONTROLLED COPY
 DO NOT DUPLICATE**

Determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

For any DoD QSM project, if samples must be analyzed with a target analyte having a %D > 20%, then the data must be qualified accordingly.

7.4.1.4 Retention Time Windows

Retention time windows must be established whenever a new column is installed in an instrument or whenever a major change has been made to an instrument.

Retention time windows are crucial to the identification of target compounds. Absolute retention times are used for compound identification in all GC and HPLC methods that do not employ internal standard calibration. Retention time windows are established to compensate for minor shifts in absolute retention times that result from normal chromatographic variability. The width of the retention time window should be carefully established to minimize the occurrence of both false positive and false negative results.

Retention time windows are established by injecting all standard mixes three times over the course of 72 hours. The width of the retention time window for each analyte, surrogate, and major constituent in multi-component analytes is defined as ± 3 times the standard deviation of the mean absolute retention time or 0.03 minutes, whichever is greater.

Establish the center of the retention time window for each analyte and surrogate by using the absolute retention time for each analyte and surrogate from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.

Peak identification is based on the retention time of a peak falling within the retention time window for a given analyte. Time reference peaks (surrogates) are used to correct for run-to-run variations in retention times due to temperature, flow, or injector fluctuations.

The retention time windows should be used as a guide for identifying compounds; however, the experience of the analyst should weigh heavily in the interpretation of the chromatograms. The analyst should monitor the retention times of known peaks (standards and surrogates) throughout an instrument run as an indication of instrument performance.

Because calculated retention time windows are generally very tight (less than ± 0.03 minutes), the retention time windows for the data

processing method are generally set wider than the calculated window. This is done to ensure that the software does not miss any potential “hits”. The analyst will then review these “hits” and determine if the retention times are close enough to the retention time of the target analyte to positively identify the peak or to require confirmation.

7.4.2 Daily Calibration Procedures

Prime the GC by injecting a conditioning standard; this is a pesticide standard that is approximately 20 times the concentration of the mid-level standard. This will aid in deactivating the injection port and column.

Analyze a DDT/Endrin breakdown standard as described in section 7.4.1.1. This standard must be analyzed at the start of each 12-hour shift.

Analyze a continuing calibration verification standard (section 7.4.3) for the single peak pesticides. Then analyze the Technical Chlordane and Toxaphene standards that are calibrated at a single concentration level. The single point standards must be analyzed every 12 hours; they do not have to be analyzed at the same frequency as the CCV standard.

For DoD QSM projects the Technical Chlordane and Toxaphene standards must be analyzed at the beginning of the 12-hour window. Additional standards may be analyzed through the run.

7.4.3 Continuing Calibration Verification (CCV)

Continuing calibration verification standards for the single peak pesticides are prepared at various concentrations; at least one CCV must be below the mid-point of the calibration curve. A continuing calibration standard must be analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally, a CCV must be analyzed after every 10 samples. If toxaphene or technical chlordane is known to be present at the site or if it is a DoD QSM project, the analyst must analyze additional CCVs for these analytes.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| should be $\leq 20\%$ for each analyte.

If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated. If the second standard meets criteria then the system is considered in control and results may be reported.

Rationale for second standard such as instrument maintenance, clipped column, remade standard, etc. must be documented in the run log or maintenance log. Reanalysis of second standard without valid rationale may require the analysis of a third standard (in which case both the second and third standard would have to pass).

NOTE: For any DoD QSM project, if the second standard meets criteria, then a third standard must be analyzed. If the third standard also meets criteria, then the system is considered in control and results may be reported.

If the $|\%D|$ is greater than 20%, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Under certain circumstances, the data may be reported. i.e. The CCV failed high, the associated QC passed, and the samples were ND.

NOTE: For any DoD QSM project, if samples must be reported with a target analyte having a $\%D > 20\%$, then the data must be qualified accordingly, regardless of whether the analyte was detected or not.

NOTE: Samples that are being reported to the State of California require that the $|\%D| \leq 15\%$ for each analyte.

NOTE: Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed, or the data must be qualified.

7.4.4 Sample Extract Analysis

7.4.4.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

- Conditioning Standard
- DDT/Endrin Breakdown Standard
- Initial Calibration Standards (or Initial CCV)
- Single Point Standards
- QC Extracts
- Sample Extracts
- CCV Standards

7.4.4.2 Four microliters (same amount as standards) of extract is injected into the GC by the autosampler. A split or splitless injection technique is used. The data system then records the resultant peak responses and retention times.

7.4.4.3 Tentative identification of an analyte occurs when the peaks from the sample extract fall within the established retention time windows for a calibrated compound on the primary column.

7.4.4.4 If the peaks of interest fall within the retention time windows on the confirmation column, the identification is confirmed. Quantitation of the analyte on the primary and confirmation column should agree within 40%. If the difference is greater than 40% and no obvious reason can

**CONTROLLED COPY
DO NOT DUPLICATE**

be found, the higher result should be reported and flagged as “estimated”; otherwise, the result from the primary column should be reported.

- 7.4.4.5 Pattern comparisons should also be used to aid in the identification of the multipeak analytes.
- 7.4.4.6 If the compound identification does not confirm on a dissimilar column, then the result should be reported as ND or “U”.
- 7.4.4.7 If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.
- 7.4.4.8 If peak identification is prevented by the presence of interferences, further cleanup may be required, or the extract must be diluted so that the interference does not mask any analytes.

7.5 Maintenance and Trouble Shooting

- 7.5.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.
- 7.5.2 All instrument maintenance must be documented in the appropriate “Instrument Repair and Maintenance” log. The log will include such items as problem, action taken, correction verification, date, and analyst.
- 7.5.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.
- 7.5.4 PC and software changes must be documented in the “Instrument Repair and Maintenance” log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of surrogates and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD).

9.1 Surrogates

- 9.1.1 Tetrachloro-m-xylene (TCMX) and Decachlorobiphenyl are used as the surrogate standards to monitor the efficiency of the extraction and clean-up procedures.

A known amount of surrogate standard is added to each sample including the QC set prior to extraction. The percent recovery for each surrogate is calculated as follows:

$$\% \text{ Recovery} = (\text{Sample Amount} / \text{Amount Spiked}) \times 100$$

The percent recovery must fall within the established control limits for both surrogates for the results to be acceptable.

- 9.1.2 If the surrogate recoveries are not within the established control limits, the following are required.
- 9.1.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, surrogate solutions or internal standards. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.
- 9.1.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.
- 9.1.2.3 If no problem is found, reanalyze the sample. **NOTE: If the recoveries are high and the sample is non-detect, then re-extraction may not be necessary; however, the resulting data must be qualified accordingly.** If there is insufficient sample for re-extraction, reanalyze the sample and footnote this on the report.
- 9.1.2.4 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Surrogates from both sets of analysis must be reported on the final report.

9.2 Method Blank

- 9.2.1 The method blank is either de-ionized water or sodium sulfate (depending upon sample matrix) to which the surrogate standard has been added. The method

blank is then extracted and taken through all cleanup procedures along with the other samples to determine any contamination from reagents, glassware, or high-level samples. The method blank must be free of any analytes of interest or interferences at $\frac{1}{2}$ the required LLOQ to be acceptable. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a "B" or "V" qualifier.

- 9.2.2 If the MB is contaminated but the samples are non-detect, then the source of contamination must be investigated and documented. The sample results can be reported without qualification. **NOTE: For samples reported to SC DHEC or DoD the associated sample results must still be reported with the B qualifier.**
- 9.2.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination must be investigated and documented. The samples results may be reported with the appropriate "B" or "V" qualifier. This must be approved by the department supervisor.
- 9.2.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination must be investigated and documented. The samples must be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

9.3 Blank Spike

- 9.3.1 The blank spike is either de-ionized water or sodium sulfate (depending upon sample matrix) to which the surrogate standard and spike standard have been added. The blank spike is then extracted and taken through all cleanup procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

$$\% \text{ Recovery} = (\text{Blank Spike Amount} / \text{Amount Spiked}) \times 100$$

The percent recovery for each analyte of interest should fall within the established control limits for the results to be acceptable. The large number of analytes in this method presents a substantial probability that a few of the analytes will fall outside of the established control limits. This may not indicate that the system is out of control; therefore, corrective action may not be necessary.

Upper and lower marginal exceedance (ME) limits can be established to determine when corrective action is necessary. A marginal exceedance in the Blank Spike is defined as a recovery being outside of 3 standard deviations but within 4 standard deviations of the mean.

The number of allowable marginal exceedances is based on the number of analytes in the Blank Spike. Marginal Exceedances must be random. If the same analyte exceeds the BS control limits repeatedly, it is an indication of a systematic problem and corrective action must be taken.

Marginal exceedances are not permitted for analytes that are deemed to be "Compounds of Concern" for a specific project. "Compounds of Concern" are different from "Target Compounds". "Target Compounds" are all analytes that are being reported for a site where "Compounds of Concern" are those analytes expected to be present at the site.

The number of allowable marginal exceedances is as follows:

- 1) 11-30 analytes in BS, 1 analyte allowed in ME range;
- 2) < 11 analytes in BS, no analytes allowed in ME range

NOTE: SC DHEC does not recognize the concept of Marginal Exceedances. Additionally, a secondary check against 70-130% limits must be performed for all analytes reported to SC DHEC.

- 9.3.2 If the blank spike recoveries are not within the established control limits, the following are required.
- 9.3.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, spike solutions or internal standards. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.
 - 9.3.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.
 - 9.3.2.3 Check to see if the recoveries that are outside of control limits are analytes of concern. If the analytes are not being reported, additional corrective action is not necessary, and the sample results can be reported without qualification.
 - 9.3.2.4 **If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable; however, the resulting data must be qualified accordingly.**
 - 9.3.2.5 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

- 9.3.2.6 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

9.4 Matrix Spike and Matrix Spike Duplicate

- 9.4.1 Matrix spike and spike duplicates are replicate sample aliquots to which the surrogate standard and spike standard have been added. The matrix spike and spike duplicate are then extracted and taken through all cleanup procedures along with the other samples to monitor the precision and accuracy of the extraction procedure. The percent recovery for each analyte is calculated as follows:

$$\% \text{ Recovery} = [(\text{Spike Amount} - \text{Sample Amount}) / \text{Amount Spiked}] \times 100$$

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

- 9.4.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, spike solutions or internal standards. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.4.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extract but are an indication of the sample matrix effects.

9.4.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

$$\text{RPD} = [| \text{MS Result} - \text{MSD Result} | / \text{Average Result}] \times 100$$

The RPD for each analyte should fall within the established control limits. If more than 33% of the RPDs fall outside of the established control limits, the MS and MSD should be reanalyzed to ensure that there was no injection problem. If upon

CONTROLLED COPY
DO NOT DUPLICATE

reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

10.0 CALCULATIONS

The concentration of each single peak pesticide or toxaphene (if using the total area technique) in the original sample is calculated as follows:

$$\text{Water (ug/l)} = (\text{CONC}_{\text{inst}}) \times (V_F / V_I) \times \text{DF}$$

$$\text{Soil (ug/kg)} = [(\text{CONC}_{\text{inst}}) \times (V_F / W_I) \times \text{DF}] / \% \text{solids}$$

CONC _{inst}	=	Instrument concentration calculated from the initial calibration using mean CF or curve fit.
DF	=	Dilution Factor
V _F	=	Volume of final extract (ml)
V _I	=	Volume of sample extracted (ml)
W _I	=	Weight of sample extracted (g)
%solids	=	Dry weight determination in decimal form

All soils are reported on a dry weight basis.

The amount of chlordane or toxaphene (if using the multipeak technique) in the samples is determined by averaging the concentration of the major peaks for each multipeak pesticide. The MS Chemstation software will automatically sum and average the peaks used for each multipeak pesticide.

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst should follow normal safety procedures as outlined in the SGS North America, Inc. Health and Safety Program and SGS Orlando SOP QA033 (Laboratory Safety Procedure), current revision. Safety glasses, lab coat, and appropriate gloves should be worn at all times when handling samples.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample must be treated as a potential health hazard. Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment must be used by all analysts.

11.2 Pollution Prevention

Waste solvents from the sample analysis and standards preparation are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

CONTROLLED COPY
DO NOT DUPLICATE

Sample Extracts are archived and stored for 60 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

SW846 Method 8000D Revision 4, July 2014

SW846 Method 8081B Revision 2, February 2007

DOD QSM 5.4, November 2021

ANALYSIS OF ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY, ELECTRON CAPTURE DETECTOR SOP Acknowledgement Form

I have read and understand this SOP. I will not knowingly deviate from this approved SOP without approval of the Department Supervisor, QA Officer, or Technical Director. If I notice any discrepancies between this SOP and the routine procedure, I will notify the Department Supervisor so that either the SOP or procedure can be changed. Furthermore, I understand that this SOP is property of SGS North America Inc. – Orlando and may not be **printed** nor duplicated in any manner.

Internal SOPs referenced within this SOP: OP008, OP009, GC001, QA020, QA029, QA033

Print Name	Signature	Date

Print the SOP Acknowledgement Form, sign, and submit to the SGS Orlando QA department.

CONTROLLED COPY
DO NOT DUPLICATE



ANALYSIS OF CHLORINATED HERBICIDES BY GAS CHROMATOGRAPHY, ELECTRON CAPTURE DETECTOR

Prepared by: Norm Farmer Date: 12/30/2020

Approved by: Naresh Jiawan Date: 12/30/2020

Annual Review

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Document Control

Issued to: QA Department - digital Date: 01/05/2021

Issued to: SVOC Department - digital Date: * 01/05/2021

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Effective 7 days after “*” date

**CONTROLLED COPY
DO NOT DUPLICATE**

TITLE: ANALYSIS OF CHLORINATED HERBICIDES BY GAS CHROMATOGRAPHY, ELECTRON CAPTURE DETECTOR

REFERENCES: SW846 8151A

REVISED SECTIONS: 1.1.2 and 7.4.1.2

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of specific chlorinated herbicides in water and solid matrices utilizing a gas chromatograph equipped with an electron capture detector.

1.1.2 The following compounds can be reported by this method:

Dalapon	Dicamba	Dichloroprop
2,4-D	2,4-DB	2,4,5-T
2,4,5-TP (Silvex)	Dinoseb	Pentachlorophenol
MCPP	MCPA	

1.1.3 The Lower Limit of Quantitation (LLOQ) or Reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. LLOQs may vary depending on matrix complications and volumes. LLOQs for the chlorinated herbicides are in the range of 0.1 to 2.5 ug/l for aqueous samples and 3.3 to 83 ug/kg for solid samples. LLOQs for MCPP and MCPA are in the range of 100 ug/l for aqueous samples and 3300 ug/kg for solid samples. Solid matrices are reported on a dry weight basis.

1.1.4 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the LLOQ. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported LLOQ.

1.1.5 The LLOQ for each analyte is evaluated on an annual basis for each matrix and instrument. The LLOQ verifications are prepared by spiking a clean matrix at 0.5 to 2 times the current LLOQ level. This LLOQ verification is carried through the same preparation and analytical procedures as the samples. Recovery of the analytes should be within the established limits. The DOD QSM requirements for Limit of Detection (LOD) and Limit of Quantitation (LOQ) verifications are different. See SOP QA020 for complete requirements for MDL, LOD, LOQ, and LLOQ.

**CONTROLLED COPY
DO NOT DUPLICATE**

1.1.6 Compounds detected at concentrations between the LLOQ and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the LLOQ be reported.

1.1.7 For DOD projects refer to QSM 5.0, Table 1; or QSM 5.x Table B-1 for additional method requirements and data qualifying guidance.

1.2 Summary

1.2.1 This method is adapted from SW846 method 8151A.

1.2.2 Samples are received, stored and extracted within the appropriate holding times.

1.2.3 Sample preparation is performed in accordance with SGS - Orlando SOP OP037 and OP038.

1.2.4 The extracts are analyzed on a gas chromatograph equipped with dual electron capture detectors.

1.2.5 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

2.1.1 Samples shall be collected in amber glass bottles with Teflon lined caps. One-liter or 250ml bottles are used for aqueous samples and 4oz jars are recommended for solid samples.

2.1.2 The samples must be protected from light and refrigerated at $\leq 6^{\circ}\text{C}$ from the time of collection until extraction. The extracts must be stored at $\leq 6^{\circ}\text{C}$ until analysis.

2.2 Holding Time

2.2.1 Aqueous samples must be extracted within 7 days of collection.

2.2.2 Solid and waste samples must be extracted within 14 days of collection.

2.2.3 Extracts must be analyzed within 40 days of extraction.

3.0 INTERFERENCES

3.1 Data from all blanks, samples, and spikes must be evaluated for interferences.

- 3.2 Method interferences may be caused by contaminants in solvents, reagents, or glassware. Interferences from phthalate esters can be eliminated by using plastic-free solvent containers and solvent rinsed glassware.
- 3.3 Other organic compounds, including organic acids, chlorinated phenols and phthalate esters may be co-extracted by this method.
- 3.4 Alkaline hydrolysis and subsequent extraction of the basic solution removes many chlorinated hydrocarbons and phthalate esters that might otherwise interfere with the electron capture analysis. However, hydrolysis may result in the loss of dinoseb and the formation of aldol condensation products if any residual acetone remains from the extraction of solids.
- 3.5 The herbicides, being strong organic acids, react readily with alkaline substances and may be lost during analysis. Therefore, glassware must be acid-rinsed and then rinsed to constant pH with organic-free reagent water. Sodium sulfate must be acidified.
- 3.6 Sample extracts must be dry prior to methylation or else poor recoveries will be obtained.

4.0 DEFINITIONS

- 4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.
- 4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).
- 4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all GC and HPLC methods, a CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.
- 4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.
- 4.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point must be at a level equal to or below the LLOQ.
- 4.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor must be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

- 4.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.
- 4.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.
- 4.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.
- 4.10 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.
- 4.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.
- 4.12 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 REAGENTS

- 5.1 Hexane – pesticide grade or equivalent
- 5.2 Herbicide stock standards – Traceable to Certificate of Analysis
- 5.3 Surrogate standard – DCAA

6.0 APPARATUS

- 6.1 Gas Chromatograph – Agilent Technologies 6890 or 7890 with 7683 Autosampler

Suitable gas chromatograph equipped with a split-splitless injection port and electron capture detectors.

Autosampler allows for unattended sample and standard injection throughout the analytical run.
- 6.2 Data System – Agilent Technologies MS Chemstation rev. DA 03.0x or EA 02.0x.

- 6.2.1 A computer system interfaced to the gas chromatograph that allows for the continuous acquisition and storage of all data obtained throughout the duration of the chromatographic program.
- 6.2.2 Data is archived to a backup server for long term storage.
- 6.3 Dual CLP/CLP2 Column or equivalent: 30m X 0.32mm X 0.32/0.25um
- 6.4 Suitable gas-tight syringes and class "A" volumetric glassware for dilutions of standards and extracts.

7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified reference standards. All standards must be logged in the Semivolatile Standards Logbook. All standards shall be traceable to their original source. The standards must be stored at $\leq 6^{\circ}\text{C}$, or as recommended by the manufacturer. Calibration levels, spike and surrogate concentrations, preparation information, and vendor part numbers can be found in the GC STD Summary in the Active SOP directory.

7.1.1 Stock Standard Solutions

Stock standards are available from several commercial vendors. All vendors must supply a "Certificate of Analysis" with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor's expiration date. Once opened, the hold time is reduced to one year or the vendor's expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with hexane. The hold time for intermediate standards is six months or the vendor's expiration date (whichever is shorter). Intermediate standards may need to be remade if comparison to other standards indicates analyte degradation or concentration changes.

7.1.3 Calibration Standards

Calibration standards for the herbicides are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. The low standard is at a concentration at or below the LLOQ and the remaining standards define the working range of the detector.

Calibration standard concentrations for the herbicides are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 Gas Chromatograph Conditions

1ul autosampler injection

Carrier gas – UHP Hydrogen (5.0 ml/min constant flow)

Detector gas – UHP Nitrogen (45 - 90 ml/min)

Injection port temperature – 250 °C Detector temperature – 325 °C

Oven program – 55 °C for 0.5 minute
35 °C/min to 190 °C for 1 minute
20 °C/min to 300 °C for 1 minute

GC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.3 Sample Preparation

7.3.1 Water Samples

A 250ml or 1000ml aliquot of sample is extracted with diethyl ether utilizing separatory funnel extraction. The extract is concentrated, esterified, and brought to 5.0ml volume with hexane.

7.3.2 Solid Samples

A 15-gram aliquot of sample is extracted with hexane and acetone utilizing a microwave extractor. The extract is concentrated, esterified, and brought to 5.0ml volume with hexane.

7.4 Gas Chromatographic Analysis

Instrument calibration consists of two major sections:

Initial Calibration Procedures
Continuing Calibration Verification

7.4.1 Initial Calibration Procedures

Before samples can be run, the chromatographic system must be calibrated, and retention time windows must be determined.

7.4.1.1 External Standard Calibration

A minimum 5-point calibration curve is created for the herbicides and DCAA. SGS Orlando routinely performs a 6-point calibration to maximize the calibration range.

CONTROLLED COPY
DO NOT DUPLICATE

The low point may be omitted from the calibration table for any compound with an LLOQ set at the level two standard. Additionally, the high point may be omitted for any compound that exhibits poor linearity at the upper end of the calibration range.

An entire level may be omitted provided that a minimum of 5 points remain. There must be technical justification to omit an entire level. This must be documented in the run log.

Historically, many analytical methods have relied on linear models of the calibration relationship, where the instrument response is directly proportional to the amount of a target compound. The linear model has many advantages including simplicity and ease of use. However, given the advent of new detection techniques and because many methods cannot be optimized for all the analytes to which they may be applied, the analyst is increasingly likely to encounter situations where the linear model neither applies nor is appropriate. The option of using non-linear calibration may be necessary to address specific instrumental techniques. However, it is not EPA's intent to allow non-linear calibration to compensate for detector saturation or avoid proper instrument maintenance.

NOTE: Because of this concern, select programs including SC DHEC do not support the use of non-linear regressions.

Calibration factors (CF) for the herbicides and surrogates are determined at each concentration by dividing the area (or height) of each compound by the concentration of the standard.

The mean CF and standard deviation of the CF are determined for each analyte. The percent relative standard deviation (%RSD) of the calibration factors is calculated for each analyte as follows:

$$\%RSD = (\text{Standard Deviation of CF} \times 100) / \text{Mean CF}$$

If the $\%RSD \leq 20\%$, linearity through the origin can be assumed and the mean CF can be used to quantitate target analytes in the samples. Alternatively, a calibration curve of response vs. amount can be plotted. This method allows for the use of average response factors, linear regressions, and non-linear regressions. Linear regressions may be unweighted or weighted as $1/x$ or $1/x^2$. If the correlation coefficient (r) is ≥ 0.995 ($r^2 \geq 0.990$) then the curve can be used to quantitate target analytes in the samples. Regardless of which calibration model is chosen, the laboratory should visually inspect the curve plots to see how the individual calibration points compare to the plot.

Alternatively, either of the two techniques described below may be used to determine whether the calibration function meets acceptable criteria. These involve refitting the calibration data back to the model. Both %

CONTROLLED COPY
DO NOT DUPLICATE

Error and Relative Standard Error (RSE) evaluate the difference between the measured and the true amounts or concentrations used to create the model.

Calculation of the % Error

$$\% \text{ ERR} = (x_i - x'_i) / x_i * 100$$

x'_i = Measured amount of analyte at calibration level i, in mass or concentration units.

x_i = True amount of analyte at calibration level i, in mass or concentration units.

Percent error between the calculated and expected amounts of an analyte should be $\leq 30\%$ for all standards. For some data uses, $\leq 50\%$ may be acceptable for the lowest calibration point.

Calculation of Relative Standard Error (%RSE)

$$RSE = 100 \times \sqrt{\sum_{i=1}^n \left[\frac{x'_i - x_i}{x_i} \right]^2 / (n - p)}$$

x'_i = Measured amount of analyte at calibration level i, in mass or concentration units.

x_i = True amount of analyte at calibration level i, in mass or concentration units.

p = Number of terms in the fitting equation.
(average = 1, linear = 2, quadratic = 3)

n = Number of calibration points.

The %RSE acceptance limit criterion is $\leq 20\%$.

7.4.1.2 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV must be prepared from a second source at a mid-range concentration.

The %D for all analytes of interest should be $\leq 15\%$. If the ICV does not meet this criteria, a second standard should be prepared. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not

**CONTROLLED COPY
DO NOT DUPLICATE**

meet criteria, analyze an ICV prepared from a third source or lot. Determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

NOTE: For any DoD QSM project, the %D for all target analytes should be $\leq 20\%$. If samples must be analyzed with a target analyte having a %D $> 20\%$, then the data must be qualified accordingly.

If the ICV still does not meet criteria, determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

7.4.1.3 Retention Time Windows

Retention time windows must be established whenever a new column is installed in an instrument or whenever a major change has been made to an instrument.

Retention time windows are crucial to the identification of target compounds. Absolute retention times are used for compound identification in all GC and HPLC methods that do not employ internal standard calibration. Retention time windows are established to compensate for minor shifts in absolute retention times that result from normal chromatographic variability. The width of the retention time window should be carefully established to minimize the occurrence of both false positive and false negative results.

Retention time windows are established by injecting all standard mixes three times over the course of 72 hours. The width of the retention time window for each analyte, surrogate, and major constituent in multi-component analytes is defined as ± 3 times the standard deviation of the mean absolute retention time or 0.03 minutes, whichever is greater.

Establish the center of the retention time window for each analyte and surrogate by using the absolute retention time for each analyte and surrogate from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.

Peak identification is based on the retention time of a peak falling within the retention time window for a given analyte. Time reference peaks (surrogates) are used to correct for run-to-run variations in retention times due to temperature, flow, or injector fluctuations.

The retention time windows should be used as a guide for identifying compounds; however, the experience of the analyst should weigh heavily in the interpretation of the chromatograms. The analyst should

monitor the retention times of known peaks (standards and surrogates) throughout an instrument run as an indication of instrument performance.

Because calculated retention time windows are generally very tight (less than ± 0.03 minutes), the retention time windows for the data processing method are generally set wider than the calculated window. This is done to ensure that the software does not miss any potential "hits". The analyst will then review these "hits" and determine if the retention times are close enough to the retention time of the target analyte to positively identify the peak or to require confirmation.

7.4.2 Continuing Calibration Verification (CCV)

Continuing calibration verification standards for the herbicides are prepared at various concentrations; at least one CCV must be below the mid-point of the calibration curve. A continuing calibration standard must be analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally, a CCV must be analyzed after every 10 samples.

The percent difference (%D) for each analyte of interest will be monitored. The $|\%D|$ should be $\leq 15\%$ for each analyte.

If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated. If the second standard meets criteria, then the system is considered in control and results may be reported.

Rationale for second standard such as instrument maintenance, clipped column, remade standard, etc. must be documented in the run log or maintenance log. Reanalysis of second standard without valid rationale may require the analysis of a third standard (in which case both the second and third standard would have to pass).

NOTE: For any DoD QSM project, if the second standard meets criteria, then a third standard must be analyzed. If the third standard also meets criteria, then the system is considered in control and results may be reported.

If the $|\%D|$ is greater than 15%, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Under certain circumstances, the data may be reported. i.e. The CCV failed high, the associated QC passed, and the samples were ND.

NOTE: For any DoD QSM project, the %D for all target analytes should be $\leq 20\%$. If samples must be reported with a target analyte having a $\%D > 20\%$, then the data must be qualified accordingly, regardless of whether the analyte was detected or not.

NOTE: Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed, or the data must be qualified.

7.4.3 Sample Extract Analysis

7.4.3.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

Conditioning Standard
Initial Calibration Standards (or Initial CCV)
QC Extracts
Sample Extracts
CCV Standards

7.4.3.2 One microliter (same amount as standards) of extract is injected into the GC by the autosampler. A splitless injection technique is used. The data system then records the resultant peak responses and retention times.

7.4.3.3 Tentative identification of an analyte occurs when the peaks from the sample extract fall within the established retention time windows for a calibrated compound on the primary column.

7.4.3.4 If the peaks of interest fall within the retention time windows on the confirmation column, the identification is confirmed. Quantitation of the analyte on the primary and confirmation column should agree within 40%. If the difference is greater than 40% and no obvious reason can be found, the higher result should be reported and flagged as "estimated"; otherwise, the result from the primary column should be reported.

7.4.3.5 If the compound identification does not confirm on a dissimilar column, then the result should be reported as ND or "U".

7.4.3.6 If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.

7.4.3.7 If peak identification is prevented by the presence of interferences, further cleanup may be required, or the extract must be diluted so that the interference does not mask any analytes.

7.5 Maintenance and Trouble Shooting

- 7.5.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.
- 7.5.2 All instrument maintenance must be documented in the appropriate "Instrument Repair and Maintenance" log. The log will include such items as problem, action taken, correction verification, date, and analyst.
- 7.5.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.
- 7.5.4 PC and software changes must be documented in the "Instrument Repair and Maintenance" log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of surrogates and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD).

9.1 Surrogates

- 9.1.1 DCAA (2,4-Dichlorophenylacetic acid) is used as the surrogate standard to monitor the efficiency of the extraction and clean-up procedures.

A known amount of surrogate standard is added to each sample including the QC set prior to extraction. The percent recovery for each surrogate is calculated as follows:

$$\% \text{ Recovery} = (\text{Sample Amount} / \text{Amount Spiked}) \times 100$$

The percent recovery must fall within the established control limits for the results to be acceptable.

CONTROLLED COPY
DO NOT DUPLICATE

- 9.1.2 If the surrogate recoveries are not within the established control limits, the following are required.
- 9.1.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or surrogate solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.
 - 9.1.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.
 - 9.1.2.3 If no problem is found, reanalyze the sample. **NOTE: If the recoveries are high and the sample is non-detect, then re-extraction may not be necessary; however, the resulting data must be qualified accordingly.** If there is insufficient sample for re-extraction, reanalyze the sample and footnote this on the report.
 - 9.1.2.4 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Surrogates from both sets of analysis must be reported on the final report.

9.2 Method Blank

- 9.2.1 The method blank is either de-ionized water or acidified sodium sulfate (depending upon sample matrix) to which the surrogate standard has been added. The method blank is then extracted and taken through all cleanup procedures along with the other samples to determine any contamination from reagents, glassware, or high-level samples. The method blank must be free of any analytes of interest or interferences at ½ the required LLOQ to be acceptable. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a "B" or "V" qualifier.
- 9.2.2 If the MB is contaminated but the samples are non-detect, then the source of contamination must be investigated and documented. The sample results can be reported without qualification. **NOTE: For samples reported to SC DHEC or DoD the associated sample results must still be reported with the B qualifier.**
- 9.2.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination must be investigated and documented. The samples results may be reported with the appropriate "B" or "V" qualifier. This must be approved by the department supervisor.

- 9.2.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination must be investigated and documented. The samples must be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

9.3 Blank Spike

- 9.3.1 The blank spike is either de-ionized water or acidified sodium sulfate (depending upon sample matrix) to which the surrogate standard and spike standard have been added. The blank spike is then extracted and taken through all cleanup procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

$$\% \text{ Recovery} = (\text{Blank Spike Amount} / \text{Amount Spiked}) \times 100$$

The percent recovery for each analyte of interest should fall within the established control limits for the results to be acceptable.

NOTE: A secondary check against 70-130% limits must be performed for all analytes reported to SC DHEC.

- 9.3.2 If the blank spike recoveries are not within the established control limits, the following are required.
- 9.3.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, spike solutions or internal standards. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.
 - 9.3.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.
 - 9.3.2.3 Check to see if the recoveries that are outside of control limits are analytes of concern. If the analytes are not being reported, additional corrective action is not necessary, and the sample results can be reported without qualification.
 - 9.3.2.4 **If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable; however, the resulting data must be qualified accordingly.**
 - 9.3.2.5 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

**CONTROLLED COPY
DO NOT DUPLICATE**

- 9.3.2.6 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

9.4 Matrix Spike and Matrix Spike Duplicate

- 9.4.1 Matrix spike and spike duplicates are replicate sample aliquots to which the surrogate standard and spike standard have been added. The matrix spike and spike duplicate are then extracted and taken through all cleanup procedures along with the other samples to monitor the precision and accuracy of the extraction procedure. The percent recovery for each analyte is calculated as follows:

$$\% \text{ Recovery} = [(\text{Spike Amount} - \text{Sample Amount}) / \text{Amount Spiked}] \times 100$$

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

- 9.4.2 If the matrix spike recoveries are not within the established control limits, the following are required.

- 9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, spike solutions or internal standards. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.
- 9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.
- 9.4.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extract but are an indication of the sample matrix effects.

9.4.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

$$\text{RPD} = [|\text{MS Result} - \text{MSD Result}| / \text{Average Result}] \times 100$$

The RPD for each analyte should fall within the established control limits. If more than 33% of the RPDs fall outside of the established control limits, the MS and MSD should be reanalyzed to ensure that there was no injection problem. If upon

CONTROLLED COPY
DO NOT DUPLICATE

reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

10.0 CALCULATIONS

The concentration of each chlorinated herbicide in the original sample is calculated as follows:

$$\text{Water (ug/l)} = (\text{CONC}_{\text{inst}}) \times (V_F / V_I) \times \text{DF}$$

$$\text{Soil (ug/kg)} = [(\text{CONC}_{\text{inst}}) \times (V_F / W_I) \times \text{DF}] / \% \text{solids}$$

CONC _{inst}	=	Instrument concentration calculated from the initial calibration using mean CF or curve fit.
DF	=	Dilution Factor
V _F	=	Volume of final extract (ml)
V _I	=	Volume of sample extracted (ml)
W _I	=	Weight of sample extracted (g)
%solids	=	Dry weight determination in decimal form

All soils are reported on a dry weight basis.

If calibration standards have been prepared in the same manner as the samples (e.g., as acid herbicides and have undergone esterification) then the calculation of concentration above should be used. However, if the calibration is performed using standards made from methyl ester compounds (compounds not esterified by application of this method) then the calculation of concentration must include a correction for the molecular weight of the methyl ester versus the acid herbicide. This correction may be accounted for in the calibration table. See the GC STD Summary for the corrected concentrations.

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst must follow normal safety procedures as outlined in the SGS Health and Safety Program, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample must be treated as a potential health hazard. Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment must be used by all analysts.

11.2 Pollution Prevention

Waste solvents from the sample analysis and standards preparation are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

Sample Extracts are archived and stored for 60 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

SW846 Method 8000D Revision 4, July 2014

SW846 Method 8151A Revision 1, December 1996

ANALYSIS OF CHLORINATED HERBICIDES BY GAS CHROMATOGRAPHY, ELECTRON CAPTURE DETECTOR

SOP Acknowledgement Form

I have read and understand this SOP. I will not knowingly deviate from this approved SOP without approval of the Department Supervisor, QA Officer, or Technical Director. If I notice any discrepancies between this SOP and the routine procedure, I will notify the Department Supervisor so that either the SOP or procedure can be changed. Furthermore, I understand that this SOP is property of SGS North America Inc. – Orlando and may not be printed nor duplicated in any manner.

Internal SOPs referenced within this SOP: OP037, OP038, GC001, QA020, QA029

Print Name	Signature	Date

Print the SOP Acknowledgement Form, sign, and submit to the SGS Orlando QA department.

CONTROLLED COPY
DO NOT DUPLICATE



DIGESTION OF WATER SAMPLES FOR ICP/ICPMS ANALYSIS

Prepared by: David Metzgar III Date: 04/13/2022

Approved by: Svetlana Izosimova Date: 04/20/2022

Annual Review

Reviewed by: Svetlana Izosimova Date: 05/26/2023

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Document Control

Issued to: QA Department - Digital Date: 04/20/2022

Issued to: Metals - Digital Date: * 04/20/2022

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Effective 7 days after "*" date

**CONTROLLED COPY
DO NOT DUPLICATE**

TITLE: DIGESTION OF WATER SAMPLES FOR ICP ANALYSIS

REFERENCES:

TNI 2016
DoD QSM 5 Series
SW846 3010A
EPA 200.7, Revision 4.4, 1994
EPA 200.8, Revision 5.4, 1994
UCMR 5.0, Version 1, December 2020

1.0 SCOPE AND APPLICATION, SUMMARY

This method is applicable for the digestion of aqueous samples, TCLP extracts and wastes that contain small amounts of suspended solids. After digestion, the samples can be analyzed by ICP. The digestion methods described in this SOP are based upon SW846 method 3010A, EPA 200.7, revision 4.4, 1994 and EPA 200.8, revision 5.4, 1994 digestion methods.

Reduced volume versions of methods 200.7, Revision 4.4 1994 and method 200.8, Rev.5.4 1994 are in use by SGS - Orlando. This approach that uses the same reagents and molar ratios is acceptable by the regulatory agents provided it meets the quality control and performance requirements stated in the method. Method EPA 200.7 and EPA 200.8 have been modified within the flexibility allowed in 40CFR136.6.

SW-846 methods, with the exception of required method use for the analysis of method-defined parameters, are intended to be guidance methods which contain general information on how to perform an analytical procedure or technique which a laboratory can use as a basic starting point for generating its own detailed Standard Operating Procedure (SOP), either for its own general use or for a specific project application. The performance data included in this method are for guidance purposes only and are not intended to be and must not be used as absolute QC acceptance criteria for purposes of laboratory accreditation.

2.0 PRESERVATION AND BOTTLEWARE

All samples should be preserved with nitric acid to a pH of <2 at the time of collection. All sample pH are checked in sample receiving and within the metals department. Samples that are received with a pH >2 must be preserved to pH <2 and held for 24 hours prior to metals digestion to dissolve any metals that absorb to the container walls. Refer to SOP SAM101, current revision for further instruction.

Final pH of TCLP extracts are checked and recorded in SGS - Orlando Extractions Department. Please refer to TCLP (1311) fluid determination logbook and SPLP (1312) fluid determination logbook for further information. TCLP extracts received from SGS - Orlando Extractions Department are prepared as soon as possible, no longer than 24 hours from time of receipt. If

**CONTROLLED COPY
DO NOT DUPLICATE**

precipitation is observed during the sample preparation process the sample(s) are immediately re-prepped on dilution until no precipitation is observed.

Samples received for dissolved metals analysis should be filtered and preserved to pH<2 as soon as possible and held for 24 hours prior to digestion. Refer to SGS - Orlando Sample Filtration Logbook for further information.

All bottleware used by SGS - Orlando is tested for cleanliness prior to shipping to clients. Analysis results must be < ½ the reporting limit to be acceptable. Refer to SOP SAM104, current revision for further instruction.

3.0 HOLDING TIME AND STORAGE

All samples should be digested and analyzed within 6 months of the time collection.

Aqueous samples do not require refrigeration.

4.0 REPORTING and METHOD DETECTION LIMITS

See analytical SOP MET100, current revision for further information.

5.0 INTERFERENCE

Organic substances in a matrix may cause interference if the sample is not digested rigorously enough. In addition, high levels of acids in the final digestate may cause interference in the analysis. This interference can be avoided by choosing the appropriate digestion method and by bringing the sample to an appropriate final volume. For a discussion of other interference, refer to specific analytical methods.

6.0 APPARATUS

The apparatus needed for this digestion procedure are listed below.

6.1 Automatic repipettor(s)

6.2 Fisher Brand 0.45 micron (um) filter or equivalent. Filter lots are checked for cleanliness through the Method Blank process. All Method Blank analytical results must be <1/2 the reporting limit to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated filters must be re-filtered through acceptable filters.

- 6.3 Environmental Express watch glasses or equivalent.
- 6.4 Thermometer(s)- capable of measuring a temperature of at least 125°C, and checked against NIST traceable thermometers. Refer to SOP QA002, current revision for further information.
- 6.5 Environmental Express Hot Block or equivalent capable of maintaining a temperature of 90-95°C.
- 6.6 Environmental Express digestion vessels or equivalent, 65ml capacity. Each Lot of digestion tubes comes with a Certificate of Analysis which demonstrates cleanliness as well as volume accuracy at graduations. If alternate digestion tubes are used and they do not come with a certificate of cleanliness then the lot is checked prior to usage and data kept on file. Please refer to Digestion Tube Certificate Logbook for further information. Tube Lots are also checked through the Method Blank process. All Method Blank analytical results must be < ½ reporting limit to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Re-digestion is required for all samples prepared with the contaminated tube lot.
- 6.7 Fisher Brand disposable 10 ml syringes or equivalent. Syringe lots are checked for cleanliness through the Method Blank process. All Method Blank results must be < ½ reporting limit to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated syringes must be re-filtered through acceptable syringes.
- 6.8 Eppendorf Pipette (s) - Pipette (s) are checked daily for accuracy and to ensure they are in good working condition prior to use. Volumes are checked at 100% of maximum volume (nominal volume). Pipettes are checked within the metals department and results are stored electronically in the "Pipette Calibration Log". Refer to SOP QA006, current revision for further information regarding pipette calibration. BIAS: mean must be within 2% of nominal volume. Precision: RSD must be \leq 1% of nominal volume based on three replicates.
- 6.9 Class A volumetric flask (s)
- 6.10 Class A volumetric pipette (s)
- 6.11 Class A graduated cylinder (s)

7.0 REAGENTS

All chemicals listed below are trace metal grade unless otherwise specified. These standards and reagents must be accompanied by the Certificate of Analysis (CoA). The CoA is examined for accuracy and completeness of the information, including verification of the reagent/standard normality/concentration. For further details refer to SOP QA017, current revision. Refer to Acid Certificate of Analysis logbook for Certificates of Analysis and compliance with the specifications of the grade listed.

- 7.1 Hydrochloric acid. Fisher Trace metal grade or equivalent
- 7.2 Nitric acid. Fisher Trace metal grade or equivalent
- 7.3 Reagent Water – Water that has been generated by any method which shall meet method specified requirements. TNI 2016 definition. Reagent water is used exclusively for laboratory purposes. Refer to SOP QA037, current revision for more information regarding testing and monitoring.
- 7.4 Metals spiking solutions:

Commercially purchased 100ppm Inorganic Ventures Ag stock spiking solution (catalog MSAG-100PPM or equivalent)

Commercially purchased Environmental Express Multi-element spiking solution (catalog # CLP-SS or equivalent) made with 5% HNO₃ and a trace of HF.

Commercially purchased Inorganic Ventures 5000 mg/l Mineral solution (catalog # Multi-B or equivalent)

100ppm Mo, Sr, Sn, Ti prepared spiking solution. Please refer to electronic standard preparation logbook for all pertinent information.

Multi element ICPMS prepared spiking solution. Please refer to electronic standard preparation logbook for all pertinent information.

8.0 PROCEDURE

SW846-3010A

- 8.1 Shake sample vigorously to ensure thorough mixing. Measure out 50 ml of each sample into a labeled digestion vessel. The sample may be measured by using a Class A graduated cylinder or by using the calibrated digestion tube. Make sure that the sample identifications are accurately recorded on the digestion vessels and in the electronic sample digestion log. In addition to the samples, a matrix spike (MS), matrix spike duplicate (MSD), duplicate, blank spike and a method blank should be set up with each batch of 20 samples. A serial dilution, as well as a post digestion spike are batched in LIMS and performed at the analytical bench. For the method blank and blank spike, 50 ml of DI water should be used. Refer to Table 1 and 2 for the spiking solution levels to use for each MS, MSD and blank spike.
 - 8.1.1 When preparing TCLP samples use 5.0mls initial volume of leachate and bring to a final volume of 50mls using DI water. Also prepare an additional leachate blank and leachate blank spike from the extraction fluid used for the samples. See section 8.7 and 8.8 of current MET SOP 100 for acceptance criteria.

CONTROLLED COPY
DO NOT DUPLICATE

8.1.2 When preparing filtered samples for dissolved metals, an additional method blank must be prepared. This is performed to ensure there is no cross contamination from the filter media into the samples. The method blank must be filtered through the same filter media as the samples. See section 8.7 of current METSOP 100 for acceptance criteria.

8.2 Pre heat the Hot Block to 90 to 95°C.

Add 1.5 ml of concentrated nitric acid to all quality control and samples.

8.3 Place the labeled digestion vessels into the heating apparatus and cover with elevated or ribbed watch glasses. Heat the samples at a gentle reflux for 2 hours.

Allow samples to cool.

8.4 Uncover all samples and matrix QC. Add an additional 1.5-ml of concentrated nitric acid to all quality control and samples. Continue heating, adding additional acid if necessary, until the digestion is complete, generally indicated when the digestate is light in color or does not change in appearance with continued refluxing.

Allow samples to cool.

8.5 Add 2.5 ml of concentrated HCL to each sample and reflux for an additional 15 minutes. Allow samples to cool. Rinse digestion vessel walls with DI water.

8.6 Bring the samples to a final volume of 50.0 ml with DI water, cap and shake. The samples are now ready for analysis by ICP. If the sample contains particulate matter, it should be filtered along with the method blank and blank spike through a 0.45um syringe filter before analysis at the analytical bench.

Method EPA200.7 / 200.8 Digestion Procedure

8.7 Shake sample vigorously to ensure thorough mixing. Measure out 50 ml of each sample into a labeled digestion vessel. The sample may be measured by using a Class A graduated cylinder or by using the calibrated digestion tube. Make sure that the sample identifications are accurately recorded on the digestion vessels and in the electronic sample digestion log. In addition to the samples, a matrix spike (MS), matrix spike duplicate (MSD), duplicate, blank spike and a method blank should be set up with each batch of 20 samples. A serial dilution, as well as a post digestion spike are batched in LIMS and performed at the analytical bench. For the method blank and blank spike, 50 ml of DI water should be used. Refer to Table 1 and 2 for the spiking solution levels to use for each MS, MSD and blank spike.

For proper heating adjust the temperature control of the hot block such that an uncovered digestion vessel containing 50 mL of water placed in the center of the hot block can be maintained at a temperature approximately but no higher than 85°C. (Once the digestion vessel is covered with a watch glass the temperature of the water will rise to approximately 95°C.)

CONTROLLED COPY
DO NOT DUPLICATE

8.7.1 Pre heat hot block to a temperature of 90-95° C. Add 0.5 mL concentrated nitric acid and 0.25mL of concentrated hydrochloric acid to all samples and matrix QC digestion vessels containing the measured volume of sample. Place the samples along with all associated matrix QC on the hot block for solution evaporation.

8.7.2 Gently heat the samples for 2 hours, reducing volume to approximately 10-20 ml. DO NOT BOIL.

8.7.3 Cover the digestion vessels with watch glasses and gently reflux for an additional 30 minutes.

Allow samples to cool.

8.7.4 Bring the samples to a final volume of 50.0 ml with DI water, cap and shake. The samples are now ready for analysis by ICP or ICPMS. If the sample contains particulate matter, it should be filtered along with the method blank and blank spike through a 0.45um syringe filter before analysis at the analytical bench.

9 QC REQUIREMENTS

For each digestion batch of 20 samples, a serial dilution (performed at analytical bench), a post digestion spike (performed at the analytical bench), a matrix spike, a matrix spike duplicate, a duplicate, a blank spike (LCS), and a method blank should be prepared. Re-digestion is suggested for QC that does not meet the SGS - Orlando QC limits. The appropriate lab supervisor or lab manager will notify the analyst of samples that need re-digestion. Please refer to TABLE 1 in this SOP for spiking volumes and concentrations. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements.

10 GLASSWARE CLEANING

All glassware should be washed with soap and tap water, rinsed with 5% nitric acid solution, and then rinsed at least 3 times with DI water. Refer to SOP GN196, current revision for further information regarding glassware cleaning.

11 DOCUMENTATION REQUIREMENTS

All digestion information should be documented in the Sample Digestion Logbook. The information required includes the sample identification (including the sample bottle number), the initial sample volume, and the final sample volume, the acids used (including lot number and manufacturer), the spiking solutions used, the digestion vessel lot number, the observed temperature, corrected temperature, the thermometer ID, analyst's signature, and the date of digestion. The analyst should write additional information such as unusual sample characteristics in the comment section.

12 SAFETY

- 12.1 The analyst should follow normal safety procedures as outlined in the SGS Health and Safety Program and SGS Orlando SOP QA033 (Laboratory Safety Procedure), current revision, which includes the use of safety glasses and lab coats. Gloves should be worn. In addition, all acids are corrosive and should be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor.
- 12.2 The toxicity or carcinogenicity of each reagent used in this method has not been precisely determined; however, each chemical should be treated as a potential health hazard. Exposure to these reagents should be reduced to the lowest possible level. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of data handling sheets should be made available to all personnel involved in these analyses.

13 POLLUTION PREVENTION AND WASTE MANAGEMENT

13.1 Pollution Prevention

Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids must be followed. All method users must be familiar with the waste management practices described in Section 13.2.

13.2 Waste Management

Individuals performing this method must follow established waste management procedures as described in the Sample and Laboratory Waste Disposal SOP SAM108, current revision. This document describes the proper disposal of all waste materials generated during the testing of samples.

14.0 GENERIC DEFINITIONS

- 14.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 24 hours whichever comes first.
- 14.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

- 14.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. A CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.
- 14.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.
- 14.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the reporting level.
- 14.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.
- 14.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the performance of a method in a given sample matrix.
- 14.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the precision and performance of a method in a given sample matrix.
- 14.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.
- 14.10 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.
- 14.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

15.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to method defined control limits. Statistical control limits are stored in the LIMS for QA purposes only. Additionally,

CONTROLLED COPY
DO NOT DUPLICATE

blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

16.0 Hot Block Maintenance

Clean surface area of hot block periodically to prevent sample and reagent build up on the surface of the block. If the hot block cannot maintain a temperature between 90-95 degree C or the user experiences any other type of mechanical or electronic error a service representative will need to be contacted. Any hot block that is not functioning properly must be tagged as "Out of Service".

Table 1: ICP Metals Spiking Levels
(Suggested levels, may vary depending on instrumentation used.)
Blank Spike, Matrix Spike, Matrix Spike Duplicate

ELEMENT	INITIAL CONC (ppm)	VOLUME USED (ml)	FINAL CONC (mg/l)	FINAL VOL. (ml)
Ba	200	0.50	2.0	50
Be	5	0.50	.05	50
Cd	5	0.50	.05	50
Cr	20	0.50	.20	50
Cu	25	0.50	.25	50
Co	50	0.50	0.50	50
Mn	50	0.50	0.50	50
V	50	0.50	0.50	50
Zn	50	0.50	0.50	50
As	200	0.50	2.0	50
Se	200	0.50	2.0	50
Pb	50	0.50	0.50	50
Tl	200	0.50	2.0	50
Sb	50	0.50	0.50	50
**Mo	100	0.25	0.50	50
**Sn	100	0.25	0.50	50
*Al	200/5000	0.5/0.25	27	50
*Fe	200/5000	0.5/0.25	26	50
*Mg	5000	0.25	25	50
*Ca	5000	0.25	25	50
*K	5000	0.25	25	50
*Na	5000	0.25	25	50
Ag	5	0.50	0.05	50
Ni	50	0.50	0.50	50
**Sr	100	0.25	0.50	50
**Ti	100	0.25	0.50	50

(*) Al, Fe, Mg, Ca, K, Na are from Multi-B (or equivalent)

(**) Mo, Sn, Sr, Ti are prepared from stock standards.

Remainder of elements from CLP-SS or equivalent

CONTROLLED COPY
DO NOT DUPLICATE

Table 2: ICPMS Metals Spiking Levels
(Suggested levels, may vary depending on instrumentation used.)
Blank Spike, Matrix Spike, Matrix Spike Duplicate

ELEMENT	INITIAL CONC (ppm)	VOLUME USED (ml)	FINAL CONC (mg/l)	FINAL VOL. (ml)
Ba	10	1.0	0.20	50
Be	10	1.0	0.20	50
Cd	10	1.0	0.20	50
Cr	10	1.0	0.20	50
Cu	10	1.0	0.20	50
Co	10	1.0	0.20	50
Mn	10	1.0	0.20	50
V	10	1.0	0.20	50
Zn	10	1.0	0.20	50
As	10	1.0	0.20	50
Se	10	1.0	0.20	50
Pb	10	1.0	0.20	50
Tl	10	1.0	0.20	50
Sb	10	1.0	0.20	50
Mo	10	1.0	0.20	50
Sn	10	1.0	0.20	50
*Al	5000	0.20	20	50
*Fe	5000	0.20	20	50
*Mg	5000	0.20	20	50
*Ca	5000	0.20	20	50
*K	5000	0.20	20	50
*Na	5000	0.20	20	50
**Ag	100	0.05	0.10	50
Ni	10	1.0	0.20	50
Sr	10	1.0	0.20	50
Ti	10	1.0	0.20	50

(*) Al, Fe, Mg, Ca, K, Na are from Multi-B (or equivalent)

(**) Ag from MSAG-100PPM or equivalent

Remainder of elements from ICPMS spiking solution.

**CONTROLLED COPY
DO NOT DUPLICATE**

REVISION HISTORY

Revision Date	Revision Number	Affected Section(s)	Revision Description
12/2020	17	“Revised Sections”	Added Revision History and removed Revised Sections. No other revisions necessary
4/13/2022	18	References	Added TNI 2016 and QSM 5 Series and UCMR 5
4/13/2022	18	1	Updated 200.7 1983 to EPA 200.7, rev 4.4 1994
4/13/2022	18	2	reformatted
4/13/2022	18	6.6	Added “If alternate digestion tubes are used and they do not come with a certificate of cleanliness then the lot is checked prior to usage and data kept on file.”
4/13/2022	18	7	Removed reference to ASTM water
4/13/2022	18	7.3	Added Reagent water
4/13/2022	18	8.1	Added “A serial dilution, as well as a post digestion spike are batched in LIMS and performed at the analytical bench.
4/13/2022	18	8.7	Added “A serial dilution, as well as a post digestion spike are batched in LIMS and performed at the analytical bench.
4/13/2022	18	8.7.2	Added “reducing volume to approximately 10-20 mls”
4/13/2022	18	8.7.3	Added “Cover the digestion vessels with watch glasses and gently reflux for an additional 30 minutes.”
4/13/2022	18	12	Update entire section
4/13/2022	18	Table 2	Remove soil spiking criteria
4/13/2022	18	General	Added SOP acknowledgement form with QA/SAM references

CONTROLLED COPY
DO NOT DUPLICATE

DIGESTION OF WATER SAMPLES FOR ICP/ICPMS ANALYSIS

SOP Acknowledgement Form

I have read and understand this SOP. I will not knowingly deviate from this approved SOP without approval of the Department Supervisor, QA Officer, or Technical Manager. If I notice any discrepancies between this SOP and the routine procedure, I will notify the Department Supervisor so that either the SOP or procedure can be changed. Furthermore, I understand that this SOP is property of SGS North America Inc. – Orlando and may not be **printed nor** duplicated in any manner.

Internal SOPs referenced within this SOP: QA006, QA017, QA033, QA037, QA002, SAM101, SAM104, SAM108, MET100, GN196

Print Name	Signature	Date

Print the SOP Acknowledgement Form, sign, and submit to the SGS Orlando QA department

**CONTROLLED COPY
DO NOT DUPLICATE**



METALS BY INDUCTIVELY COUPLED PLASMA – MASS SPECTROMETRY (ICP-MS)

Prepared by: Dave Metzgar Date: 04/06/2022

Approved by: Svetlana Izosimova Date: 04/20/2022

Annual Review

Reviewed by: Svetlana Izosimova Date: 05/26/2023

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Document Control

Issued to: QA Department - Digital Date: 04/20/2022

Issued to: Metals Department - Digital Date: * 04/20/2022

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Effective 7 days after “*” date

**CONTROLLED COPY
DO NOT DUPLICATE**

TITLE: METALS BY INDUCTIVELY COUPLED PLASMA – MASS SPECTROMETRY (ICP-MS)

REFERENCES:

TNI 2016 Standards
DoD QSM 5.0 - Series
SW846 6020B, Revision 2, July 2014.
EPA200.8, Revision 5.4, 1994.

Note: Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements. Also check with metals supervisor for additional information. Please refer to current version of DoD QSM 5 for quality control criteria.

Main Instrument: Agilent 7700x, serial # JP12151709
Auto-sampler: CETAC ASX500, serial # US091320A520

1.0 SCOPE AND APPLICATION

- 1.1 This method is applicable for the determination of total and dissolved metals in water samples and in waste extracts or in solid or aqueous digests. Please refer to table 1 for a list of reportable elements.

2.0 SUMMARY

- 2.1 Samples are prepared for analysis by digestion. Please refer to method specific digestion SOP's within the metals department for more information. The prepared samples are introduced into a radiofrequency plasma by pneumatic nebulization. There the energy transfer processes cause desolvation, atomization, and ionization. The ions are extracted from the plasma through a differentially pumped vacuum interface and separated on the basis of their mass to charge ratio by a quadrupole mass spectrometer. The ions transmitted through the quadrupole are detected by an electron multiplier and the ion information is processed by a data handling system.

3.0 REPORTING LIMIT(RL)

- 3.1 Reporting limits (RL) are based on the extraction procedure. Reporting limits may vary depending on matrix complications, volumes and by client needs, but the reporting limits must always be verified with a low check which meets the criteria outlined in this SOP. Solid matrices are reported on a dry weight basis. Refer to table 1 of this SOP for SGS - Orlando

**CONTROLLED COPY
DO NOT DUPLICATE**

typical reporting limits. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific reporting limits.

- 3.2 Method Detection Limit: MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is distinguishable from method blank results. Experimentally determine MDLs using the procedure specified in 40 CFR, Part 136, Appendix B, Rev. 2. For further details on the procedure refer to SOP QA020, current revision
- 3.3 Lower limit of quantitation check sample (LLOQ). The lower limit of quantitation check (LLQC) sample should be analyzed after establishing the lower laboratory reporting limits and on a quarterly basis to demonstrate the desired detection capability. The LLQC sample is carried through the entire preparation and analytical procedure. Lower limits of quantitation are verified when all analytes in the LLQC sample are detected within 20 percent of their true value.
- 3.4 Compounds detected at concentrations between the RL and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the RL be reported.
- 3.5 Instrument Detection Limits (IDL). IDL's should be completed upon initial instrument installation. SGS - Orlando does not report to IDL.

4.0 GENERIC DEFINITIONS

BATCH. A group of 20 samples or less that behaves similarly with respect to the sampling or the testing procedures being employed and which are processed as a unit within a 24 hour period. For QC purposes, if the number of samples in a group is greater than 20, then each group of 20 samples or less will all be handled as a separate batch.

CALIBRATION CHECK STANDARD. (CCV) calibration check standard is a mid-range calibration standard.

EXTERNAL CHECK STANDARD. (ICV) The external check standard is a standard from a separate source than the calibration curve that is used to verify the accuracy of the calibration standards.

SPIKE BLANK OR LAB CONTROL SAMPLE. Digest and analyze a laboratory control sample or spike blank with each set of samples. A minimum of one lab control sample or spike blank is required for every 20 sample batch.

MATRIX: The component or substrate (e.g., water, soil) which contains the analyte of interest.

MATRIX DUPLICATE: A duplicate sample is digested at a minimum of 1 in 20 samples. They are used to document the precision and bias of a method in a given sample matrix.

CONTROLLED COPY
DO NOT DUPLICATE

MATRIX SPIKE: The laboratory must add a known amount of each analyte to a minimum of 1 in 20 samples.

MATRIX SPIKE DUPLICATES: Intralaboratory split samples spiked with identical concentrations of target analyte(s). The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.

METHOD BLANK. The laboratory must digest and analyze a method blank with each set of samples. A minimum of one method blank is required for every 20 sample batch

REAGENT GRADE. Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents which conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.

STANDARD ADDITION. The practice of adding a known amount of an analyte to a sample immediately prior to analysis. It is typically used to evaluate interferences.

STANDARD CURVE: A plot of concentrations of known analyte standards versus the instrument response to the analyte. Calibration standards are prepared by successively diluting a standard solution to produce working standards which cover the working range of the instrument.

5.0 HEALTH & SAFETY

- 5.1 The analyst should follow normal safety procedures as outlined in the SGS Health and Safety Program and SGS Orlando SOP QA033 (Laboratory Safety Procedure), current revision, which includes the use of safety glasses and lab coats. Gloves should be worn. In addition, all acids are corrosive and should be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor.
- 5.2 The toxicity or carcinogenicity of each reagent used in this method has not been precisely determined; however, each chemical should be treated as a potential health hazard. Exposure to these reagents should be reduced to the lowest possible level. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of data handling sheets should be made available to all personnel involved in these analyses.

6.0 SAMPLE COLLECTION, PRESERVATION & HOLDING TIME

All samples should be preserved with nitric acid to a pH of <2 at the time of collection. All sample pH are checked in sample receiving and within the metals department. Samples that are received with a pH >2 must be preserved to pH <2 and held for 24 hours prior to metals digestion to dissolve any metals that absorb to the container walls. Refer to SOP SAM101, current revision for further instruction.

Samples received for dissolved metals analysis should be filtered and preserved to pH<2 as soon as possible and held for 24 hours prior to digestion. Refer to SGS - Orlando Sample Filtration Logbook for further information.

All soil samples must be stored in a refrigerator at $\leq 6^{\circ}\text{C}$ upon receipt. Refer to SOP SAM101, current revision for further instruction.

All bottle ware used by SGS - Orlando is tested for cleanliness prior to shipping to clients. Analysis results must be less than one half the reporting limit to be acceptable. Refer to SOP SAM104, current revision for further instruction.

7.0 INTERFERENCES

- 7.1 Several types of interferences can cause inaccuracies in trace metals determinations by ICP-MS. These interferences are discussed below.
- 7.2 Isobaric elemental interferences are caused by isotopes of different elements which form singly or doubly charged ions of the same nominal mass-to-charge ratio and which cannot be resolved by the mass spectrometer in use. If isobaric interferences are present in the ion being analyzed, then the data must be corrected by measuring the signal from another isotope of the interfering element and subtracting the appropriate signal ratio from the element of interest.
- 7.3 Abundance sensitivity is a property that defines the degree to which the wings of a mass peak contribute to adjacent masses and is affected by ion energy and quadrupole operating pressure. Wing overlap interferences may result when a small ion peak is being measured next to a large one. Spectrometer resolution should be adjusted to minimize these interferences.
- 7.4 Isobaric polyatomic ion interferences are caused by ions consisting of more than one atom which have the same nominal mass-to-charge ratio as the isotope of interest, and which cannot be resolved by the mass spectrometer in use. Refer to method 200.8, and 6020B for lists of common interferences and correction equations to be applied. If these interferences cannot be avoided by the use of different isotopes, then correction equations should be applied to the data. Alternatively, collision/reaction cell technology can be applied to physically and chemically remove interferences.
- 7.5 Physical interferences can occur during the transfer of the solution to the nebulizer (viscosity effects).
- 7.6 Memory interferences can be caused by buildup on the sampler and skimmer cones, and from buildup of sample material in the torch and spray chamber. Some elements, such as mercury, can suffer from severe memory effects. In that case, gold is added to the rinse solution to decrease the Hg rinse out time.
- 7.7 Interference correction equation procedure.

Interference correction equations are used to correct interference with target elements due to other elements or formation of polyatomic ions. Specify the elements related to the interference to be corrected. Isotope masses and isotope ratios are displayed in Mass table. Select the check boxes for the masses for which correction equations are set. Equations are displayed in the Equation table. Select the elements for which the correction equations are set. Select the masses for which the correction equations are set. Select positive or negative sign for the factor, enter masses in the Mass field and enter the factors of the correction equations in the Multiplier field. "OK" applies to settings and the specified interference correction equation is displayed in the "Select Elements on Periodic Table" dialog box.

8.0 APPARATUS

- 8.1 Currently in use is an Agilent 7700x ICP-MS with collision/reaction cell capacity and HMI (High matrix interface) and the associated autosampler.
- 8.2 Data system
 - 8.2.1 Microsoft Windows 7 Professional Version 2009
 - 8.2.2 Agilent Masshunter, Version B.01.03, Build 393.17, Patch 2, 2014
 - 8.2.3 Computer system interfaced with Agilent ICP-MS that allows continuous data acquisition and storage of all data obtained throughout the duration of the analytical run sequence. Data is backed up and archived for long-term storage
- 8.3 Class A volumetric glassware as needed.
- 8.4 Instrument autosampler tubes.
- 8.5 Polypropylene bottles for standard storage. These bottles must also be cleaned as outlined above.
- 8.6 Eppendorf Pipette (s) - Pipette (s) are checked daily for accuracy and to ensure they are in good working condition prior to use. Volumes are checked at 100% of maximum volume (nominal volume). Pipettes are checked within the metals department and results are stored electronically in the "Pipette Calibration Log". Refer to SOP QA006, current revision for further information regarding pipette calibration. BIAS: mean must be within 2% of nominal volume. Precision: RSD must be $\leq 1\%$ of nominal volume based on three replicates.
- 8.7 Fisher Brand 0.45 micron (μm) filter or equivalent. Filter lots are checked for cleanliness through the Method Blank process. All Method Blank analytical results must be less than one half the reporting limit to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated filters must be re-filtered through acceptable filters.

- 8.8 Fisher Brand disposable 10 ml syringes or equivalent. Syringe lots are checked for cleanliness through the Method Blank process. All Method Blank results must be less than one half the reporting limit to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated syringes must be re-filtered through acceptable syringes.
- 8.9 Polypropylene auto sampler tubes.

Note: All glassware must be washed with soap and tap water and then soaked in a 10% nitric acid bath for several hours. It must then be rinsed at least 3 times with distilled, deionized water.

9.0 REAGENTS AND STANDARDS

Please refer to electronic standard logbook for detailed information regarding standard preparation.

Note: All reagents can be scaled up or down proportionately if different final volumes are required. All chemicals listed below are reagent grade unless otherwise specified.

- 9.1 Reagent Water – Water that has been generated by any method which shall meet method specified requirements. TNI 2016 definition. Reagent water is used exclusively for laboratory purposes. Refer to SOP QA037, current revision for more information regarding testing and monitoring.
- 9.2 Hydrochloric acid, trace metals grade.
- 9.3 Nitric acid, trace metals grade. Note – ultra trace grade may be required if lower detection limits than normal are needed.
- 9.4 Standard stock solutions available from Inorganic Ventures, Ultra Scientific, VHGLaboratories or equivalent. Note: All standards must be ICP-MS quality standards or must be demonstrated to be free of interferences at the levels of use. Standards should come labeled with an expiration date and certificate of concentrations from the manufacturer. The certificate of concentrations is examined for accuracy and completeness of the information, including verification of the reagent/standard normality/concentration. If both of these items are not received, then the manufacturer should be contacted before use of the standard. For further details refer to SOP QA017, current revision.
- 9.5 Calibration Standards: These can be made up by diluting the stock solutions to the appropriate concentrations. Fresh calibration standards should be prepared a minimum of every two weeks. They must be monitored weekly for stability.
- 9.5.1 Standards and blanks should be made in a low acid matrix. Concentrations of 1 to 2 percent nitric acid and 0 to 0.5 percent hydrochloric acid are suggested, although any acid concentration that provides good analytical results may be used. High chloride concentrations may cause interferences so chloride concentrations should be limited. HCl may be omitted if silver and antimony are not elements of interest.

- 9.5.2 Refer to the electronic standard prep logbook for the make-up and concentrations of standards and stock solutions being used to calibrate the ICP-MS. Suggested standard levels are shown in Table 2.
- 9.6 Aglient P/A Factor and Tuning/Performance Check Solution. Mix 1.0 ml of PA Tuning 1 solution and 1.0 ml of PA Tuning 2 solution (available from Aglient, part number 5188-6524) and bring to 100 ml final volume. This final solution contains 200 ppb of As, Be, Cd, Zn; 100 ppb of Mg, Ni, and Pb; 50 ppb of Al, Ba, Bi, Co, Cr, Cu, In, Li⁶, Lu, Mn, Na, Sc, Sr, Th, Tl, U, and V; and 25 ppb of Y and Yb; 100 ppb of Ge, Mo, Pd, Ru, Sb, Sn ; and 50 ppb of Ir and Ti.
- 9.7 Tuning Standard, Agilent ICP-MS. This solution is used to verify mass calibration and thermal stability and must contain a mix of elements representing all of the mass regions of interest. Elements include 1 ppb Ce, Co, Li, Mg, Tl, and Y.
- 9.8 Internal Standards. Internal standards are added to all calibration standards, quality control, and samples during analysis, normally using a second channel of the peristaltic pump and a mixing manifold. The internal standard solution is recommended to contain Sc, Y, In, Tb, and Bi.
- 9.8.1 For the Aglient instrument, a solution containing 1 ppm of Li, Sc, Lu, In, Tb, Bi, Te and Ge in 1 % nitric is recommended. Refer to Table 3.
- 9.9 Calibration/Rinse Blank. The calibration blank is used to establish the analytical calibration curve and the rinse blank is used to flush the instrument between samples in order to reduce memory interferences.
- 9.10 Continuing Calibration Verification Check (CCV). The metals should be at concentrations near the middle of the calibration curve. (Note: This check is run after the calibration, after every 10 samples or every 2 hours during an analysis run, whichever is more frequent, and at the end of the sample run.) CCV should be prepared from the same source as the calibration standards. Refer to Table 2 for suggested concentrations for the CCV.
- 9.11 Matrix Spike and Spike Blank Solution. Suggested levels for the final concentrations of the spike are shown in Table 4.
- 9.12 Lab Control Solution. This solution is prepared by adding either mixed or single element metal solutions to a fixed final volume. Suggested levels for the final concentrations of the spike are shown in Table 4.
- 9.13 Interference Element Check Solutions or spectral interference check solutions (SIC). The purpose of the ICSA and ICSAB solutions is to demonstrate the magnitude of interferences and provide an adequate test of any corrections. It is recommended that the following solutions be purchased commercially.
- 9.13.1 ICSA Solution. The ICSA solution contains only the interfering elements. The recommended concentrations are shown below. The ICSA solution must be made fresh weekly.

Al	100 mg/L
Ca	100 mg/L
Fe	100 mg/L
Mg	100 mg/L
Na	100 mg/L
P	100 mg/L
K	100 mg/L
S	100 mg/L
C	200 mg/L
Cl	1000 mg/L
Mo	2.00 mg/L
Ti	2.00mg/L

9.13.2 ICSAB Solution. The ICSAB solution contains both the interferents and the analytes of interest. The recommended concentrations are shown below. The ICSAB solution must be made fresh weekly.

Al	100 mg/L
Ca	100 mg/L
Fe	100 mg/L
Mg	100 mg/L
Na	100 mg/L
P	100 mg/L
K	100 mg/L
S	100 mg/L
C	200 mg/L
Cl	1000 mg/L
Mo	2.00 mg/L
Ti	2.00mg/L
As	0.020 mg/l
Cd	0.020 mg/l
Cr	0.020 mg/l
Co	0.020 mg/l
Cu	0.020 mg/l
Mn	0.020 mg/l
Ni	0.020 mg/l
Ag	0.020 mg/l
Zn	0.020 mg/l

9.14 Initial Calibration Verification (ICV) or Quality Control Sample (QCS). The metals in this solution should be at final concentrations that are at the mid-point of the calibration curve. Please see Table 2 for suggested levels. The ICV sample must be from an independent source from the calibration standards.

CONTROLLED COPY
DO NOT DUPLICATE

- 9.15 CRIA Standards. The CRIA standard must contain the elements of interest at (or below) the reporting limit for each element. The CRIA levels are shown in Table 1. This should be prepared by diluting calibration standard(s) to the reporting limit level for each element.
- 9.16 Liquid Argon or Argon Gas (99.999% purity). Argon is provided by Air Gas in micro bulk tank. No lab monitoring of the tank is normally necessary.
- 9.17 Helium Gas. Required for running the reaction cell on the Agilent 7700X.

10.0 INITIAL INSTRUMENT SET-UP PROCEDURE FOR THE AGILENT 7700X ICP-MS

Refer to section 11 and the QC Summary page for more information regarding QC criteria.

- 10.1 A general procedure on how to operate the Agilent 7700X ICP-MS is given below. Refer to the operation manual for further details.
- 10.2 Before bringing up the instrument, make sure that the lines, the torch, the nebulizer, and the spray chamber are clean, and that there are no leaks in the torch area.
- 10.3 Turn the vacuum pump and the heat exchanger on and verify that the liquid argon is turned on and the helium gas is turned on.
- 10.4 Connect the pump tubing and engage the peristaltic pump.
- 10.5 Put a new solution of acid rinse into the rinse reservoir. (Note: the composition of the rinse solution may be periodically changed to minimize sample introduction problems and sample carryover.) Make sure that sufficient internal standard solution is present.
- 10.6 Open the ICP-MS Mass Hunter software. Click on the instrument and open the instrument control panel. Click the plasma on. The instrument will automatically go through the start-up cycle. Then let the instrument warm up for at least 30 minutes.
- 10.7 Tune the instrument on a daily basis. Tuning must always be done after moving the position of the torch or the cones. Tuning can be done either manually or by following autotune procedures. It is recommended that autotune procedures be followed initially and then manual tuning be done as a second step. The purpose of tuning is to optimize the instrument for the highest sensitivity while obtaining low levels of oxides and doubly charged species. After the tune is complete, make sure to save the optimized parameters.
 - 10.7.1 Open the ICP-MS top software, click on the instrument, and open the ICP-MS tuning page.
 - 10.7.2 Click file and open the 6020B_200.8 Method .b file. Keep the internal standard line in a solution of 1% nitric acid and 0.5% hydrochloric acid. Place the carrier line into the 1 ppb tuning solution. (see 9.7). On the tuning page, click start under the tune window to see the counts and RSD values. Do not start the tune process until the count and

mean have similar readings and the RSD is < 5%. The counts per second values should be > 40000 for all masses. Click stop under tune window.

- 10.7.3 Before starting auto tune and printing tune report, create a new batch folder from existing method 6020B_200.8.b. Save new batch using format "xaMMDDm1".
- 10.7.4 On the tuning page, click Autotune, type the date (MMDDYYM1) on the popup window and click OK. This will perform the tuning of the instrument. Verify acceptable mass calibration by monitoring the peak width measurement at 5% of peak maximum for Co_59, Y_89, and Tl_205. If the peak widths are outside of the range of 0.65 to 0.85 and the masses are off by more than 0.1 amu, then redo the mass calibration. After all criteria is met, print the report and include with raw data. The tune report is automatically stored in the batch folder.
- 10.8 Before calibrating, run and print out a performance test. This must include the following items.
 - 10.8.1 Relative standard deviations of the absolute signals must be less than 5 percent for all monitored masses. This includes Li_7, Y_89, and Tl_205. If these criteria are not met, correct the problem and then repeat the stability test. Print the results of this test and store with the raw data for the run.
- 10.9 Before starting sample analysis, set up the internal standards. Internal standards are added to all calibration standards, quality control, and samples during analysis, normally using a second channel of the peristaltic pump and a mixing manifold. Refer to Table 3 and Section 9.8 for additional information.
- 10.10 To start running samples, add samples to sequence and click "Add to Queue". Unpause once ready to start analysis.
- 10.11 Calibrate the instrument using a minimum of a calibration blank and three non-zero standards that bracket the desired sample concentration range. Currently SGS- Orlando employs a curve consisting of a blank and 6 non-zero standards. The lowest non-zero standard must be at or lower than the RL levels for all the elements. (Note: The calibration standards may be included in the autosampler program or they may be run separately.) A correlation coefficient **of 0.998 or better** must be obtained using a first order (linear) curve fit. A minimum of three replicate integrations are required for all data acquisitions.
 - 10.11.1 In between each analysis of a separate standard or sample, a rinse blank must be run through the lines of the sample introduction system. Each sample or standard should be aspirated for a minimum of 30 seconds prior to the acquisition of data to allow equilibrium to be established.
- 10.12 After the instrument is properly calibrated, begin by analyzing the ICV solution.
- 10.13 An ICB may be run after the ICV but is not required for this method. If it is run, then all elements must be less than ½ the reporting limit for each element

**CONTROLLED COPY
DO NOT DUPLICATE**

- 10.14 Run the CRIA solution right after the ICV and ICB.
- 10.15 Then analyze the continuing calibration verification (CCV) and continuing calibration blank (CCB) check standards.
- 10.16 After the initial QC is completed and before any samples are analyzed, the ICSA and ICSAB solutions (SIC solutions) must be analyzed.
- 10.16.1 If the run is longer than 12 hours, a second ICSA, ICSAB pair must be analyzed before the next 12 hours is started.
- 10.16.2 If mass changes are made for the analysis of an element, all QC criteria must be met for the new mass and it must be verified that appropriate correction factors are in place.
- 10.16.3 The Agilent 7700X includes collision/reaction cell technology. The instrument is tuned in regular (non-cell) mode and in helium (collision/reaction) cell mode. This technology is used to minimize interferences during analysis. If this technology is not applied, then correction factors for interferences must be added into the method.
- 10.17 After the initial analytical quality control has been analyzed, the samples and the preparation batch quality control should be analyzed. This includes the method blank, blank spike, duplicate, serial dilution, post digestion spike, matrix spike, and matrix spike duplicate. Depending on the type of digestion and the sample matrix, samples and the associated QC should normally be diluted by a factor of from 2 to 5 before analysis. This dilution factor should be indicated in the sample ID file on the instrument.
- 10.18 Each sample analysis must be a minimum of 3 integrations. For samples containing levels of elements greater than approximately 5 times the reporting limits, the relative standard deviations for the replicates should be less than 10%. If not, reanalyze the sample. If, upon reanalysis, the RSDs are acceptable, then report the data from the reanalysis. If RSD's are not acceptable on reanalysis, then the results for that element may, on the reviewer's discretion, be footnoted that there are possible analytical problems indicated by a high RSD between replicates. In some cases, an additional dilution analysis may be needed. Check with the area supervisor or manager for additional information.
- 10.19 The internal standard levels must be monitored for all samples and quality control. If the internal standard is not within 70%-120% of the internal standard level for the initial calibration blank, then the sample must be diluted to bring the internal standard to within the correct range. If the internal standard is still outside of the range after the initial dilution, then additional dilutions must be done until the internal standard is within the appropriate range.
- If an internal standard is present in a sample, then do not use that internal standard. For example, Y is sometimes seen in real samples. If the Y recoveries are high relative to the other internal standards, then do not use the Y internal standard.
- 10.20 For readings that exceed the linear range for a given element, a dilution is required. For method 6020B, after calibration the laboratory may choose to analyze a standard at a higher concentration than the high standard used in the calibration curve. The

CONTROLLED COPY
DO NOT DUPLICATE

standard must recover within 10 percent of the true value, and if successful, establishes the linear range. The linear range standards must be analyzed in the same instrument run as the calibration they are associated with but may be analyzed anywhere in the run. After a high reading, the following samples must be examined for possible carryover. A verification may be necessary by rinsing the lines with an acid solution and then re-reading the sample.

- 10.21 Indicate dilution factors for samples using "df" followed by the dilution factor after the sample ID. There should be a space between the sample number and the df.
- 10.22 Between each sample, flush the nebulizer and solution uptake system with a blank rinse solution for a minimum of 30 seconds or for the required period of time to ensure that analyte memory effects are not occurring. (60 seconds is recommended for normal methods excluding Hg and B. Longer times may be needed when Hg and B are being analyzed.)
- 10.23 Analyze the continuing calibration verification (CCV) solution and the continuing calibration blank (CCB) after every ten samples and at the end of the sample run.
- 10.24 The CRIA must be analyzed at the beginning of each analytical run.

10.24.1 It is recommended that the CRIA check be run bracketing every 4 to 8 hour period of analysis. It may be run as frequently as every 10 samples if the supervisory staff deems that this is necessary.

- 10.25 After the run is completed, convert the data file to a CSV format using the option on the results screen. First save the file on the local drive using the file naming system described below. Update the run in the LIMS and enter the run name into the workgroup using lower case characters. Then copy the data from the local drive to the LIMS drive.

10.25.1 The file should be named as followed- initial instrument indicator (xa), date (MMDD), year, and sequential run number for that day (M1). For example, the first run from 12/17/02 would be designated xa121702m1.csv.

- 10.26 Calculations are done in the LIMS using the calculations shown below.

10.26.1 Calculation for aqueous samples.

$$\begin{aligned} &\text{original sample concentration of metal } (\mu\text{g/l}) = \\ &\frac{(\text{conc. in the digestate } (\mu\text{g/l})) \times (\text{final digestate volume (ml)})}{(\text{Initial sample volume (ml)})} \end{aligned}$$

10.26.2 Calculation for solid samples.

$$\begin{aligned} &\text{original sample concentration of metal (mg/kg)} = \\ &\frac{(\text{conc. in the digestate } (\mu\text{g/l})) \times (\text{final digestate volume (ml)})}{(\text{Initial sample weight (g)}) \times (\% \text{sol}/100)} \end{aligned}$$

CONTROLLED COPY
DO NOT DUPLICATE

10.27 At the end of the analysis day the ICP-MS must be brought down using the following sequence.

10.21.1 Rinse the tip in a solution of 1 percent nitric acid and 0.5 percent hydrochloric acid for 10 minutes and in DI water for 20 minutes. (Note: a stronger acid solution may be needed depending on the matrix of the samples that were analyzed.)

10.21.2 Turn off the plasma using off button.

10.21.3 Release the tension on the pump tubing.

10.21.4 Turn off the cool flow and the printer.

11.0 QC REQUIREMENTS

Note: Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements. Also check with metals supervisor for additional information.

11.1 This section outlines the QA/QC requirements necessary to meet the method 6020B.

11.2 Instrument Detection Limits (IDLs). IDLs must be established for all analytes. Please refer to specific method for instructions on performing IDL studies.

11.3 Lower Limit of Quantitation (LLOQ) check standard. LLOQ is the lowest point of quantitation. The LLOQ is initially verified by the analysis of 7 replicate samples, spiked at the LLOQ and processed through all preparation and analysis steps of the method. The mean recovery should be within +/- 35 percent of the true value with an RSD \leq 20 percent.

Ongoing Lower limit of quantitation (LLOQ) check sample. The lower limit of quantitation check sample should be analyzed on a quarterly basis to demonstrate the desired detection capability. The LLOQ sample is carried through the entire preparation and analytical procedure.

11.4 LLQC (Lower Limit of Quantitation Check Sample) or LOQ Verification sample. A sample must be digested and analyzed initially and on an as needed basis to verify the quantitation limits for the method. Recoveries of this check must be within 70 to 130% of the true value, 80 to 120% for method 6020B. If recoveries are outside of this level, then the reporting limit (LLOQ) must be increased to a level that can be verified.

11.5 Linear Calibration ranges. The upper limit of the linear dynamic range needs to be established for each wavelength used by determining the signal responses from a minimum of three, preferably five, different concentration standards across the linear range. The linear calibration range which may be used for the analysis of samples should be judged by the analyst from the resulting data. The data, calculations and rationale for the choice of range made must be documented and kept on file. A standard at the upper limit must be prepared, analyzed and quantitated against the normal calibration curve. The calculated value should

CONTROLLED COPY
DO NOT DUPLICATE

be within $\pm 10\%$ of the true value. Linear calibration ranges should be determined whenever there is a significant change in instrument response. They must be done at least every six months. For any readings that exceed the linear range for a given element, a dilution is required. In addition, if there are significant interferences generated from elements above the linear range, then these elements must also be diluted so that accurate interfering element corrections can be applied.

For method 6020B, after calibration the laboratory may choose to analyze a standard at a higher concentration than the high standard used in the calibration curve. The standard must recover within 10 percent of the true value, and if successful, establishes the linear range. The linear range standards must be analyzed in the same instrument run as the calibration they are associated with but may be analyzed anywhere in the run. Normal linear range values by element are shown in Table 2.

- 11.6 Initial Calibration Verification (ICV) or Quality Control Sample (QCS) and Initial Calibration Blank (ICB). After every new calibration, an ICV must be analyzed. The analysis of the ICV may be followed by the analysis of the ICB, although this is not required by the method.

11.6.1 For the ICV, all elements to be reported must be within 10 percent of the true value and the replicates that exceed 5 times the reporting limit should have a relative standard deviation of less than 5 percent. The ICV must be from a different source than the calibration standards and must be near the mid-point of the calibration curve. If the ICV does not meet criteria, then the problem must be identified and corrected before samples can be run and reported for the element(s) that are outside of criteria. Correction of the problem can be verified by rerunning the check standard and showing that it meets QC criteria.

11.6.2 For the ICB, all elements to be reported must be less than $1/2$ the reporting limit. If the ICB is outside of criteria, then the problem must be identified and corrected before samples can be run and reported for the element(s) that are outside of criteria. Correction of the problem can be verified by rerunning the check standard and showing that it meets QC criteria. Analysis of a CCB before running any reportable samples can be used to verify that the system meets calibration blank requirements.

- 11.7 Continuing Calibration Verification (CCV), also referred to as IPC, and Continuing Calibration Blank (CCB). Analyze the continuing calibration verification solution and the continuing calibration blank after every tenth sample and at the end of the sample run.

11.7.1 For the CCV, all elements to be reported must be within 10 percent of the true value and the replicates that are greater than 5 times the reporting limit should have a relative standard deviation of less than 5 percent. The CCV should be made from the same source as the calibration standards at a concentration near the mid-level of the calibration curve. If an element does not meet the recovery criteria of the CCV, then no samples can be reported for that element in the area bracketed by the CCV.

11.7.2 For the CCB, all elements to be reported must be less than $1/2$ the reporting limit. If an element does not meet this criteria, then no samples can be reported for that element in the area bracketed by the CCB.

CONTROLLED COPY
DO NOT DUPLICATE

- 11.8 Interference Check Standards. After the initial QC is completed and before any samples are analyzed, the ICSA and ICSAB solutions (SIC solutions) must be analyzed. The method does not give specific criteria for the ICSA and ICSAB, but in house criteria should be applied. For all the spiked elements, the analyzed results must be within 20 percent of the true results. For unspiked elements, the interfering element solution should contain less than the absolute value of 2 times the reporting limit for each element. If these criteria are not met, then samples with significant interferences cannot be reported until the correction factors are optimized and the ICSA and ICSAB are within specifications.
- 11.8.1 If the run is longer than 12 hours, a second ICSA, ICSAB pair must be analyzed before the next 12 hours is started.
- 11.8.2 If mass changes are made for the analysis of an element, all QC criteria must be met for the new mass and it must be verified that appropriate correction factors are in place.
- 11.9 CRIA. Also referred to as LLCCV, LOQ, LLOQ. The CRIA standard containing the elements of interest at (or below) the reporting level for each element. The CRIA must be analyzed at the beginning of each analysis batch. The acceptance criteria for the CRIA check is 70 to 130% for method 200.8 and 80-120% for method 6020B. If an element does not meet this criteria, then all bracketed samples for that element in the concentration range between the CRIA and the CCV must be reanalyzed. Samples containing concentrations higher than the CCV may be reported as long as CCV criteria are met.
- 11.9.1 More frequent CRIA checks may be analyzed during the course of the run if system stability at the low end of the calibration is questionable.
- 11.9.2 It is recommended that the CRIA check be analyzed every 4 to 8 hour period of analysis. It may be run as frequently as every 10 samples if the supervisory staff deems that this is necessary.
- 11.10 Method Blank. The laboratory must digest and analyze a method blank with each set of samples. A minimum of one method blank is required for every 20 sample batch.
- 11.10.1 The default SOP limit for the method blank is that it must be less than one half of the reporting limit.
- 11.10.2 In addition, the blank is considered acceptable if it is less than 10% of the regulatory limit, or less than 10% of the lowest sample concentration for each analyte in a given preparation batch, whichever is greater. Samples associated with the contaminated blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-digesting and reanalyzing the samples, qualifying the results with a "B" or "V" qualifier, or raising the reporting limit to greater than two times the background concentration. All samples associated with an out of compliance method blank shall be qualified and footnoted in LIMS as well as the case/run narrative.

11.11 Lab Control Sample. Also referred to as Spike Blank. The laboratory must digest and analyze a laboratory control sample or spike blank with each set of samples. A minimum of one lab control sample or spike blank is required for every 20 sample batch. The laboratory should assess laboratory performance of the LCS against recovery limits of 80 to 120 percent for method 6020B. Recovery must be within 85 to 115 percent for method 200.8. In house LCS limits may also be generated to support these default limits. If the LCS is outside of the control limits for a given element, all samples must be redigested and reanalyzed for that element.

11.11.1 If solid lab controls are used, then the manufacturer's limits should be applied.

11.12 Matrix Spike. The laboratory must add a known amount of each analyte to a minimum of 1 in 20 samples. The matrix spike recovery is calculated as shown below. Recoveries should be assessed against default limits of 80 to 120 percent for method 6020B. Recovery must be within 70 to 130 percent for 200.8. In house limits may be generated for this method for informational purposes only. If a matrix spike is out of control, then the results should be flagged with the appropriate footnote and it is recommended that a post-digest spike be analyzed for the out of control element(s). If the matrix spike amount is less than one fourth of the sample amount, then the sample cannot be assessed against the control limits and should be footnoted to that effect. Note: Both the matrix spike amount and the sample amount are calculated to the IDL for any given element. Any value less than the IDL is treated as zero.

$((\text{Spiked Sample Result} - \text{Sample Result}) / \text{Amount Spiked}) \times 100 = \text{matrix spike recovery}$

11.12.1 If a post-digest spike is required, the sample should be spiked with approximately 2 times the sample level or two times the reporting limits, whichever is greater. Limits of 80 to 120 percent are normally applied. The post-digest spike recovery must be footnoted on the matrix spike recovery or otherwise noted in the quality control summary report.

11.13 Matrix Spike Duplicate (MSD) or Matrix duplicate (DUP). The laboratory must digest a matrix spike duplicate or matrix duplicate sample for a minimum of 1 in 20 samples. The relative percent difference (RPD) between the MSD and the MS or between the DUP and the sample should be assessed. The RPD is calculated as shown below. The control limit for the duplicate RPD is method defined as 20%. If the sample and the duplicate results are less than 5 times the reporting limits and are within a range of \pm the reporting limit, then the duplicate is considered to be in control. Note: Both the duplicate amount and the sample amount are calculated to the IDL for any given element. Any value less than the IDL is treated as zero.

11.13.1 If an MSD or duplicate is out of control, then the data should be checked carefully to confirm that the high RPD for a given element is not a result of an analytical problem. If an analytical problem is suspected, the MSD or duplicate must be reanalyzed for confirmation. If the initial and reanalysis are in agreement, within 20%, then the high RPD is a result of preparation or sample issues and further analysis of the initial preparation is not required. If the initial and reanalysis are not in agreement due to

an analytical problem, then any affected samples in the associated batch should also be reanalyzed for that element.

11.13.2 If more than 50% of the elements in a sample have levels of at least 5 times the reporting limit and have a high RPD, then the MSD or duplicate should be re-digested for confirmation, unless the sample matrix is such that the non-homogeneity of the sample is visually apparent. If the results confirm, the results from the original MSD or duplicate should be flagged as indicative of possible sample non-homogeneity. If the results do not confirm, then the whole batch should be re-digested and reanalyzed.

11.13.3 If 50% or less of the elements in a sample have levels of at least 5 times the reporting limit and have a high RPD, then the high RPD should be footnoted as indicating possible sample non-homogeneity unless other problems are suspected. If problems are suspected, the reviewer will initiate re-digestion and reanalysis of the batch.

11.13.4 The calculations used to calculate RPD are shown below.

$$\frac{(|\text{MS Result} - \text{MSD Result}|) \times 100}{(\text{MS Result} + \text{MSD Result})/2} = \text{MSD RPD}$$

$$\frac{(|\text{Sample Result} - \text{Duplicate Result}|) \times 100}{(\text{Sample Result} + \text{Duplicate Result})/2} = \text{Duplicate RPD}$$

11.14 Serial Dilution. A serial dilution is required on a frequency of one in 20 samples. It is normally done on the same sample as is used for the matrix spike. If the analyte concentration is within the linear dynamic range of the instrument and sufficiently high (minimally a factor of at least 100 times greater than the concentration in the reagent blank), then an analysis of a fivefold (1+4) dilution must agree to within $\pm 10\%$ of the original determination. If not, an interference effect must be suspected and the serial dilution result for the element with the suspected interference must be footnoted. The serial dilution is calculated as shown below.

$$\frac{100 \times ((\text{Sample result} - \text{Serial dilution result}))}{\text{Sample result}} = \text{Serial dilution percent difference}$$

11.14.1 Results of less than the IDL are treated as 0. The concentration in the reagent blank is normally < 3 times the IDL, so the factor of 100 times the concentration in the reagent blank (listed above) so the limits should be applied to sample concentrations of greater than 300 times the IDL.

11.15 Percent Relative Error

The laboratory shall use and document a measure of relative error in the calibration;

**CONTROLLED COPY
DO NOT DUPLICATE**

- i. For calibrations evaluated using an average response, the determination of the relative standard deviation (RSD) is the measure of the relative error.
- ii. For calibrations evaluated using correlation coefficient or coefficient of determination, the laboratory shall evaluate relative error by either:
 - a. Measurement of the Relative Error (%RE)

Relative error is calculated using the following equation:

$$\% \text{ Relative Error} = \frac{X'_i - X_i}{X_i} \times 100$$

X_i = True value for the calibration standard

X'_i = Measured concentration of the calibration standard

This calculation shall be performed for two calibration levels: the standard at or near the mid-point of the initial calibration and the standard at the lowest level.

The Relative Error at both of these levels shall meet the criteria specified in the method. If no criteria for the lowest calibration standard is specified in the method, the criteria and the procedure for deriving the criteria shall be specified in the SOP.

SGS Orlando has established the % Relative Error as follows:

LLCCV must be within 20%.

MidPoint must be within 10%.

12.0 DOCUMENTATION REQUIREMENTS

- 12.1 If samples or QC checks require reanalysis, a brief explanation of the reason must be documented on the run log. All instrument data should be exported to the LIMS system.
- 12.2 The Electronic Standard Preparation Logbook must be completed for all standard preparations. All information requested must be completed. The SGS - Orlando Lot Number must be cross-referenced on the standard vial.
- 12.3 The Instrument Maintenance Logbook must be completed when any type of maintenance is performed on the instrument. Each instrument has a separate log.
- 12.4 The correction factors from each method must be printed out each time a change is made and stored in a notebook in the lab. Each time the correction factors are modified, a new printout must be obtained.

CONTROLLED COPY
DO NOT DUPLICATE

- 12.5 Any corrections to laboratory data must be done using a single line through the error. The initials of the person and date of correction must appear next to the correction.
- 12.6 Supervisory (or peer) personnel must routinely review (approximately once per month) all laboratory logbooks to ensure that information is being recorded properly. Additionally, the maintenance of the logbooks and the accuracy of the recorded information should also be verified during this review.

13.0 INSTRUMENT MAINTENANCE and TROUBLESHOOTING

Recommended periodic maintenance includes the items outlined below.

- 13.1 Change the pump tubing weekly or as needed.
- 13.2 Clean the nebulizer, torch, and injector tube every two to four weeks or more often as needed.
- 13.3 Change the sampler tip as needed (every one to two months).
- 13.4 Clean the recirculating pump lines as needed.

Record all maintenance in the Maintenance logbook. Repairs by manufacturer representative and outside contractors must be documented in this logbook as well.

14.0 POLLUTION PREVENTION & WASTE MANAGEMENT

- 14.1 Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents, and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids to the environment must be followed. All method users must be familiar with the waste management practices described in section 14.2
- 14.2 Waste Management. Individuals performing this method must follow established waste management procedures as described in the waste management SOP, SAM108, current revision. This document describes the proper disposal of all waste materials generated during the testing of samples as follows:
- 14.2.1 Non hazardous aqueous wastes.
 - 14.2.2 Hazardous aqueous wastes
 - 14.2.3 Chlorinated organic solvents
 - 14.2.4 Non-chlorinated organic solvents

CONTROLLED COPY
DO NOT DUPLICATE

14.2.5 Hazardous solid wastes

14.2.6 Non-hazardous solid wastes

15.0 METHOD PERFORMANCE

Method performance (accuracy and precision) is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to method defined control limits. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

Filtered method blanks and blank spikes to act as QC check of the filters. Unfiltered method blanks and blank spikes are used to monitor overall method performance.

QC Criteria Summary

Quality Control	Frequency	Acceptance Criteria	Corrective Action
Initial Calibration: r = coefficient of correlation	Daily	≥ 0.998	Rerun calibration standards, and/or prepare new calibration standards and recalibrate the instrument, or document why the data are acceptable.
Percent Relative Error (%RE)	Each initial calibration	80 – 120 % of the lowest cal. standard's true value. 90-110% of the calibration standard at or near the mid-point's true value	Rerun calibration standards, and/or prepare new calibration standards and recalibrate the instrument.
Initial Calibration Verification standard (ICV)	One per calibration	90 – 110% of the standard's true value	Rerun standard, and/or prepare new standard, and/or recalibrate instrument, or document why the data are acceptable.
Continuing Calibration Verification standard (CCV)	After initial calibration, every tenth sample, and at end.	90 - 110% of the standard's true value	Rerun standard, and/or recalibrate instrument and reanalyze all samples run since the last acceptable CCV, or document why the data are acceptable.
Blanks (MB)(ICB)(CCB)	(MB) One per batch (ICB) After initial calibration (CCB) After initial calibration, every 10 th sample, and at the end.	$< \frac{1}{2}RL$	Reanalyze, and/or stop the run and determine the source of contamination, or document why the data are acceptable.
Blank Spike (BS or LCS)	One per batch	85-115% 200.8 80-120% 6020B	Determine and correct the problem, reanalyze samples, if necessary, or document why data are acceptable. For DoD, assess against DoD criteria.
Sample RSD	NA	Elements >5x RL, RSD<5%	Reanalyze sample, or document why the data are acceptable.

CONTROLLED COPY
DO NOT DUPLICATE

Quality Control	Frequency	Acceptance Criteria	Corrective Action
High Standard Readback	NA	NA	NA
MS/MSD/DUP	5% of matrix	70-130%, 200.8 80-120%, 6020B %RPD \leq 20%	If the results are outside these criteria then matrix interference should be suspected, and the proper footnote entered into LIMS. For DoD, assess against DoD criteria.
Linear Calibration Range (LCR)	Every 6 months	\pm 10% of the standard's true value	See section 11.5 for more detail
Low level CCV (CRIA)	One per calibration	70-130% 200.8 80-120% 6020B	Rerun standard, and/or prepare new standard, and/or recalibrate instrument, or document why the data are acceptable.
ICSA and ICSAB	One per calibration	Concentration measured for any target analyte must be $< 2 \times$ RL. For spiked elements, results must be within 20% of standard's true value.	Rerun standard, and/or prepare new standard, and/or recalibrate instrument, or document why the data are acceptable.
Serial Dilution (SDL)	One per batch	The results of the 1:5 dilution shall agree within 10 percent of the true value as long as the analyte concentration is within the linear range of the instrument and sufficiently high (minimally, a factor of 25 times greater than the RL).	If the results are outside these criteria then matrix interference should be suspected, and the proper footnote entered into LIMS.

CONTROLLED COPY
DO NOT DUPLICATE

Quality Control	Frequency	Acceptance Criteria	Corrective Action
Internal Standard	All samples and standards	70-120% referenced against ICB	Dilute sample until internal standard are within range. Footnote data accordingly in LIMS.

Table 1
Elements, Masses, and Reporting Limit for Agilent ICP-MS

Mass and Element	Associated Tune (1 = no gas, 2= helium, 3= optimized helium) (this may vary)	CRIA Check (ug/L)	Normal Digested Aqueous Sample Reporting (ug/l) DF 2	Normal Digested Solid Sample Reporting Limit (mg/kg) DF5	Comments
9Be	2	1.0	2.0	0.5	
11B	2	NA	NA	NA	
23Na	2	100	200	25	
24Mg	2	100	200	25	
27Al	2	100	200	25	
39K	2	100	200	25	
44Ca	2	100	200	25	
47Ti	2	1.0	2.0	0.5	
51V	2	1.0	2.0	0.5	
52Cr	2	1.0	2.0	0.5	
55Mn	2	1.0	2.0	0.5	
56Fe	2	100	200	25	
59Co	2	1.0	2.0	0.5	
60Ni	2	1.0	2.0	0.5	
63Cu	2	1.0	2.0	0.5	
66Zn	2	1.0	2.0	0.5	
75As	2	1.0	2.0	0.5	
78Se	2	1.0	2.0	0.5	
88Sr	2	1.0	2.0	0.5	
95Mo	2	1.0	2.0	0.5	
107Ag	2	1.0	2.0	0.5	
111Cd	2	1.0	2.0	0.5	
118Sn	2	1.0	2.0	0.5	
121Sb	2	1.0	2.0	0.5	
137Ba	2	1.0	2.0	0.5	
205Tl	2	1.0	2.0	0.5	
208Pb	2	1.0	2.0	0.5	

CONTROLLED COPY
DO NOT DUPLICATE

Table 2:
Recommended Standard Concentration Levels; ICV/CCV Levels; Normal Linear Ranges in (ug/L)

Mass and Element	StdA	StdB	StdC	StdD	StdE	StdF	StdG				NORMAL LINEAR RANGE	ICV	CCV
6Li	0	NA	NA	NA	NA	NA	NA				1000	NA	NA
9Be	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
11B	0	0.5	1.0	10.0	50.0	100.0	200				NA	100	100
23Na	0	50	100	1000	5000	10000	20000				100000	10000	10000
24Mg	0	50	100	1000	5000	10000	20000				100000	10000	10000
27Al	0	50	100	1000	5000	10000	20000				100000	100	100
39K	0	50	100	1000	5000	10000	20000				100000	10000	10000
44Ca	0	50	100	1000	5000	10000	20000				100000	10000	10000
47Ti	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
51V	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
52Cr	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
55Mn	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
56Fe	0	50	100	1000	5000	10000	20000				100000	10000	10000
59Co	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
60Ni	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
63Cu	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
66Zn	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
75As	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
78Se	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
88Sr	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
95Mo	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
107Ag	0	0.5	1.0	10.0	50.0	100.0					1000	50	50
111Cd	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
118Sn	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
121Sb	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
137Ba	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
205Tl	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100
208Pb	0	0.5	1.0	10.0	50.0	100.0	200				1000	100	100

Table 3
Internal Standard Masses and Tune Mode

Mass and Element (this may vary)	Associated Tune for Aglient only (1 = no gas, 2= helium, 3= optimized helium) (this may vary)	Comments
6Li	2	
45Sc	2	
72, 74 Ge	2	
115 In	2	
125 Te	2	
159 Tb	2	
175 Lu	2	
209 Bi	2	

Table 4
MS, MSD and Blank Spike Concentrations

Element	Soils Final Concentration in mg/kg	Aqueous Final Concentration in µg/l	
Ag	2.5	50	
Al	500	10000	
As	5	100	
B	NA	NA	
Ba	5	100	
Be	5	100	
Ca	500	10000	
Cd	5	100	
Co	5	100	
Cr	5	100	
Cu	5	100	
Fe	500	10000	
K	500	10000	
Mg	500	10000	
Mn	5	100	
Mo	5	100	
Na	500	10000	
Ni	5	100	
Pb	5	100	
Sb	5	100	
Se	5	100	
Tl	5	100	
V	5	100	
Zn	5	100	
Sn	5	100	
Sr	5	100	
Ti	5	100	
Pd	NA	NA	

REVISION HISTORY

Revision Date	Revision Number	Affected Section(s)	Revision Description
12/2020	04	“Revised Sections”	Added Revision History and removed Revised Sections. Sec. 11.10.2 added detail “All samples associated with an out of compliance method blank shall be qualified and footnoted in LIMS as well as the case/run narrative.” METHOD BLANK in Definitions – removed reference to WV blank evaluation.
4/7/2022	05	9.5.1	Added acid matrix concentration information
4/7/2022	05	General	Removed all references to acid matrix makeup with the exception of section 9.5.1
4/7/2022	05	10.11	Update calibration information
4/7/2022	05	References	Added TNI, removed 6020A
4/7/2022	05	3	Added detail
4/7/2022	05	4.2-4.3	Updated MDL procedure
4/7/2022	05	5	Updated health and safety
4/7/2022	05	6	Updated preservation
4/7/2022	05	8	Added auto-sampler tubes
4/7/2022	05	9.1	Added reagent water
4/7/2022	05	General	Changed CRI to CRIA
4/7/2022	05	10.11	Updated calibration curve information
4/7/2022	05	10	Removed QC criteria references, they are located in section 11, Quality Control
4/7/2022	05	10.12.1 – 10.12.2	Removed, moved to sections 10.13 and 10.14
4/7/2022	05	10.17	Added matrix QC
4/7/2022	05	11.9.1	Re-worded

**CONTROLLED COPY
DO NOT DUPLICATE**

4/7/2022	05	11.12.1	Removed serial dilution reference
4/7/2022	05	12.2	Added "Electronic"
4/7/2022	05	Table 2	Added low standard
4/7/2022	05	General	Added SOP acknowledgement form
4/7/2022	05	8	Added section 8.6-8.9
4/7/2022	05	General	Added QC Summary
4/7/2022	05	11.15	Added % relative error

METALS BY INDUCTIVELY COUPLED PLASMA – MASS SPECTROMETRY (ICP-MS)

SOP Acknowledgement Form

I have read and understand this SOP. I will not knowingly deviate from this approved SOP without approval of the Department Supervisor, QA Officer, or Technical Manager. If I notice any discrepancies between this SOP and the routine procedure, I will notify the Department Supervisor so that either the SOP or procedure can be changed. Furthermore, I understand that this SOP is property of SGS North America Inc. – Orlando and may not be **printed nor** duplicated in any manner.

Internal SOPs referenced within this SOP: QA020, QA006, QA017, QA033, QA037, SAM101, SAM104, SAM108

Print Name	Signature	Date

Print the SOP Acknowledgement Form, sign, and submit to the SGS Orlando QA department

**CONTROLLED COPY
DO NOT DUPLICATE**



ANALYSIS OF PER- and POLYFLUORINATED ALKYL SUBSTANCES (PFAS) IN AQUEOUS AND SOLID SAMPLES BY LC/MS/MS

Prepared by: Norm Farmer Date: 08/01/2022

Approved by: Mike Eger Date: 08/03/2022

Annual Review

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Document Control

Issued to: QA Department - digital Date: 08/05/2022

Issued to: LCMS Department - digital Date: * 08/08/2022

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Effective 7 days after "*" date

**CONTROLLED COPY
DO NOT DUPLICATE**

TITLE: ANALYSIS OF PER- and POLYFLUORINATED ALKYL SUBSTANCES (PFAS) IN AQUEOUS AND SOLID SAMPLES BY LC/MS/MS

REFERENCES: EPA draft Method 1633 and QSM 5.4 Table B-24

REVISED SECTIONS: Tables 2 and 3.

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

- 1.1.1 This method is used to determine the concentrations of select Per- and Polyfluorinated Alkyl Substances (PFAS) in aqueous, solid (soil, sediment, biosolids) and tissue matrices utilizing an HPLC equipped with a tandem mass spectrometer (MS/MS).
- 1.1.2 Analytes that may be reported under this method are listed in TABLE 1. Translations between analytes names and acronyms used in EPA 1633 versus the laboratory report and raw data are listed in TABLE 4.
- 1.1.3 The Lower Limit of Quantitation (LLOQ) or Reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. LLOQs may vary depending on matrix complications and volumes. LLOQs for this method are 0.002-0.050 ug/l for aqueous samples and 0.2-50 ug/kg for solid samples. Solid matrices are reported on a dry weight basis.
- 1.1.4 **MeFOSA, EtFOSA, MeFOSE, and EtFOSE** tend to recover erratically by SPE cartridge. These analytes may also be lost during the evaporative step. Data for these analytes should be reviewed carefully.
- 1.1.5 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the LLOQ. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported LLOQ.
- 1.1.6 The LLOQ for each analyte is evaluated on an annual basis for each matrix and instrument. The LLOQ verifications are prepared by spiking a clean matrix at 0.5 to 2 times the current LLOQ level. This LLOQ verification is carried through the same preparation and analytical procedures as the samples. Recovery of the analytes should be within the established limits. The DOD QSM requirements for Limit of Detection (LOD) and Limit of Quantitation (LOQ) verifications are different. See SOP QA020 for complete requirements for MDL, LOD, LOQ, and LLOQ.

**CONTROLLED COPY
DO NOT DUPLICATE**

- 1.1.7 Compounds detected at concentrations between the LLOQ and MDL are quantitated and qualified as estimated values and reported with either a “J” or “I” qualifier. Some program or project specifications may require that no values below the LLOQ be reported.
- 1.1.8 This method is “performance-based,” meaning that modifications may be made without additional EPA review to improve performance (e.g., overcome interferences, or improve the sensitivity, accuracy, or precision of the results) provided that all performance criteria in this method are met.

1.2 Summary

- 1.2.1 This method is adapted from draft EPA Method 1633 for the analysis of environmental water and soil samples. Additions and modifications have been added for compliance with QSM 5.4 Table B-24.

This SOP is not designed to be used to analyze aqueous and solid samples by the laboratory’s in-house LCMSMS method. Those samples should be analyzed by MS014 or MS019 with QSM 5.3 Table B-15.

This SOP is not designed to be used to analyze drinking water by EPA 537.1 or EPA 533. Drinking water samples should be analyzed by SOP MS017 or MS022

- 1.2.2 Samples are received, stored, and extracted within the appropriate holding times.
- 1.2.3 Sample preparation is performed in accordance with SGS – Orlando SOP OP075 and OP076.
- 1.2.4 Samples known to be high in PFAS (such as AFFF or AFFF impacted waters) should be screened by serial dilution and direct injection onto the LC/MS/MS in order to determine the appropriate subsample size.

High level water and soil samples require that a smaller sample aliquot be used so that the analytes fall within the instrument calibration range.

For definitive analysis AFFF samples must be subcontracted to a laboratory certified for AFFF analysis by QSM 5.4.

- 1.2.5 Per- and Polyfluorinated Alkyl Analytes are separated, detected and quantitated using an LC/MS/MS. After HPLC separation and ionization, the specific Perfluorinated compound is isolated in the first mass spectrometer and transferred to a collision cell for fragmentation. The resulting fragments are introduced into the second mass spectrometer where they are detected and quantified.
- 1.2.6 Per- and Polyfluorinated Alkyl Analytes may exist in branched and/or linear form. Fluorotelomer production results in linear isomers only but electrochemical fluorination results in branched and linear isomers. The branched isomers may account for up to 30% of the total analyte. The branched isomers will elute just

before the linear isomer. A qualitative branched/linear RT standard with additional branched isomers is used to help establish transition windows.

1.2.7 Manual integrations are performed in accordance with SOP QA029.

2.0 COLLECTION, PRESERVATION, STORAGE, AND HOLDING TIME

2.1 Collection

2.1.1 Aqueous samples should be collected in 500mL high density polyethylene bottles (HDPE). Caps must not have Teflon liners. Alternate size bottles may be used depending on project requirements.

Additional bottles should be provided for solids determination, dilutions, and pre-screening of samples.

2.1.2 Solid samples shall be collected in 4oz or 2oz HDPE wide mouth jars. Caps must not have Teflon liners.

2.1.3 The samples must be chilled to $\leq 6^{\circ}\text{C}$ from the time of collection until arrival at the laboratory.

2.2 Storage

2.2.1 Samples may be stored in the dark at either $\leq 6^{\circ}\text{C}$ or $\leq -20^{\circ}\text{C}$.

Issues were observed with MeFOSE, EtFOSE, MeFOSAA and EtFOSAA after 7 days when stored at $\leq 6^{\circ}\text{C}$. These issues are more likely to elevate the observed concentrations of other PFAS compounds via the transformation of these precursors if they are present in the sample.

2.2.2 The extracts should be stored in the dark at $\leq 4^{\circ}\text{C}$. All extracts must be allowed to come to room temperature and vortexed just prior to transfer to the autosampler vials.

2.3 Holding Time

2.3.1 Aqueous and solid samples must be extracted within 28 days of collection if stored at $\leq 6^{\circ}\text{C}$.

2.3.2 Aqueous and solid samples must be extracted within 90 days of collection if stored at $\leq -20^{\circ}\text{C}$.

2.3.3 Extracts should be analyzed within 28 days of extraction but must be analyzed within 90 days of extraction.

3.0 INTERFERENCES

- 3.1 Data from all blanks, samples, and spikes must be evaluated for interferences. Method interferences may be caused by contaminants in solvents, reagents, or glassware. The analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) or Teflon products, HPLC solvent lines, methanol, aluminum foil, SPE transfer lines, bottle caps, etc. All materials must be demonstrated to be free from interferences.
- 3.2 Contact with glass containers, pipettes, or syringes should be minimized since the Perfluorinated compounds can potentially adsorb to glass surfaces.
- 3.3 Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the sample. Humic and/or fulvic material can be co-extracted during SPE and high levels can cause enhancement and/or suppression in the electrospray ionization source or low recoveries on the SPE sorbent. Total organic carbon (TOC) is a good indicator of the humic content of the sample. High levels of iron have been shown to reduce the d5-EtFOSAA recoveries.
- 3.4 When establishing the chromatographic conditions, it is important to consider the potential interference of bile salts during analyses of tissue samples. A standard containing TDCA should be injected to ensure that TDCA does not coelute with any of the target analytes, EIS, or NIS standards. Analytical conditions must be set to allow a separation of at least 1 minute between the bile salts and PFOS.
- 3.5 SPE cartridges can be a source of interferences. The analysis of field and method blanks can provide important information regarding the presence or absence of such interferences. Brands and lots of SPE devices must be tested to ensure that contamination does not preclude analyte identification and quantitation.
- 3.6 Water and containers used for equipment blanks or field blanks must be tested prior to use. For smaller sampling events DI water will be provided in the same type of bottle used for sample collection. For larger sampling events four-liter HDPE containers should be used. Containers should be filled with DI water and allowed to sit for several hours before testing. If the bottles are from the same lot and filled with DI on the same day, then one analysis per 10 containers should suffice. The DI water and container blanks must be free of any analytes of interest or interferences at ½ the required LLOQ to be acceptable.
- 3.7 A field blank should be collected with each set of samples. Each field blank consists of 4 bottles. Two bottles are filled with DI water at the lab and the other two bottles are empty. At the sampling site the sampler should open then two empty bottles and transfer the DI water from the full bottles into them. Cap the bottles, label as field blanks, and return them to the laboratory along with the samples for analysis.

4.0 DEFINITIONS

- 4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.
- 4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS) or the Ongoing Precision and Recovery Standard (OPR).
- 4.3 Low Level Blank Spike (LLBS): An analyte-free matrix spiked with a known amount of analyte(s) at 2x LLOQ, processed simultaneously with the samples through all the steps of the analytical procedure. Low-Level Blank Spike Recoveries are used to document laboratory performance at the LLOQ for a given method. This may also be called a Low-Level Laboratory Control Sample (LLCS) or the Low-Level Ongoing Precision and Recovery Standard (LLOPR).
- 4.4 Bile Salt Check: A Retention Time Standard containing Taurodeoxycholic Acid (TDCA) and PFOS used to verify separation between TDCA and PFOS.
- 4.5 Branched/Linear RT Check: A qualitative standard that contains various commercially available branched and linear PFAS analytes which is used to help identify branched isomers and to ensure that the transition windows are wide enough to capture the branched peaks.
- 4.6 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all GC and HPLC methods, a CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.
- 4.7 Continuing Calibration Blank (CCB): An instrument blank analyzed immediately after a CCV used to verify that there is no carry-over from the CCV.
- 4.8 Extracted Internal Standards (EIS): A standard containing isotopically labelled versions of the native target analytes. These isotopes are usually labelled with C13, d2, or O18 atoms. Isotope Dilution Standards are used to measure the extraction efficiency and to correct the concentrations of the native analytes based on the recovery of their isotopically labelled analogs.

The terms isotope dilution standards and extracted internal standard are used interchangeably throughout this SOP. Technically if a direct mass labelled analog is used to quantitate the native analyte it is an isotope dilution technique; however, if a direct mass labelled analog is not available for quantitation and a similar mass labelled analog is used, it is an extracted internal standard technique.

- 4.9 Field Blank (FB): An aliquot of reagent water that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site,

CONTROLLED COPY
DO NOT DUPLICATE

exposure to sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the FB is to determine if method analytes or other interferences are present in the field environment.

- 4.10 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still considered valid.
- 4.11 Isotope Dilution Standards (IDS): See Extracted Internal Standard.
- 4.12 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point must be at a level equal to or below the LLOQ.
- 4.13 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor must be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.
- 4.14 Instrument Blank (IBLK): An instrument blank analyzed immediately after the High Standard used to verify that there is no carry-over.
- 4.15 Matrix Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.
- 4.16 Matrix Spike (MS): A sample spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.
- 4.17 Matrix Spike Duplicate (MSD): A replicate sample spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.
- 4.18 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.
- 4.19 Non-Extracted Internal Standards (NIS): Labeled PFAS compounds spiked into the concentrated extract immediately prior to injection of an aliquot of the extract into the LC-MS/MS.
- 4.20 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

5.0 REAGENTS

- 5.1 Acetonitrile – HPLC grade or equivalent (Eluent A)
- 5.2 Water – HPLC grade or equivalent
- 5.3 Ammonium Acetate – LCMS grade or equivalent
- 5.4 Ammonium Hydroxide – Fisher A669-212 or equivalent (28-30% Aqueous Ammonia)
- 5.5 Eluent A - Acetonitrile
- 5.6 Eluent B – 2mM Ammonium Acetate in 95:5 Water:Acetonitrile

Dissolve 0.154 grams of ammonium acetate in 950ml of water and 50ml of acetonitrile.

- 5.7 Dilution Mix - Methanol with 4% water, 1% ammonium hydroxide and 0.625% acetic acid

Add ammonium hydroxide (3.3ml of 30%), reagent water (1.7ml) and acetic acid (0.625ml) to methanol (92ml). Store at room temperature, replace after 1 month.

- 5.8 Nitrogen – various grades
- 5.9 Perfluorinated Alkyl Substances stock standards – Traceable to Certificate of Analysis.
- 5.10 Mass labeled – Non-Extracted Internal Standards

¹³ C ₃ -PFBA	¹³ C ₄ -PFOA	¹³ C ₂ -PFDA	¹³ C ₄ -PFOS
¹³ C ₂ -PFHxA	¹³ C ₅ -PFNA	¹⁸ O ₂ -PFHxS	

- 5.11 Mass labeled – Extracted Internal Standards

¹³ C ₄ -PFBA	¹³ C ₉ -PFNA	¹³ C ₃ -PFBS	¹³ C ₂ -8:2 FTS	D ₅ -NEtFOSAA
¹³ C ₅ -PFPeA	¹³ C ₆ -PFDA	¹³ C ₃ -PFHxS	¹³ C ₈ -PFOSA	D ₇ -NMeFOSE
¹³ C ₅ -PFHxA	¹³ C ₇ -PFUnA	¹³ C ₈ -PFOS	D ₃ -NMeFOSA	D ₉ -NEtFOSE
¹³ C ₄ -PFHpA	¹³ C ₂ -PFDaA	¹³ C ₂ -4:2 FTS	D ₅ -NEtFOSA	¹³ C ₃ -HFPO-DA
¹³ C ₈ -PFOA	¹³ C ₂ -PFTeDA	¹³ C ₂ -6:2 FTS	D ₃ -NMeFOSAA	

6.0 APPARATUS

6.1 HPLC – Agilent Technologies 1260 or 1290

Suitable HPLC equipped with an autosampler, pump, and column compartment. System may have a membrane degasser if shown to not adversely affect the analysis.

6.2 MS/MS – Agilent Technologies 6470A or 6495B

LC/MS/MS must be capable of negative ion electrospray ionization near the required flow rate of the HPLC Column. The system must be capable of performing MS/MS to produce unique precursor and product ions for the PFAS method analytes within the specified retention time segments. A minimum of 10 scans across each peak is required to ensure adequate precision.

6.3 Data System – Agilent Technologies MassHunter B10.0x

6.3.1 A computer system interfaced to the HPLC/MS/MS that allows for the continuous acquisition and storage of all data obtained throughout the duration of the chromatographic program.

6.3.2 The software must allow for the viewing of the specific MS/MS Spectra acquired over the analytical run. Comparisons can then be made between spectra from standards and samples.

6.3.3 Data is archived to a backup server for long term storage.

6.4 Columns: Agilent Poroshell 120 EC C18 2.7um, 100 x 2.1 mm ID or equivalent

6.5 Delay Columns: Agilent Poroshell or Eclipse C18 50 x 4.6 mm ID or equivalent

6.6 Disposable polyethylene transfer pipettes

6.7 15ml Centrifuge tubes

6.8 HDPE or Polypropylene screw cap and autosampler vials

6.9 Volumetric Pipettors and volumetric “plasticware” for dilutions of standards and extracts.

6.10 Class A volumetric flasks.

6.11 HDPE bottles – various sizes, shown to be PFAS free

7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified neat or reference standards. All standards must be logged in the HPLC Standards Logbook. All standards shall be traceable to their original source. The standards must be stored at $\leq 6^{\circ}\text{C}$, or as recommended by the manufacturer. Calibration levels, spike and isotope dilution standard concentrations, preparation information, and vendor part numbers can be found in the LCMS STD Summary in the Active SOP directory. A summary of the calibration concentrations can be found in Table 3.

7.1.1 Stock Standard Solutions

Stock standards are available from some commercial vendors. All vendors must supply a "Certificate of Analysis" with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor's expiration date. Once opened, the hold time is reduced to one year or the vendor's expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with methanol. The hold time for intermediate standards is six months or the vendor's expiration date (whichever is shorter). Intermediate standards may need to be remade if comparisons to other standards indicate analyte degradation or concentration changes. Intermediate standards should be prepared using the dilution mix and stored in polyethylene vials.

7.1.3 Calibration Standards

Calibration standards for Perfluorinated analytes are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. Calibration standards are prepared in methanol. The low standard is at a concentration at or below the RL and the remaining standards defines the working range of the detector. Calibration standards should be prepared using the dilution mix and be stored in polyethylene vials. See Table 3 for levels.

Calibration standards concentrations for the sulfonates may need to be corrected for the molecular weight of the cation in the salt. Check the vendor's Certificate of Analysis to see if their nominal concentration is based on the acid or salt

$$\text{Mass}_{\text{acid}} = \text{Mass}_{\text{salt}} \times \text{MW}_{\text{acid}}/\text{MW}_{\text{salt}}$$

MW_{acid} = Molecular weight of PFAA

MW_{salt} = Molecular weight of the salt

Perfluorinated analytes may exist in branched and/or linear form. If a branched form is commercially available, then the calibration standards

**CONTROLLED COPY
DO NOT DUPLICATE**

must contain the branched and linear form. PFHxS, PFOS, MeFOSAA and EtFOSAA are currently available in mixes of branched and linear isomers.

Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 HPLC/MS/MS Conditions

7.2.1 HPLC Conditions

6-10ul autosampler injection Column temperature – 50.0 °C

Gradient Program

Eluent A – Acetonitrile

Eluent B – 2mM ammonium acetate in 95:5 water:acetonitrile

Time (min)	A (%)	B (%)	Flow (mL/min)
0.20 min	10.0 %	90.0 %	0.350 mL/min
4.00 min	30.0 %	70.0 %	0.350 mL/min
7.00 min	55.0 %	45.0 %	0.350 mL/min
9.00 min	75.0 %	25.0 %	0.350 mL/min
10.00 min	95.0 %	5.0 %	0.400 mL/min
10.30 min	95.0 %	5.0 %	0.400 mL/min
10.40 min	2.0 %	98.0 %	0.400 mL/min
11.80 min	2.0 %	98.0 %	0.400 mL/min
13.00 min	2.0 %	98.0 %	0.350 mL/min

7.2.2 MS/MS Conditions

Parameter	Value	Parameter	Value
Gas Temp C	250	Sheath Gas Flow (l/min)	10
Gas Flow (l/min)	10	Capillary (V)	3500
Nebulizer (psi)	50	V Charging	500
Sheath Gas Heater	300	Ionization Mode	Neg ESI
Collision Cell Gas (psi)	40	Collision Cell Gas	UHP N2

Fragmentation voltages and collisions energies are optimized for each analyte and are stored in the instrument method. Precursor ions and transition masses are listed in Table 2.

LC/MS/MS conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

CONTROLLED COPY
DO NOT DUPLICATE

7.3 Sample Preparation

7.3.1 Low Level Aqueous Samples

A 500ml aliquot of sample (entire bottle) is extracted utilizing a solid phase extraction cartridge. The cartridge is eluted with basic methanol. The extract is carbon cleaned, filtered and the final volume is adjusted to 5.0ml, and then transferred to a centrifuge tube for storage. Refer to SOP OP075.

7.3.2 Solid Samples

A 5-gram aliquot of sample is extracted with basic methanol utilizing vortex mixer and a shaker table. The extract is carbon cleaned, SPE cleaned, filtered and the final volume is adjusted to 5.0ml, and then transferred to a centrifuge tube for storage. Refer to SOP OP076.

7.4 HPLC/MS/MS Analysis

Instrument calibration consists of four major sections:

Mass Tuning and Calibration
Transition Window Selection
Initial Calibration Procedures
Continuing Calibration Verification

7.4.1 Mass Calibration and Transition Window Selection

The instrument must have a valid mass calibration prior to any sample analysis. The mass calibration must be updated as needed. (i.e. QC failures, ion masses showing large deviations from known masses, or after major instrument maintenance is performed). It is recommended that the mass calibration be verified weekly through the analysis of a Check Tune. The Agilent Check Tune Masses range from 112.99 to 2233.91 amu for MS1 and 69.00 to 2233.91 for MS2.

The Check Tune Report may show both Positive and Negative ESI Results. Only the Negative results need to be evaluated. Unit resolution is demonstrated when the value of the peak width at half-height is within 0.5 ± 0.1 amu of the true value.

MS1 (UNIT)	MS2 (UNIT)
	69.00
112.99	112.99
302.00	302.00
601.98	601.98
1033.99	1033.99
1633.95	1633.95
2233.91	2233.91

Since masses greater than 1033.99 amu are not used for this method, the 1633.95 and 2233.91 amu masses must be present but do not need to be within 0.1 amu of the true value.

The Branched/Linear RT Check and mid-point calibration standard are used to check the analyte retention times. These retention times are used to update the transition windows. The windows must be wide enough to ensure that the branched and linear isomer the PFAS analytes are completely within the transition window. The branched isomers will elute just prior to the linear isomer. If they are partially cut off, adjust the retention time of the linear isomer or the width of the transition window. Use a similar size window for the other analytes that do not have a branched standard. Later eluting peaks are broader and require a slightly wider transition windows because of peak broadening.

7.4.2 Initial Calibration Procedures

Before samples can be run, the LC/MS/MS system must be calibrated.

7.4.2.1 Isotope Dilution Standard (Extracted Internal Standard) Calibration

A minimum 7-point calibration curve is created for the native PFAS compounds using an Isotope Dilution or Extracted Internal Standard technique. SGS - Orlando routinely performs an 8-point calibration to maximize the calibration range and to allow for quadratic fits. See Table 3.

The calibration standards for PFHxS, PFOS, MeFOSAA, and EtFOSAA must consist of both branched and linear isomers. The branched isomer elutes just prior to the linear isomer. These four PFAS are currently being reported as the sum of the branched and linear isomers so both the branched and linear isomers in the calibration standards must be integrated.

Response factors (RF) for each analyte at each calibration level are determined as follows:

$$RF = (A_{\text{analyte}} \times C_{\text{ids}}) / (A_{\text{ids}} \times C_{\text{analyte}})$$

A_{analyte}	=	area of the analyte
A_{ids}	=	area of the isotope dilution standard
C_{analyte}	=	concentration of the analyte
C_{ids}	=	concentration of the isotope dilution standard.

The mean RF and standard deviation of the RF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

$$\%RSD = (\text{Standard Deviation of RF} \times 100) / \text{Mean RF}$$

**CONTROLLED COPY
DO NOT DUPLICATE**

If the $\%RSD \leq 20\%$, linearity through the origin can be assumed and the mean RF can be used to quantitate target analytes in the samples.

Alternatively, a calibration curve of response vs. amount can be plotted. Linear regressions may be unweighted or weighted as $1/x$ or $1/x^2$. If a linear or non-linear regression is used, then the Relative Standard Error (%RSE) must be calculated.

Calculation of Relative Standard Error (%RSE)

$$RSE = 100 \times \sqrt{\sum_{i=1}^n \left[\frac{x'_i - x_i}{x_i} \right]^2 / (n - p)}$$

x'_i = Measured amount of analyte at calibration level i , in mass or concentration units.

x_i = True amount of analyte at calibration level i , in mass or concentration units.

p = Number of terms in the fitting equation.
(average = 1, linear = 2, quadratic = 3)

n = Number of calibration points.

If Relative Standard Error (%RSE) $\leq 20\%$, then the curve can be used to quantitate target analytes in the samples.

This method allows for the use of average response factors, linear regressions, and non-linear regressions.

Regardless of which model is used, each point should be refitted against the initial calibration. Use % Error to evaluate the difference between the measured and the true amounts or concentrations used to create the model. The MassHunter software will do this automatically.

Calculation of the % Error

$$\% \text{ ERR} = (x_i - x'_i) / x_i * 100$$

x'_i = Measured amount of analyte at calibration level i , in mass or concentration units.

x_i = True amount of analyte at calibration level i , in mass or concentration units.

Percent error between the calculated and expected amounts of an analyte should be $\leq \pm 30\%$ (70-130% of True Value) for all standard levels, except the lowest point which should be $\leq \pm 50\%$ (50-150% of True Value).

7.4.2.2 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV must be prepared from a second source at a mid-range concentration.

NOTE: Second source standards may consist of linear isomers only.

The %D for the compound of interest must be $\leq \pm 30\%$ (70-130% of True Value). If the ICV does not meet criteria, a fresh standard must be prepared. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, make fresh calibration standards. Recalibrate the instrument.

NOTE: Analyze the branched/linear standard to identify the branched isomers. This is a qualitative standard only. Currently is should contain branched isomers of PFOA, PFNA, PFOSA, MeFOSE, EtFOSE, MeFOSA and EtFOSA. This standard is loaded into LIMS as an ICV.

7.4.2.3 Bile Salt Interference Check and Branched/Linear Retention Time Check.

The separation between Taurodeoxycholic Acid (TDCA) and PFOS must be verified with each ICAL.

Inject a mid-level PFAS standard that has been fortified with 1 ug/ml TDCA. The standard may also contain Taurochenodeoxycholic Acid (TCDCA) and Tauroursodeoxycholic Acid (TUDCA) as well.

PFOS and TDCA must be separated by at least 1 minute.

7.4.2.4 Branched/Linear RT Check

Analyze the branched/linear RT standard to identify the branched isomers. This is a qualitative standard only. Currently is should contain branched isomers of PFOA, PFNA, PFOSA, MeFOSE, EtFOSE, MeFOSA and EtFOSA. This standard is loaded into LIMS as an RT Check.

7.4.2.5 Highest Standard and Instrument Blank

Analyze an instrument blank (IBLK) immediately following the highest standard analyzed. The highest standard analyzed may be analyzed as part of the calibration curve or following the calibration curve. The highest standard may be at or above the concentration of highest level of the calibration. It cannot be used to extend the calibration range.

The instrument blank must be analyzed immediately following the highest standard. The instrument blank must be free of any analytes of interest or interferences at $\frac{1}{2}$ the required LOQ to be acceptable.

If the acceptance criteria is not met, the concentration of the standard should be lowered and another blank analyzed.

The highest standard and instrument blank pair are used only to document a highest concentration at which carryover does not occur. If a sample concentration exceeds this range and the sample(s) following have reportable detections for that analyte, then they must be reanalyzed.

7.4.2.6 Retention Time Windows

The retention time of each analyte and extracted internal standard must fall within **0.4 minutes** of the predicted retention times from the daily calibration verification or from the midpoint standard of the ICAL (on days when an ICAL is performed).

Establish the center of the retention time window for each analyte and surrogate by using the absolute retention time for each analyte and extracted internal standard from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.

Initial peak identification is based on the retention time of a peak falling within the retention time window for a given analyte. Time reference peaks (extracted internal standards) are used to correct for run-to-run variations in retention times due to temperature, flow, or injector fluctuations. HPLC retention times tend to shift more than GC retention times.

The retention time of the target analyte must fall within **0.1 minutes** of the associated isotope dilution standard (for analytes that have an exact isotopic counterpart).

7.4.2.7 Ion Ratios and Signal to Noise

A minimum of two transition ions are monitored for each target analyte except for those analytes in Table 2 which only have a single transition ion.

The ratio of the primary and secondary transition masses should be updated from the initial calibration. They may be updated from the midpoint standard or from an average of all levels. Additionally, the ion ratio may be updated from the opening daily CCV.

Isotope Ratio criteria is still being developed for EPA method 1633. The MassHunter software calculates the ratio as the response of the primary transition mass divided by the response of the secondary transition mass times 100. It is set to flag the analyte if the ratio of these ions is not within $\pm 50\%$ of the expected, (e.g., if the ion ratio is expected to be 50% in the standard, the ion ratio in the corresponding sample must be between 25 and 75%).

Primary and secondary transition masses must maximize within ± 2 seconds.

The signal to noise ratio for the primary transition mass must be at least 3 times that of the background and the secondary transition mass must be at least 3 times that of the background.

7.4.3 Daily Calibration and Carryover Verifications

7.4.3.1 Continuing Calibration Verification (CCV)

Continuing calibration verification standards for the Perfluorinated compounds are prepared at low and mid-range concentration. CCV standards are prepared from the same stock as the initial calibration standards.

A low level CCV must be analyzed at the beginning of each analytical sequence (prior to sample analysis) and at least once every 24 hours during the sequence to ensure accuracy at the LOQ.

The CCV must be analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally, the mid-point CCV must be analyzed after every 10 samples.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| must be $\leq \pm 30\%$ for the target analytes and EIS in each CCV.

If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet

criteria, the system must be recalibrated. If the second standard meets criteria, then a third standard must be analyzed. If the third standard also meets criteria, then the system is considered in control and results may be reported.

If the [%D] is outside the control limits, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Qualifying the data should only be done if the sample cannot be reanalyzed. Under certain circumstances, the data may be reported, i.e. The CCV failed high, the associated QC passed, and the samples were ND.

For QSM 5.4 all samples must be bracketed with passing CCV.

NOTE: Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed, or the data must be qualified.

7.4.3.2 Carryover Verification

A high standard and an instrument blank (IBLK) must be analyzed each day prior to the analysis of samples. The high standard may be at or above the concentration of highest level of the calibration.

The instrument blank must be analyzed immediately following the high standard. The instrument blank must be free of any analytes of interest or interferences at $\frac{1}{2}$ the required LOQ to be acceptable.

If the acceptance criteria are not met, the concentration of the standard should be lowered, and another blank analyzed.

The highest standard and instrument blank pair are used only to document a highest concentration at which carryover does not occur. If sample concentrations exceed this range and the sample(s) following exceed this acceptance criteria ($>1/2$ LOQ), they must be reanalyzed.

7.4.3.3 Continuing Calibration Blank (CCB)

An additional blank must be analyzed after each CCV to ensure no carry over from the standard. The instrument blank must be free of any analytes of interest or interferences at $\frac{1}{2}$ the required LOQ to be acceptable. The CCB is loaded into LIMS as "ICCB".

If the acceptance criteria are not met, the system should be checked. Any samples bracketed by the failing CCB must be reanalyzed.

Review the data to see if there was a high sample prior to the CCV/CCB pair that may have contaminated the system? If so, clean the system and run additional blanks to see if the system is in control.

7.4.3.4 Bile Salt Interference Check.

For QSM 5.4 the separation between Taurodeoxycholic Acid (TDCA) and PFOS must be verified daily.

Inject a mid-level PFAS standard that has been fortified with 1 ug/ml TDCA. The standard may also contain Taurochenodeoxycholic Acid (TCDCA) and Tauroursodeoxycholic Acid (TUDCA) as well.

PFOS and TDCA must be separated by at least 1 minute.

7.4.3.5 Branched.Linear RT Check

Analyze the branched/linear RT standard daily to identify the branched isomers. This is a qualitative standard only. Currently is should contain branched isomers of PFOA, PFNA, PFOSA, MeFOSE, EtFOSE, MeFOSA and EtFOSA. This standard is loaded into LIMS as an RT Check

7.4.4 Sample Extract Analysis

7.4.4.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

- Initial Calibration Standards (or Initial CCV and low level CCV)
- Carryover Check Standard
- Instrument Blank (IBLK)
- Bile Salt Interference Check
- Branched/Linear RT Check
- CCV Standards
 - Low-Level (LOQ)
 - Mid-Level
- QC Extracts
- Sample Extracts
- Bracketing CCV Standards
- Bracketing CCB Standards

7.4.4.2 Six to ten microliters (same amount as standards) of extract is injected into the HPLC by the autosampler. The data system then records the resultant peak responses and retention times.

7.4.4.3 Tentative identification of an analyte occurs when the peak from the sample extract falls within the retention time window of the target compound.

- 7.4.4.4 Positive identification is confirmed by comparing the ion ratio in the sample to the ion ratio of the standards. For the linear isomer, the primary and secondary transition masses must both be present. For the branched isomers the primary and secondary transition masses should both be present. In rare circumstances a particular branched peak may only exhibit the primary transition ion. These should be omitted from the quantitation.

The MassHunter software is set to flag the analyte if the ratio of these ions is not within $\pm 30\%$ of the expected, (e.g., if the ion ratio is expected to be 50% in the standard, the ion ratio in the corresponding sample must be between 20 and 80%).

The signal to noise ratio for the primary transition mass must be at least 3 times that of the background and the secondary transition mass must be at least 3 times that of the background.

- 7.4.4.5 Some of the PFASs may have multiple chromatographic peaks due to the presence of linear and branched isomers. This is prevalent in PFHxS and PFOS. The areas of all the linear and branched isomers peaks must be included and the concentrations reported as a total for each of these analytes.

NOTE: The branched isomers must be included in the quantitation even if the calibration is based on just the linear isomer.

- 7.4.4.6 If the compound identification does not confirm, then the result should be reported as ND or "U".
- 7.4.4.7 If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.

Dilutions for this method are performed differently depending on the concentration of the target analytes in the extract. For dilutions in the 2x to 10x range, the extract is diluted with the dilution mix. No additional EIS nor NIS are added.

If the responses for each EIS in the diluted extract meet the S/N requirements in Section 7.4.2.6 and retention time requirements in Section 7.4.2.5, and the EIS recoveries from the analysis of the diluted extract are greater than 5%, then the compounds associated with those EISs may be quantified using isotope dilution.

Use the EIS recoveries from the original analysis to select the dilution factor, with the objective of keeping the EIS recoveries in the dilution above that 5% lower limit (i.e., if the EIS recovery of the affected analyte in the undiluted analysis is 50%, then the sample cannot be

diluted more than 10:1; if the if the EIS recovery of the affected analyte in the undiluted analysis is 30%, then the sample cannot be diluted more than 6:1).

For dilutions greater than 10-fold, a smaller aliquot should be extracted. The estimated analyte concentration from below can be used to determine the best aliquot size.

If no additional sample is available, then additional EIS and NIS are added, and the sample re-analyzed. The theoretical concentration of the isotope dilution standards in the extract will need to be entered into MassHunter so that the software can correctly calculate the native analyte concentration. This result is estimated based on an internal standard approach. The results should be footnoted as such.

- 7.4.4.8 If peak identification is prevented by the presence of interferences, further cleanup may be required, or the extract must be diluted so that the interference does not mask any analytes.

7.5 Maintenance and Trouble Shooting

- 7.5.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.
- 7.5.2 All instrument maintenance must be documented in the appropriate "Instrument Repair and Maintenance" log. The log will include such items as problem, action taken, correction verification, date, and analyst.
- 7.5.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.
- 7.5.4 PC and software changes must be documented in the "Instrument Repair and Maintenance" log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), low-level blank spikes (LLBS), matrix spikes (MS), matrix spike duplicates (MSD) and sample duplicates (DUP). The MB, BS, LLBS are used to monitor overall method performance, while the MS and MSD or DUP are used to evaluate the method performance and reproducibility in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

CONTROLLED COPY
DO NOT DUPLICATE

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of isotope dilution standards and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), matrix spike duplicate (MSD) or sample duplicate (DUP). All control limits are updated annually and are listed in the LIMS.

9.1 Non-Extracted Internal Standards (NIS)

9.1.1 The analytes listed in section 5.10 are used as the Non-Extracted Internal Standards for this method. The response of the NIS in all subsequent runs must be 30-200% of the average response from the initial calibration.

9.1.2 If the NIS responses are not within limits, the following are required.

9.1.2.1 Check to be sure that there are no errors in calculations, integrations, or internal standards solutions. If errors are found, recalculate the data accordingly.

9.1.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.1.2.3 If no problem is found, prepare a second aliquot of extract and reanalyze the sample.

9.1.2.4 If upon reanalysis, the responses are still not within limits, reanalyze the sample at a dilution.

9.1.2.5 If upon analysis of the dilution the responses are within limits, then the sample or select analytes may need to be reported from the dilution or qualified.

9.2 Extracted Internal Standard (EIS)

9.2.1 The analytes listed in section 5.11 are used as the Extracted Internal Standards for this method.

A known amount of isotope dilution standard is added to each sample including the QC set prior to extraction. The recovery (corrected for dilution) for each isotope dilution standard must be 20% to 150%.

The % recovery may be calculated are calculated from the calculated concentrations.

$$\% \text{ Recovery} = (\text{Sample Amount} / \text{Amount Spiked}) \times 100$$

Only those isotope dilution standards that directly link to the native analytes being reported need to pass. For example, 13C4-PFBA only needs to pass if PFBA is being reported.

- 9.2.2 If any isotope dilution standard response/recovery is not within the established control limits, the following are required.
- 9.2.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, isotope dilution standard solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.
 - 9.2.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.
 - 9.2.2.3 Check for instrument suppression or enhancement by reanalyzing the sample at a dilution.
 - 9.2.2.4 If no problem is found re-extract and reanalyze the sample. **NOTE:** If the recoveries are high and the sample is non-detect, then re-extraction may not be necessary. If there is insufficient sample for re-extraction, reanalyze the sample and footnote this on the report.
 - 9.2.2.5 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Isotope dilution standards from both sets of analysis must be reported on the final report.

9.2 Method Blank

- 9.2.1 The method blank is either HPLC water or cleaned sand (depending upon sample matrix). The method blank is then taken through all procedures along with the other samples to determine any contamination from reagents, glassware, or high-level samples. The method blank must be free of any analytes of interest or interferences at ½ the required LOQ to be acceptable. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a "B" or "V" qualifier.
- 9.2.2 If the MB is contaminated but the samples are non-detect, then the source of contamination must be investigated and documented. The samples may need to be re-extracted and reanalyzed for confirmation. **For any DoD QSM projects the resulting data must be qualified accordingly.** If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

**CONTROLLED COPY
DO NOT DUPLICATE**

- 9.2.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination must be investigated and documented. The samples results may be reported with the appropriate "B" or "V" qualifier. This must be approved by the department supervisor.
- 9.2.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination must be investigated and documented. The samples must be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

9.3 Blank Spike

- 9.3.1 The blank spike is either HPLC water or cleaned sand (depending upon sample matrix) to which the spike standard has been added. The blank spike is then taken through all procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

$$\% \text{ Recovery} = (\text{Blank Spike Amount} / \text{Amount Spiked}) \times 100$$

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable. As additional analytes are added to this method, the recoveries will need to be carefully evaluated.

- 9.3.2 If the blank spike recoveries are not within the established control limits, the following are required.
- 9.3.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.
- 9.3.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.
- 9.3.2.3 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable. **For any DoD QSM projects the resulting data must be qualified accordingly.**
- 9.3.2.4 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

- 9.3.2.5 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

9.4 Low-Level Blank Spike

- 9.4.1 The low-level blank spike is either HPLC water or cleaned sand (depending upon sample matrix) to which the spike standard has been added at no more than 2 times the LLOQ. The low-level blank spike is then taken through all procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

$$\% \text{ Recovery} = (\text{Blank Spike Amount} / \text{Amount Spiked}) \times 100$$

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable. As additional analytes are added to this method, the recoveries will need to be carefully evaluated.

- 9.4.2 If the low-level blank spike recoveries are not within the established control limits, the following are required.
- 9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.
- 9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.
- 9.4.2.3 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable. **For any DoD QSM projects the resulting data must be qualified accordingly.**
- 9.4.2.4 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.
- 9.4.2.5 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers must be added to the results. This must be approved by the department supervisor.

9.5 Matrix Spike and Matrix Spike Duplicate

- 9.5.1 Matrix spike and spike duplicates are replicate sample aliquots to which the spike standard has been added. The matrix spike and spike duplicate are then taken through all procedures along with the other samples to monitor the precision and accuracy of the procedure. The percent recovery for each analyte is calculated as follows:

$$\% \text{ Recovery} = [(\text{Spike Amount} - \text{Sample Amount}) / \text{Amount Spiked}] \times 100$$

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

- 9.5.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.5.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.5.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.5.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extract but are indications of the sample matrix effects.

9.5.3 Precision

Matrix spike and spike duplicate recoveries for each analyte OR sample result and duplicate result are used to calculate the relative percent difference (RPD) for each compound.

$$\text{RPD} = [| \text{MS Result} - \text{MSD Result} | / \text{Average Result}] \times 100$$

The RPD for each Perfluorinated compound must be less than 30%. If the RPDs fall outside of the established control limits, the MS/MSD should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

9.5 Matrix Duplicate

- 9.5.1 The duplicate is a replicate sample that is taken through all procedures along with the other samples to monitor the precision. The matrix duplicates are analyzed with each batch of samples.
- 9.5.2 Matrix spike and spike duplicate recoveries for each analyte OR sample result and duplicate result are used to calculate the relative percent difference (RPD) for each compound.

$$RPD = [| \text{Sample Result} - \text{DUP Result} | / \text{Average Result}] \times 100$$

The RPD for each Perfluorinated compound must be less than 30%. If the RPDs fall outside of the established control limits, the DUP should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

10.0 CALCULATIONS

The concentration of each Perfluorinated compound in the original sample is calculated as follows:

$$\text{Water (ug/l)} = (\text{CONC}_{\text{inst}}) \times (V_F / V_I) \times \text{DF}$$

$$\text{Soil (ug/kg)} = [(\text{CONC}_{\text{inst}}) \times (V_F / W_I) \times \text{DF}] / \% \text{solids}$$

CONC _{inst}	=	Instrument concentration calculated from the initial calibration using mean CF or curve fit (ppb)
DF	=	Dilution Factor
V _F	=	Volume of final extract (ml)
V _I	=	Volume of sample extracted (ml)
W _I	=	Weight of sample extracted (g)
%solids	=	Dry weight determination in decimal form

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst must follow normal safety procedures as outlined in the SGS Health and Safety Program, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample must be treated as a potential health hazard. Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure

must be reduced to the lowest possible level. Personal protective equipment must be used by all analysts.

11.2 Pollution Prevention

Wastewater and acetonitrile from the instrument are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

Sample Extracts are archived and stored for 30 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

Draft EPA Method 1633, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, August 2021

2nd Draft EPA Method 1633, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, June 2022

Revised Errata Sheet for Draft Method 1633, February 2022

DOD QSM 5.4, November 2021

TABLE 1: Target Analytes

PFAS Analyte	Acronym	CAS #
Perfluorobutanoic acid	PFBA	375-22-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluoroundecanoic acid	PFUnA	2058-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorotridecanoic acid	PFTriA	72629-94-8
Perfluorotetradecanoic acid	PFTeA	376-06-7
Perfluorobutane sulfonate	PFBS	29240-43-3
Perfluoropentane sulfonate	PFPeS	2706-91-4
Perfluorohexane sulfonate	PFHxS	108427-53-8
Perfluoroheptane sulfonate	PFHpS	375-92-8
Perfluorooctane sulfonate	PFOS	1763-23-1
Perfluorononane sulfonate	PFNS	68259-12-1
Perfluorodecane sulfonate	PFDS	67906-42-7
Perfluorododecanesulfonate	PFDoDS	79780-39-5
4:2 Fluorotelomer sulfonate	4:2 FTS	757124-72-4
6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4

TABLE 1: Target Analytes

PFAS Analyte	Acronym	CAS #
3:3 Fluorotelomer carboxylate	3:3 FTCA	356-02-5
5:3 Fluorotelomer carboxylate	5:3 FTCA	914637-49-3
7:3 Fluorotelomer carboxylate	7:3 FTCA	812-70-4
N-ethyl perfluorooctanesulfonamido acetic acid	EtFOSAA	2991-50-6
N-methyl perfluorooctanesulfonamido acetic acid	MeFOSAA	2355-31-9
Perfluorooctane sulfonamide	PFOSA	754-91-6
N-Ethyl perfluorooctane sulfonamide	EtFOSA	4151-50-2
N-Methyl perfluorooctane sulfonamide	MeFOSA	31506-32-8
N-Ethyl perfluorooctane sulfonamidoethanol	EtFOSE	1691-99-2
N-Methyl perfluorooctane sulfonamidoethanol	MeFOSE	24448-09-7
Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6
11-chloroicosafuoro-3-oxaundecade-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
4,8-dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6
Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA	113507-82-7
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5

TABLE 2: Precursor and Primary Transition Masses

Analyte	Type	RT	Primary Transition	Secondary Transition	Reference Compound
13C3-PFBA	NIS	3.34	216.0 -> 172.0		
13C4-PFBA	EIS	3.34	216.8 -> 171.9		13C3-PFBA
PFBA	Target	3.34	212.8 -> 168.9		13C4-PFBA
PFMPA	Target	3.99	229.0 -> 84.9		13C5-PFPeA
3:3FTCA	Target	4.32	241.0 -> 177.0	241.0 -> 117.0	13C5-PFPeA
13C5-PFPeA	EIS	4.93	268.3 -> 223.0		13C2-PFHxA
PFPeA	Target	4.93	263.0 -> 219.0		13C5-PFPeA
PFMBA	Target	5.38	279.0 -> 85.1		13C5-PFPeA
13C2-4:2FTS	EIS	5.85	329.1 -> 80.9		18O2-PFHxS
4:2FTS	Target	5.85	327.1 -> 307.0	327.1 -> 80.9	13C2-4:2FTS
NFDHA	Target	6.08	295.0 -> 201.0	295.0 -> 84.9	13C5-PFHxA
13C3-PFBS	EIS	6.15	302.1 -> 79.9		18O2-PFHxS
PFBS	Target	6.15	298.7 -> 79.9	298.7 -> 98.8	13C3-PFBS
13C2-PFHxA	NIS	6.20	315.1 -> 270.0		
13C5-PFHxA	EIS	6.20	318.0 -> 273.0		13C2-PFHxA
PFHxA	Target	6.20	313.0 -> 269.0	313.0 -> 118.9	13C5-PFHxA
13C3-HFPO-DA	EIS	6.59	286.9 -> 168.9		13C2-PFHxA
HFPO-DA	Target	6.59	284.9 -> 168.9	284.9 -> 184.9	13C3-HFPO-DA
PFEESA	Target	6.71	314.8 -> 134.9	314.8 -> 82.9	13C5-PFHxA
5:3FTCA	Target	6.82	341.0 -> 237.1	341.0 -> 217.0	13C5-PFHxA
13C4-PFHpA	EIS	7.14	367.1 -> 322.0		13C2-PFHxA
PFHpA	Target	7.14	363.1 -> 319.0	363.1 -> 169.0	13C4-PFHpA
PFPeS	Target	7.22	349.1 -> 79.9	349.1 -> 98.9	13C3-PFHxS
ADONA	Target	7.40	376.8 -> 250.9	376.8 -> 84.8	13C3-HFPO-DA
13C2-6:2FTS	EIS	7.56	429.1 -> 80.9		18O2-PFHxS
6:2FTS	Target	7.56	427.1 -> 407.0	427.1 -> 80.9	13C2-6:2FTS
13C4-PFOA	NIS	7.81	417.1 -> 172.0	417.1 -> 372.0	
13C8-PFOA	EIS	7.81	421.0 -> 376.0		13C4-PFOA
PFOA	Target	7.81	413.0 -> 369.0	413.0 -> 169.0	13C8-PFOA
PFHxS	Target	7.96	398.9 -> 79.9	398.9 -> 98.9	13C3-PFHxS
18O2-PFHxS	NIS	7.97	403.0 -> 83.9		
13C3-PFHxS	EIS	7.97	402.1 -> 79.9		18O2-PFHxS
7:3FTCA	Target	8.27	441.0 -> 316.9	441.0 -> 336.9	13C5-PFHxA
13C5-PFNA	NIS	8.40	468.0 -> 427.0		
13C9-PFNA	EIS	8.40	472.1 -> 427.0		13C5-PFNA
PFNA	Target	8.40	463.0 -> 419.0	463.0 -> 219.0	13C9-PFNA

**CONTROLLED COPY
DO NOT DUPLICATE**

TABLE 2: Precursor and Primary Transition Masses

Analyte	Type	RT	Primary Transition	Secondary Transition	Reference Compound
PFHpS	Target	8.58	449.0 -> 79.9	449.0 -> 98.8	13C8-PFOS
13C2-8:2FTS	EIS	8.69	529.1 -> 80.9		18O2-PFHxS
8:2FTS	Target	8.70	527.1 -> 507.0	527.1 -> 80.8	13C2-8:2FTS
13C2-PFDA	NIS	8.95	515.1 -> 470.1		
13C6-PFDA	EIS	8.95	519.1 -> 474.1		13C2-PFDA
PFDA	Target	8.95	512.9 -> 469.0	512.9 -> 219.0	13C6-PFDA
d3-MeFOSAA	EIS	8.97	573.2 -> 419.0		13C4-PFOS
MeFOSAA	Target	8.97	570.1 -> 419.0	570.1 -> 483.0	d3-MeFOSAA
13C4-PFOS	NIS	9.14	503.8 -> 79.9		
13C8-PFOS	EIS	9.13	507.1 -> 79.9		13C4-PFOS
PFOS	Target	9.14	498.9 -> 79.9	498.9 -> 98.8	13C8-PFOS
d5-EtFOSAA	EIS	9.19	589.2 -> 419.0		13C4-PFOS
EtFOSAA	Target	9.20	584.2 -> 419.1	584.2 -> 526.0	d5-EtFOSAA
13C7-PFUnDA	EIS	9.44	570.0 -> 525.1		13C2-PFDA
PFUnDA	Target	9.44	563.1 -> 519.0	563.1 -> 269.1	13C7-PFUnDA
9CI-PF3ONS	Target	9.49	530.8 -> 351.0	532.8 -> 353.0	13C3-HFPO-DA
PFNS	Target	9.63	548.8 -> 79.9	548.8 -> 98.8	13C8-PFOS
13C2-PFDoDA	EIS	9.87	615.1 -> 570.0		13C2-PFDA
PFDoDA	Target	9.87	613.1 -> 569.0	613.1 -> 319.0	13C2-PFDoDA
PFDS	Target	10.05	599.0 -> 79.9	599.0 -> 98.8	13C8-PFOS
13C8-FOSA	EIS	10.23	506.1 -> 77.8		13C4-PFOS
FOSA	Target	10.23	498.1 -> 77.9	498.1 -> 478.0	13C8-FOSA
PFTeDA	Target	10.26	663.0 -> 619.0	663.0 -> 168.9	13C2-PFDoDA
11CI-PF3OUdS	Target	10.32	630.9 -> 451.0	632.9 -> 453.0	13C3-HFPO-DA
13C2-PFTeDA	EIS	10.60	715.1 -> 670.0		13C2-PFDA
PFTeDA	Target	10.60	713.1 -> 669.0	713.1 -> 168.9	13C2-PFTeDA
PFDoDS	Target	10.75	699.1 -> 79.9	699.1 -> 98.8	13C8-PFOS
d7-MeFOSE	EIS	11.21	623.1 -> 58.9		13C4-PFOS
MeFOSE	Target	11.22	616.1 -> 58.9		d7-MeFOSE
d3-MeFOSA	EIS	11.30	515.0 -> 219.0		13C4-PFOS
MeFOSA	Target	11.30	512.0 -> 219.0	512.0 -> 169.0	d3-MeFOSA
d9-EtFOSE	EIS	11.45	639.1 -> 58.9		13C4-PFOS
EtFOSE	Target	11.46	630.0 -> 58.9		d9-EtFOSE
d5-EtFOSA	EIS	11.53	531.1 -> 219.0		13C4-PFOS
EtFOSA	Target	11.53	526.0 -> 219.0	526.0 -> 169.0	d5-EtFOSA

TABLE 3: Standard Levels (Targets)

Compound	CS1	CS2	CS3	CS4 (CV1)	CS5	CS6	CS7	CS8
Perfluoroalkyl carboxylic acids								
PFBA	0.8	2.0	5.0	10	20	50	100	250
PFPeA	0.4	1.0	2.5	5	10	25	50	125
PFHxA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFHpA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFOA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFNA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFDA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFUnA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFDoA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFTTrDA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
PFTeDA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
Perfluoroalkyl sulfonic acids								
PFBS	0.177	0.444	1.109	2.218	4.435	11.0875	22.175	55.438
PFPeS	0.188	0.471	1.176	2.353	4.705	11.7625	23.525	58.813
PFHxS	0.183	0.457	1.143	2.285	4.570	11.4250	22.850	57.125
PFHpS	0.191	0.477	1.191	2.383	4.765	11.9125	23.825	59.563
PFOS	0.186	0.464	1.160	2.320	4.640	11.6000	23.200	58.000
PFNS	0.192	0.481	1.203	2.405	4.810	12.0250	24.050	60.125
PFDS	0.193	0.483	1.206	2.413	4.825	12.0625	24.125	60.313
PFDoS	0.194	0.485	1.213	2.425	4.850	12.1250	24.250	60.625
Fluorotelomer sulfonic acids								
4:2FTS	0.750	1.875	4.688	9.375	18.750	46.875	93.750	234.375
6:2FTS	0.760	1.900	4.750	9.500	19.000	47.500	95.000	237.500
8:2FTS	0.768	1.920	4.800	9.600	19.200	48.000	96.000	240.000
Perfluorooctane sulfonamides								
PFOSA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
NMeFOSA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
NEtFOSA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
Perfluorooctane sulfonamidoacetic acids								
NMeFOSAA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
NEtFOSAA	0.2	0.5	1.25	2.5	5.0	12.5	25	62.5
Perfluorooctane sulfonamide ethanols								
NMeFOSE	2	5.0	12.5	25	50	125	250	625
NEtFOSE	2	5.0	12.5	25	50	125	250	625
Per- and polyfluoroether carboxylic acids								
HFPO-DA	0.8	2.0	5.0	10	20	50	100	250
ADONA	0.756	1.89	4.725	9.45	18.9	47.25	94.5	236.25
PFMPA	0.4	1.0	2.5	5.0	10	25	50	125
PFMBA	0.4	1.0	2.5	5.0	10	25	50	125
NFDHA	0.4	1.0	2.5	5.0	10	25	50	125
Ether sulfonic acids								
9Cl-PF3ONS	0.748	1.87	4.675	9.35	18.7	46.75	93.5	233.75
11Cl-PF3OUdS	0.756	1.89	4.725	9.45	18.9	47.25	94.5	236.25
PFEESA	0.356	0.89	2.225	4.45	8.90	22.25	44.50	111.25
Fluorotelomer carboxylic acids								
3:3FTCA	0.9984	2.496	6.24	12.48	25.0	62.4	124.8	312.0
5:3FTCA	4.992	12.40	31.20	62.4	124.8	312.0	624.0	1560
7:3FTCA	4.992	12.40	31.20	62.4	124.8	312.0	624.0	1560

CONTROLLED COPY
DO NOT DUPLICATE

TABLE 3: Standard Levels (EIS and NIS)

	CS1	CS2	CS3	CS4 (CV1)	CS5	CS6	CS7	CS8
Extracted Internal Standard (EIS) Analytes								
B C4-PFBA	10	10	10	10	10	10	10	10
B C5-PFPeA	5	5	5	5	5	5	5	5
B C5-PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B C4-PFHpA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B C8-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B C9-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
B C6-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
B C7-PFUnA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
B C2-PFDoA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
B C2-PFTeDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
B C3-PFBS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B C3-PFHxS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B C8-PFOS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B C2-4:2 FTS	5	5	5	5	5	5	5	5
B C2-6:2 FTS	5	5	5	5	5	5	5	5
B C2-8:2 FTS	5	5	5	5	5	5	5	5
B C8-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
D3-NMeFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
D5-NMeFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
D3-NMeFOSAA	5	5	5	5	5	5	5	5
D5-NMeFOSAA	5	5	5	5	5	5	5	5
D7-NMeFOSE	25	25	25	25	25	25	25	25
D9-NMeFOSE	25	25	25	25	25	25	25	25
B C3-HFPO-DA	10	10	10	10	10	10	10	10
Non-extracted Internal Standard (NIS) Analytes								
B C3-PFBA	5	5	5	5	5	5	5	5
B C2-PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B C4-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B C5-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
B C2-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
B C2-PFHxS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B C4-PFOS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

TABLE 4: Method Names vs Lab Names

METHOD		LABORATORY		
ANALYTE NAME	ACRONYM	LIMS REPORT NAME	RAW DATA NAME	RAW DATA EIS as ISTD
Perfluorobutanoic acid	PFBA	Perfluorobutanoic acid	PFBA	
Perfluoropentanoic acid	PFPeA	Perfluoropentanoic acid	PFPeA	
Perfluorohexanoic acid	PFHxA	Perfluorohexanoic acid	PFHxA	
Perfluoroheptanoic acid	PFHpA	Perfluoroheptanoic acid	PFHpA	
Perfluorooctanoic acid	PFOA	Perfluorooctanoic acid	PFOA	
Perfluorononanoic acid	PFNA	Perfluorononanoic acid	PFNA	
Perfluorodecanoic acid	PFDA	Perfluorodecanoic acid	PFDA	
Perfluoroundecanoic acid	PFUnA	Perfluoroundecanoic acid	PFUnDA	
Perfluorododecanoic acid	PFDoA	Perfluorododecanoic acid	PFDoDA	
Perfluorotridecanoic acid	PFTTrDA	Perfluorotridecanoic acid	PFTTrDA	
Perfluorotetradecanoic acid	PFTeDA	Perfluorotetradecanoic acid	PFTeDA	
Perfluorobutanesulfonic acid	PFBS	Perfluorobutanesulfonic acid	PFBS	
Perfluoropentanesulfonic acid	PFPeS	Perfluoropentanesulfonic acid	PFPeS	
Perfluorohexanesulfonic acid	PFHxS	Perfluorohexanesulfonic acid	PFHxS	
Perfluoroheptanesulfonic acid	PFHpS	Perfluoroheptanesulfonic acid	PFHpS	
Perfluorooctanesulfonic acid	PFOS	Perfluorooctanesulfonic acid	PFOS	
Perfluorononanesulfonic acid	PFNS	Perfluorononanesulfonic acid	PFNS	
Perfluorodecanesulfonic acid	PFDS	Perfluorodecanesulfonic acid	PFDS	
Perfluorododecanesulfonic acid	PFDoS	Perfluorododecanesulfonic acid	PFDoDS	
1H,1H,2H,2H-Perfluorohexane sulfonic acid	4:2FTS	4:2 Fluorotelomer sulfonate	4:2FTS	
1H,1H,2H,2H-Perfluorooctane sulfonic acid	6:2FTS	6:2 Fluorotelomer sulfonate	6:2FTS	
1H,1H,2H,2H-Perfluorodecane sulfonic acid	8:2FTS	8:2 Fluorotelomer sulfonate	8:2FTS	
Perfluorooctanesulfonamide	PFOSA	PFOSA	FOSA	
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	EtFOSAA	EtFOSAA	
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	MeFOSAA	MeFOSAA	
N-ethyl perfluorooctanesulfonamide	NEtFOSA	EtFOSA	EtFOSA	
N-methyl perfluorooctanesulfonamide	NMeFOSA	MeFOSA	MeFOSA	
N-ethyl perfluorooctanesulfonamidoethanol	NEtFOSE	EtFOSE	MeFOSE	
N-methyl perfluorooctanesulfonamidoethanol	NMeFOSE	MeFOSE	EtFOSE	
Hexafluoropropylene oxide dimer acid	HFPO-DA	HFPO-DA (GenX)	HFPO-DA	
4,8-dioxa-3H-perfluorononanoic acid	ADONA	ADONA	ADONA	
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	9Cl-PF3ONS (F-53B Major)	9Cl-PF3ONS	
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	11Cl-PF3OUdS (F-53B Minor)	11Cl-PF3OUdS	
Perfluoro-3-methoxypropanoic acid	PFMPA	PFMPA	PFMPA	
Perfluoro-4-methoxybutanoic acid	PFMBA	PFMBA	PFMBA	
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	NFDHA	NFDHA	
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	PFEESA	PFEESA	
3-Perfluoropropyl propanoic acid	3:3FTCA	3:3 Fluorotelomer carboxylate	3:3FTCA	
2H,2H,3H,3H-Perfluorooctanoic acid	5:3FTCA	5:3 Fluorotelomer carboxylate	5:3FTCA	
3-Perfluoroheptyl propanoic acid	7:3FTCA	7:3 Fluorotelomer carboxylate	7:3FTCA	

TABLE 4: Method Names vs Lab Names

METHOD		LABORATORY		
ANALYTE NAME	ACRONYM	LIMS REPORT NAME	RAW DATA NAME	RAW DATA EIS as ISTD
Perfluoro-n-[13C4]butanoic acid	13C4-PFBA	13C4-PFBA	13C4-PFBA	M4-PFBA
Perfluoro-n-[13C5]pentanoic acid	13C5-PFPeA	13C5-PFPeA	13C5-PFPeA	M5-PFPeA
Perfluoro-n-[1,2,3,4,6-13C5]hexanoic acid	13C5-PFHxA	13C5-PFHxA	13C5-PFHxA	M5-PFHxA
Perfluoro-n-[1,2,3,4-13C4]heptanoic acid	13C4-PFHpA	13C4-PFHpA	13C4-PFHpA	M4-PFHpA
Perfluoro-n-[13C8]octanoic acid	13C8-PFOA	13C8-PFOA	13C8-PFOA	M8-PFOA
Perfluoro-n-[13C9]nonanoic acid	13C9-PFNA	13C9-PFNA	13C9-PFNA	M9-PFNA
Perfluoro-n-[1,2,3,4,5,6-13C6]decanoic acid	13C6-PFDA	13C6-PFDA	13C6-PFDA	M6-PFDA
Perfluoro-n-[1,2,3,4,5,6,7-13C7]undecanoic acid	13C7-PFUnA	13C7-PFUnDA	13C7-PFUnDA	M7-PFUnDA
Perfluoro-n-[1,2-13C2]dodecanoic acid	13C2-PFDoA	13C2-PFDoDA	13C2-PFDoDA	M2-PFDoDA
Perfluoro-n-[1,2-13C2]tetradecanoic acid	13C2-PFTeDA	13C2-PFTeDA	13C2-PFTeDA	M2-PFTeDA
Perfluoro-1-[2,3,4-13C3]butanesulfonic acid	13C3-PFBS	13C3-PFBS	13C3-PFBS	M3-PFBS
Perfluoro-1-[1,2,3-13C3]hexanesulfonic acid	13C3-PFHxS	13C3-PFHxS	13C3-PFHxS	M3-PFHxS
Perfluoro-1-[13C8]octanesulfonic acid	13C8-PFOS	13C8-PFOS	13C8-PFOS	M8-PFOS
1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]hexanesulfonic acid	13C2-4:2FTS	13C2-4:2FTS	13C2-4:2FTS	M2-4:2FTS
1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]octanesulfonic acid	13C2-6:2FTS	13C2-6:2FTS	13C2-6:2FTS	M2-6:2FTS
1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]decanesulfonic acid	13C2-8:2FTS	13C2-8:2FTS	13C2-8:2FTS	M2-8:2FTS
Perfluoro-1-[13C8]octanesulfonamide	13C8-FOSA	13C8-FOSA	13C8-FOSA	M8-FOSA
N-ethyl-d5-perfluoro-1-octanesulfonamide	D5-NEtFOSA	d5-EtFOSA	d5-EtFOSA	M5-EtFOSA
N-methyl-d3-perfluoro-1-octanesulfonamide	D3-NMeFOSA	d3-MeFOSA	d3-MeFOSA	M3-MeFOSA
N-ethyl-d5-perfluoro-1-octanesulfonamidoacetic acid	D5-NEtFOSAA	d5-EtFOSAA	d5-EtFOSAA	M5-EtFOSAA
N-methyl-d3-perfluoro-1-octanesulfonamidoacetic acid	D3-NMeFOSAA	d3-MeFOSAA	d3-MeFOSAA	M3-MeFOSAA
N-methyl-d7-perfluorooctanesulfonamidoethanol	D7-NMeFOSE	d7-MeFOSE	d7-MeFOSE	M7-MeFOSE
N-ethyl-d9-perfluorooctanesulfonamidoethanol	D9-NEtFOSE	d9-EtFOSE	d9-EtFOSE	M9-EtFOSE
Tetrafluoro-2-heptafluoropropoxy-13C3-propanoic acid	13C3-HFPO-DA	13C3-HFPO-DA	13C3-HFPO-DA	M3-HFPO-DA
Perfluoro-n-[2,3,4-13C3]butanoic acid	13C3-PFBA	13C3-PFBA	13C3-PFBA	
Perfluoro-n-[1,2,3,4-13C4]octanoic acid	13C4-PFOA	13C4-PFOA	13C4-PFOA	
Perfluoro-n-[1,2-13C2]decanoic acid	13C2-PFDA	13C2-PFDA	13C2-PFDA	
Perfluoro-n-[1,2,3,4-13C4]octanesulfonic acid	13C4-PFOS	13C4-PFOS	13C4-PFOS	
Perfluoro-1-hexane[18O2]sulfonic acid	18O2-PFHxS	18O2-PFHxS	18O2-PFHxS	
Perfluoro-n-[1,2-13C2]hexanoic acid	13C2-PFHxA	13C2-PFHxA	13C2-PFHxA	
Perfluoro-n-[1,2,3,4,5-13C5]nonanoic acid	13C5-PFNA	13C5-PFNA	13C5-PFNA	

ANALYSIS OF PER- and POLYFLUORINATED ALKYL SUBSTANCES BY LC/MS/MS AND ISOTOPE DILUTION

SOP Acknowledgement Form

I have read and understand this SOP. I will not knowingly deviate from this approved SOP without approval of the Department Supervisor, QA Officer, or Technical Director. If I notice any discrepancies between this SOP and the routine procedure, I will notify the Department Supervisor so that either the SOP or procedure can be changed. Furthermore, I understand that this SOP is property of SGS North America Inc. – Orlando and may not be printed nor duplicated in any manner.

Internal SOPs referenced within this SOP: OP075, OP076, GC001, QA029

Print Name	Signature	Date

Print the SOP Acknowledgement Form, sign, and submit to the SGS Orlando QA department.

CONTROLLED COPY
DO NOT DUPLICATE



STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF PESTICIDES AND/OR PCBs FROM WATER SAMPLES

Prepared by: Norm Farmer Date: 08/16/2021

Approved by: David Chandler Date: 08/23/2021

Annual Review

Reviewed by: Norm Farmer Date: 06/15/2022

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Document Control

Issued to: QA Department - digital Date: 06/17/2022

Issued to: Organics Prep Department - digital Date: * 06/17/2022

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Effective 7 days after "*" date

**CONTROLLED COPY
DO NOT DUPLICATE**

TITLE: STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF PESTICIDES AND/OR PCBs FROM WATER SAMPLES

REFERENCES: EPA 608.3, SW846 3510C/8081B, and SW846 3510C/8082A

REVISED SECTIONS: 7.2.2, 7.2.4, 7.2.10, 7.2.12, 7.3.2, 7.3.4, 7.3.10, and 7.3.12

1.0 SUMMARY, SCOPE AND APPLICATION

1.1 Summary

Aqueous samples are serially extracted with methylene chloride; solvent exchanged into hexane, concentrated by TurboVap or Buchi, and stored in glass vials with Teflon lined screw caps.

1.2 Scope and Application

This procedure is applicable to aqueous samples submitted for Pesticide and/or PCB analysis by GC/ECD methods, including EPA 608.3, SW-846 8081B, and SW-846 8082A.

2.0 DISCUSSION AND COMMENTS

This procedure is adapted from SW-846 methods 3500C and 3510C. The method utilizes "Separatory Funnel Liquid-Liquid Extraction"; it is not applicable to samples requiring "Continuous Liquid-Liquid Extraction".

The ECD is an extremely sensitive detector that will respond to many organic and some inorganic compounds that exhibit a strong electronegativity. This includes phthalates and sulfur compounds. It is important to minimize extraneous contaminants by scrupulously cleaning all glassware and by using only high purity reagents. Additionally, all extraction items that come in contact with the sample must be made from glass or Teflon.

In order to lessen the impact on the environment, this method has been modified to include an option to use a 250ml sample size and 1/4 the amount of solvent. Extraction volume used is dependent on the sample bottles received. Some State and Regulatory Agencies require the conventional 1000ml bottles. Therefore, if 1000ml bottles are received, they must be used, and the entire volume must be extracted.

3.0 PRESERVATION AND HOLDING TIMES

3.1 Preservation

- 3.1.1 Samples shall be collected in either 1000ml or 250ml amber glass bottles with Teflon lined caps.
- 3.1.2 The samples must be protected from light and refrigerated at $\leq 6^{\circ}\text{C}$ from the time of collection until extraction. The extracts must be refrigerated at $\leq 6^{\circ}\text{C}$ until analysis.

3.2 Holding Time

- 3.2.1 Aqueous samples must be extracted within 7 days of collection. The Date/Time that the extraction is started and completed must be recorded on the prep sheet.
- 3.2.2 Extracts must be analyzed within 40 days of extraction.

4.0 DEFINITIONS

- 4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 12 hours whichever comes first.
- 4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).
- 4.3 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.
- 4.4 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.
- 4.5 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.
- 4.6 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

- 4.7 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.
- 4.8 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.
- 4.9 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 REAGENTS

- 5.1 Acetone – pesticide grade or equivalent
- 5.2 Methylene chloride – pesticide grade or equivalent
- 5.3 Hexane – pesticide grade or equivalent
- 5.4 Anhydrous sodium sulfate – precleaned to remove phthalates
- 5.5 Activated Copper Powder
- 5.6 Reagent water – distilled or deionized - free of interferences
- 5.7 10 Normal NaOH
- 5.8 1:1 H₂SO₄
- 5.9 Concentrated H₂SO₄
- 5.10 Pesticide/PCB Surrogate Solution – prepared in acetone at a concentration specified by the GC analyst. All surrogate solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.
- 5.11 **Pesticide** Spike Solution – prepared in acetone at a concentration specified by the GC analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.
- 5.12 **Chlordane/Toxaphene** Spike Solution – prepared in acetone at a concentration specified by the GC analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.
- 5.13 **PCB** Spike Solution – prepared in acetone at a concentration specified by the GC analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

6.0 GLASSWARE AND APPARATUS

- 6.1 250ml or 1000ml graduated cylinder
- 6.2 2-liter separatory funnel
- 6.3 250ml or 500ml separatory funnel
- 6.4 250ml or 500ml Erlenmeyer flasks
- 6.5 0.5ml or 1.0ml syringes
- 6.6 200ml graduated TurboVap tube or Buchi tube (as appropriate)
- 6.7 10ml graduated concentrator tube
- 6.8 Disposable transfer pipettes
- 6.9 pH paper
- 6.10 Glass wool – precleaned
- 6.11 Filter funnel
- 6.12 Fisher P8 filters, or equivalent
- 6.13 2.0ml glass screw cap vials – caps must have Teflon lined septa
- 6.14 8ml glass screw cap vials – caps must have Teflon lined septa
- 6.15 Zymark TurboVap II or equivalent
- 6.16 Buchi Syncore including chiller and solvent condenser

7.0 PROCEDURE

- 7.1 The extraction of all samples must be documented on a “prep sheet”. The prep sheet will include such items as: batch number, sample ID, bottle number, initial amount, final volume, solvent lot numbers, spike and surrogate lot numbers, batch numbers, extraction dates and times, and extraction technician.

The extraction technician is responsible for filling out all the required information on the prep sheet. A copy of the prep sheet will be submitted to the GC analyst with the extracts. The Batch number, extraction technician, and extraction start Date and Time are entered into LIMS. **NOTE: 1000ml and 250ml samples must be batched separately.**

For 1000ml Bottles

7.2 Sample Transfer

- 7.2.1 Label the glassware and separatory funnels with the QC and sample numbers.
- 7.2.2 For the samples, mark the sample level (upper edge) on the bottle with a marker. Transfer the entire sample directly into the appropriately labeled separatory funnel.
- 7.2.3 Using a 1000ml-graduated cylinder, transfer 1000ml of reagent water for the method blank (MB) and blank spike (BS).
- 7.2.4 If there are separate bottles for the MS and MSD, mark the level of the sample on the bottle with a marker. If there is only one bottle, then the sample should be split between the two appropriately labeled separatory funnels. Record both the sample ID and volume on the prep sheet.
- 7.2.5 Using the dedicated surrogate syringe add 0.5ml of surrogate solution to each of the samples including the MB, BS, MS, and MSD samples. Record the surrogate lot number on the prep sheet.
- 7.2.6 Three primary spiking solutions are used in this SOP. If the samples are to be analyzed for “pesticides” only, use the **Pesticide** spiking solution. [An additional BS should also be prepared using the Chlordane/Toxaphene spiking solution.](#)
- 7.2.7 If the samples are to be analyzed for “PCBs” only, use the **PCB** spiking solution. The normal PCB spiking solution contains PCB 1016 and 1260. **NOTE:** Some projects may require alternate PCBs (such as 1254) to be spiked.
- 7.2.8 If the samples are to be analyzed for both “pesticides” and “PCBs” two separate sets of QC (BS, MS, and MSD) must be prepared, one using the **Pesticide** spiking solution and one using the **PCB** spiking solution.
- 7.2.9 Using the dedicated spike syringe add 0.5ml of the appropriate spike solution to the BS, MS, and MSD. Record the spike lot number on the prep sheet. [An additional MS/MSD should also be prepared using the Chlordane/Toxaphene spiking solution if the samples are being analyzed for P8081CHL or P8081TOX only.](#)
- 7.2.10 Add 50-60ml methylene chloride to each sample bottle and QC separatory funnel. Cap the bottle and invert several times to thoroughly rinse the walls and cap. Transfer the solvent from the sample bottles to the appropriate separatory funnels.

CAUTION: ALL SOLVENT ADDITIONS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.
- 7.2.11 Fill the bottle to the sample mark with tap water. Transfer the water to a 1000ml graduated cylinder and record the sample volume. Discard the tap water.

7.2.12 Alternative procedure for samples with high solids content.

The entire contents of the sample bottle should be analyzed for aqueous samples, including any solids that may have been collected. However, high levels of solids in the sample can create heavy emulsions that cannot be broken down by the various mechanical means.

The solids will normally settle out during storage. If the sample bottle contains more than an inch of solids, it may be necessary to decant the water phase rather than extracting the entire sample. The decision to decant a water sample should be based on the experience and judgment of the extraction technician or the department supervisor. If the sample is decanted, it must be noted on the prep sheet.

Pour the sample into a 1000ml-graduated cylinder taking care to minimize the amount of solids that are transferred. Record the actual sample volume and then transfer the sample to the appropriately labeled separatory funnel. Add the appropriate surrogate as per 7.2.5. Add the appropriate spike solutions as per 7.2.6-7.2.9 if the decanted sample is to be used for MS or MSD. Rinse the graduated cylinder with a 50-60ml aliquot of methylene chloride and transfer it to the appropriate separatory funnel.

CAUTION: ALL SOLVENT ADDITIONS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.

The graduated cylinder must be rinsed with tap water, reagent water, and methylene chloride between samples in order to prevent cross contamination.

7.2.10 Proceed to section 7.4

For 250ml Bottles

7.3 Sample Transfer

- 7.3.1 Label the glassware and separatory funnels with the QC and sample numbers.
- 7.3.2 For the samples, mark the sample level (upper edge) on the bottle with a marker. Transfer the entire sample directly into the appropriately labeled separatory funnel.
- 7.3.3 Using a 250ml-graduated cylinder, transfer 250ml of reagent water for the method blank (MB) and blank spike (BS).
- 7.3.4 If there are separate bottles for the MS and MSD, mark the level of the sample on the bottle with a marker. If there is only one bottle, then the sample should be split between the two appropriately labeled separatory funnels. Record both the sample ID and volume on the prep sheet.

- 7.3.5 Using the dedicated surrogate syringe add 0.5ml of surrogate solution to each of the samples including the MB, BS, MS, and MSD samples. Record the surrogate lot number on the prep sheet.
- 7.3.6 Three primary spiking solutions are used in this SOP. If the samples are to be analyzed for “pesticides” only, use the **Pesticide** spiking solution. [An additional BS should also be prepared using the Chlordane/Toxaphene spiking solution.](#)
- 7.3.7 If the samples are to be analyzed for “PCBs” only, use the **PCB** spiking solution. The normal PCB spiking solution contains PCB 1016 and 1260. **NOTE:** Some projects may require alternate PCBs (such as 1254) to be spiked.
- 7.3.8 If the samples are to be analyzed for both “pesticides” and “PCBs” two separate sets of QC (BS, MS, and MSD) must be prepared, one using the **Pesticide** spiking solution and one using the **PCB** spiking solution.
- 7.3.9 Using the dedicated spike syringe add 0.5ml of the appropriate spike solution to the BS, MS, and MSD. Record the spike lot number on the prep sheet. [An additional MS/MSD should also be prepared using the Chlordane/Toxaphene spiking solution if the samples are being analyzed for P8081CHL or P8081TOX only.](#)
- 7.3.10 Add 15ml methylene chloride to each sample bottle and QC separatory funnel. Cap the bottle and invert several times to thoroughly rinse the walls and cap. Transfer the solvent from the sample bottles to the appropriate separatory funnels.

CAUTION: ALL SOLVENT ADDITIONS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.

- 7.3.11 Fill the bottle to the sample mark with tap water. Transfer the water to a 250ml graduated cylinder and record the sample volume. Discard the tap water.
- 7.3.12 **Alternative procedure for samples with high solids content.**

The entire contents of the sample bottle should be analyzed for aqueous samples, including any solids that may have been collected. However, high levels of solids in the sample can create heavy emulsions that cannot be broken down by the various mechanical means.

The solids will normally settle out during storage. If the sample bottle contains more than a half inch of solids, it may be necessary to decant the water phase rather than extracting the entire sample. The decision to decant a water sample should be based on the experience and judgment of the extraction technician or the department supervisor. If the sample is decanted, it must be noted on the prep sheet.

Pour the sample into a 250ml-graduated cylinder taking care to minimize the amount of solids that are transferred. Record the actual sample volume and then transfer the sample to the appropriately labeled separatory funnel. Add the

appropriate surrogate as per 7.3.5. Add the appropriate spike solutions as per 7.3.6-7.3.9 if the decanted sample is to be used for MS or MSD. Rinse the graduated cylinder with a 15ml aliquot of methylene chloride and transfer it to the appropriate separatory funnel.

CAUTION: ALL SOLVENT ADDITIONS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.

The graduated cylinder must be rinsed with tap water, reagent water, and methylene chloride between samples in order to prevent cross contamination.

- 7.4 Check the pH of each sample by dipping a disposable transfer pipette into the sample and touching it to the pH paper. Record the pH on the prep sheet. If necessary, adjust the pH to between 5 and 9 by adding a few drops of 10 N NaOH or 1:1 H₂SO₄.

- 7.5 Cap and shake each separatory funnel for two minutes.

CAUTION: THE SEPARATORY FUNNELS MUST BE PERIODICALLY VENTED TO AVOID AN EXCESSIVE BUILDUP IN PRESSURE. THIS SHOULD BE DONE IN A HOOD.

- 7.6 After shaking, allow the layers to separate for at least 10 minutes. Collect the solvent layer (bottom) in a labeled 250ml Erlenmeyer flask.

NOTE: Some samples may form emulsions. If emulsions are present, the technician must take steps to breakdown the emulsion. This may include filtering the emulsion through a smaller separatory funnel, centrifuging, or filtering through sodium sulfate.

- 7.7 Repeat steps 7.5 and 7.6 two additional times using either 50ml or 15ml aliquots of methylene chloride. Combine the extract in the Erlenmeyer flask.

- 7.8 If the entire extraction procedure cannot be completed on the same day, the Erlenmeyer flasks may be covered with aluminum foil and refrigerated.

- 7.9 Extracts may be concentrated using either the TurboVap option (Section 7.10) or the Buchi option (Section 7.11). The entire batch must be concentrated using the same option.

7.10 TurboVap Concentrator Option

7.10.1 Label the TurboVap tubes and place them in the metal support rack.

7.10.2 This step is **optional**, but it must be performed if the extracts appear cloudy or contain water droplets. Place a glass filter funnel containing sodium sulfate supported on a Fisher P8 filter on the TurboVap tube. Pour the extracts through the sodium sulfate into the appropriate tube and rinse with methylene chloride. Care must be taken not to overfill the tube.

- 7.10.3 If the extract appears to be dry, simply transfer it to an appropriately labeled TurboVap tube. Rinse the Erlenmeyer flask with methylene chloride and transfer to the appropriate tube. Care must be taken not to overfill the tube.

CAUTION: ALL EXTRACT TRANSFERS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.

- 7.10.4 Set the water bath temperature for the TurboVap to 40 - 45 °C. Place the tubes in the TurboVap. Concentrate the extract to less than 5ml.
- 7.10.5 If necessary, remove the TurboVap tube and transfer the remaining extract from the Erlenmeyer flask to the appropriate tube. Rinse each Erlenmeyer flask with methylene chloride and transfer it to the appropriate tube.
- 7.10.6 Add approximately 50ml of hexane to the each of the TurboVap tubes. Increase the TurboVap water bath temperature to 55 - 65 °C and concentrate the extract to less than 5ml.

CAUTION: ALL SOLVENT ADDITIONS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.

- 7.10.7 Remove the TurboVap tubes and place them in the metal support rack to allow it to cool.
- 7.10.8 Proceed to Section 7.12.

7.11 Buchi Concentrator Option

- 7.11.1 Turn on the Buchi system and allow it to warm up to 75 °C. Set chiller to 5 °C and turn on the vacuum pump. Once the chiller and the Buchi system are at the appropriate temperature, press the start button for the chiller to begin circulating.
- 7.11.2 Label the Buchi tubes and place them in the metal support rack.
- 7.11.3 This step is **optional**, but it must be performed if the extracts appear cloudy or contain water droplets. Place a glass filter funnel containing sodium sulfate supported on a Fisher P8 filter on the Buchi tube. Pour the extracts through the sodium sulfate into the appropriate tube and rinse with methylene chloride. Care must be taken not to overfill the tube.
- 7.11.4 If the extract appears to be dry, simply transfer it to an appropriately labeled Buchi tube. Rinse the Erlenmeyer flask with methylene chloride and transfer to the appropriate tube. Care must be taken not to overfill the tube.

CAUTION: ALL EXTRACT TRANSFERS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.

- 7.11.5 Unscrew the lid on the Buchi system. Place the filled Buchi tubes into the Buchi system. If there are empty positions, fill them with empty tubes. Each position must have a tube. Replace the top and secure with screws.
- 7.11.6 Turn the Buchi speed to 300rpm, select the appropriate preset program on the Buchi display, and press start.
- 7.11.7 Once the Buchi system has finished, the extracts should be below 5ml. If not, use the manual mode on the Buchi system until each extract is below 5ml.
- 7.11.8 Unscrew the lid to the Buchi system. Add any remaining extract (if necessary) and add approximately 50ml of hexane to each of the Buchi tubes.

CAUTION: ALL SOLVENT ADDITIONS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.

- 7.11.9 Replace the lid and secure with screws and restart the system. Concentrate the extract to less than 5ml.
- 7.11.10 Remove the Buchi tubes and place them in the metal support rack to allow it to cool.
- 7.11.11 Proceed to Section 7.12.
- 7.12 If the extract is cloudy or contains water droplets, run the extract through a micro column of glass wool and sodium sulfate.
- 7.13 Transfer the extract to a graduated 10ml concentrator tube. Rinse the TurboVap or Buchi tube with small amount of hexane and transfer it to the concentrator tube. Adjust the final volume to 5.0ml. Use a transfer pipet to thoroughly mix the extract. Be sure to record the final volume on the prep sheet.
- 7.14 If the extract is to be analyzed for pesticides, transfer some of the extract to an appropriately labeled 2ml screw cap vial. If the extract is to be analyzed for PCBs, transfer some of the extract to an appropriately labeled 8ml screw cap vial.
- 7.15 Proceed to section 8.0 for acid cleaning procedure and section 9.0 for sulfur cleaning procedure. The PCB fraction undergoes both the acid and sulfur cleanup procedures. The pesticide fraction undergoes only the sulfur cleanup procedure.

8.0 ACID CLEANING PROCEDURE (PCB only)

NOTE: This cleaning procedure can be used on the PCB fraction only. It will destroy the pesticides.

- 8.1 Each 8ml vial should contain 3 to 5ml of extract.
- 8.2 Add 2ml of concentrated H₂SO₄ to each of the vials. Cap the vial and shake for one minute.

**CONTROLLED COPY
DO NOT DUPLICATE**

- 8.3 Allow the extracts to stand for 10 minutes. Transfer the hexane layer (top) to an appropriately labeled 2.0ml screw cap vial.
- 8.4 Store the extracts in the “extract refrigerator” until they are needed for analysis.

9.0 SULFUR CLEANING PROCEDURE (Pesticide and PCB) Copper option

- 9.1 Each 2ml vial should contain about 1.5ml of extract.
- 9.2 Fill the 2ml screw cap vials to the 0.5ml mark with copper (approximately 1.5 grams).
- 9.3 Allow the extracts to stand for at least 1 hour prior to analysis. Extracts may be stored in contact with the copper.
- 9.4 Store the extracts in the “extract refrigerator” until they are needed for analysis.

10.0 QUALITY ASSURANCE AND QUALITY CONTROL

- 10.1 An extraction batch is defined as samples of a similar matrix that are prepared for a particular parameter. The batch size is limited to 20 samples. A batch may be held open for up to 12 hours; however, samples should not be added after the QC set has been completed. **NOTE:** Some project plans may require different batch definitions.
- 10.2 A method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD) must be extracted with each new batch of samples.

11.0 SAFETY AND WASTE DISPOSAL

- 11.1 Safety
 - 11.1.1 Safety glasses, gloves and lab coats should be worn when handling samples, standards or solvents.
 - 11.1.2 Safety Data Sheets (SDS) are available for all reagents and solvents used in the lab. Technicians should review the SDS prior to using any new reagents or solvents.
 - 11.1.3 Methylene chloride is an inhalation hazard and a suspected carcinogen. Fume hoods must be used to minimize exposure to vapors.

11.2 Waste Disposal

11.2.1 Waste methylene chloride is placed in the "chlorinated waste" container.

11.2.2 Waste acetone is placed in the "non-chlorinated waste" container.

11.2.3 Waste sodium sulfate is placed in a waste container after the solvent has drained.

11.2.4 Extracted water samples are rinsed down the drain with large amounts of water.

11.2.5 Samples are archived and stored for 30 days after analysis. After the storage time has elapsed, the remaining aqueous samples are transferred to the appropriate drums for disposal.

12.0 REFERENCES

EPA 608.3, 12/16

SW-846 Method 3500C, Rev. 3, 02/07

SW-846 Method 3510C, Rev. 3, 12/96

SW-846 Method 8081B, Rev. 2, 02/07

SW-846 Method 8082A, Rev. 1, 02/07

SW-846 Method 3660B, Rev. 2, 12/96

SW-846 Method 3665A, Rev. 1, 12/96

STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF PESTICIDES AND/OR PCBs FROM WATER SAMPLES SOP Acknowledgement Form

I have read and understand this SOP. I will not knowingly deviate from this approved SOP without approval of the Department Supervisor, QA Officer, or Technical Director. If I notice any discrepancies between this SOP and the routine procedure, I will notify the Department Supervisor so that either the SOP or procedure can be changed. Furthermore, I understand that this SOP is property of SGS North America Inc. – Orlando and may not be **printed nor** duplicated in any manner.

Internal SOPs referenced within this SOP: na

Print Name	Signature	Date

Print the SOP Acknowledgement Form, sign, and submit to the SGS Orlando QA department.



STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF CHLORINATED HERBICIDES FROM WATER SAMPLES Reduced Volume

Prepared by: Norm Farmer Date: 06/11/20

Approved by: David Chandler Date: 06/12/20

Annual Review

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Document Control

Issued to: QA Department Date: 06/15/20

Issued to: Organics Prep Department Date: * _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Effective 7 days after "*" date

**CONTROLLED COPY
DO NOT DUPLICATE**

TITLE: STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF CHLORINATED HERBICIDES FROM WATER SAMPLES – REDUCED VOLUME

REFERENCES: SW846 8151A

REVISED SECTIONS: 5.14, 7.20.1, 7.21.1, 7.21.2 and 7.21.3

1.0 SUMMARY, SCOPE AND APPLICATION

1.1 Summary

Aqueous samples are serially extracted with diethyl ether, concentrated by TurboVap, esterified with diazomethane and stored in glass vials with Teflon lined screw caps.

1.2 Scope and Application

This procedure is applicable to aqueous samples submitted for chlorinated herbicide analysis by GC/ECD method SW-846 8151A.

2.0 DISCUSSION AND COMMENTS

This procedure is adapted from SW-846 methods 3500C and 8151A. The method utilizes "Separatory Funnel Liquid-Liquid Extraction".

The ECD is an extremely sensitive detector that will respond to many organic and some inorganic compounds that exhibit a strong electronegativity. This includes phthalates and sulfur compounds. It is important to minimize extraneous contaminants by scrupulously cleaning all glassware and by using only high purity reagents. Additionally, all extraction items that come in contact with the sample must be made from glass or Teflon.

The herbicides, being strong organic acids, react readily with alkaline substances and may be lost during analysis. Therefore, glassware must be acid-rinsed and then rinsed to constant pH with organic-free reagent water. Sodium sulfate must be acidified.

In order to lessen the impact on the environment, this method has been modified to use a 250ml sample size and 1/4 the amount of solvent. Extraction volume used is dependant on the sample bottles received. Some State and Regulatory Agencies require the conventional 1000ml bottles. Therefore, if 1000ml bottles are received, they must be used and the entire volume must be extracted. Refer to non-Reduced Volume version of this SOP OP037.

3.0 PRESERVATION AND HOLDING TIME

3.1 Preservation

3.1.1 Samples shall be collected in 250ml amber glass bottles with Teflon lined caps.

3.1.2 The samples must be protected from light and refrigerated at $\leq 6^{\circ}\text{C}$ from the time of collection until extraction. The extracts must be protected from light and refrigerated at $\leq 6^{\circ}\text{C}$ until analysis.

3.2 Holding Time

3.2.1 Aqueous samples must be extracted within 7 days of collection. The Date/Time that the extraction is started and completed must be recorded on the prep sheet.

3.2.2 Extracts must be analyzed within 40 days of extraction.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 12 hours whichever comes first.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.4 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.5 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.6 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.7 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

CONTROLLED COPY
DO NOT DUPLICATE

- 4.8 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.
- 4.9 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 REAGENTS

- 5.1 Acetone – pesticide grade or equivalent
- 5.2 Diethyl Ether – pesticide grade or equivalent – free of peroxides
- 5.3 Hexane – pesticide grade or equivalent
- 5.4 Methylene Chloride – pesticide grade or equivalent
- 5.5 Methanol – pesticide grade or equivalent
- 5.6 Acidified sodium sulfate – precleaned to remove phthalates – stored at 130°C

CAUTION: COOL TO ROOM TEMPERATURE BEFORE USING.

- 5.7 Reagent water – distilled or deionized - free of interferences
- 5.8 10 Normal NaOH
- 5.9 1:1 H₂SO₄
- 5.10 37% Potassium Hydroxide Solution
- 5.11 Carbitol – diethylene glycol monoethyl ether
- 5.12 Diazald – High Purity
- 5.13 Trimethylsilyldiazomethane (TMSD) – 2.0 M in ether or hexane
- 5.14 Acetic Acid – HPLC grade or equivalent
- 5.15 Herbicide Surrogate Solution – prepared in methanol at a concentration specified by the GC analyst. All surrogate solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.
- 5.16 Herbicide Spike Solution – prepared in methanol at a concentration specified by the GC analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

CONTROLLED COPY
DO NOT DUPLICATE

6.0 GLASSWARE AND APPARATUS

- 6.1 250ml or 500ml graduated cylinder
- 6.2 500ml separatory funnel (Teflon)
- 6.3 250ml separatory funnel (Teflon)
- 6.4 250ml or 500ml Erlenmeyer flasks
- 6.5 0.5ml or 1.0ml syringes
- 6.6 200ml graduated TurboVap tube
- 6.7 10ml graduated concentrator tube
- 6.8 Disposable transfer pipettes
- 6.9 pH paper
- 6.10 glass wool – precleaned and acidified
- 6.11 Glass filter funnel
- 6.12 Fisher P8 filters, or equivalent
- 6.13 8.0ml amber glass screw cap vials – caps must have Teflon lined septa
- 6.14 Zymark TurboVap II or equivalent
- 6.15 Nitrogen evaporator
- 6.16 Diazomethane Generator

7.0 PROCEDURE

- 7.1 The extraction of all samples must be documented on a “prep sheet”. The prep sheet will include such items as: batch number, sample ID, bottle number, initial amount, final volume, solvent lot numbers, spike and surrogate lot numbers, batch numbers, extraction dates and times, and extraction technician.

The extraction technician is responsible for filling out all the required information on the prep sheet. A copy of the prep sheet will be submitted to the GC analyst with the extracts. The Batch number, extraction technician, and extraction start Date and Time are entered into LIMS.

7.2 Sample Transfer

- 7.2.1 Label the glassware and separatory funnels with the QC and sample numbers.
- 7.2.2 For the samples, mark the sample level (upper edge) on the bottle with a marker.
- 7.2.3 Using a 250ml or 500ml-graduated cylinder, transfer 250ml of reagent water for the method blank (MB) and blank spike (BS).
- 7.2.4 If there are separate bottles for the MS and MSD, mark the level of the sample on the bottle with a marker. The spike and surrogate should be added directly to them. If there is only one bottle, then the sample should be split between the two appropriately labeled separatory funnels and the spike and surrogate should be added to the sample after it has been transferred to the separatory funnels. Record both the sample ID and volume on the prep sheet.
- 7.2.5 Using the dedicated surrogate syringe add 0.5ml of Herbicide surrogate solution to each of the samples including the MB, BS, MS, and MSD samples. Record the surrogate lot number on the prep sheet.
- 7.2.6 Using the dedicated spike syringe add 0.5ml of Herbicide spike solution to the BS, MS, and MSD. Record the spike lot number on the prep sheet.
- 7.2.7 Transfer each of the samples to the appropriately labeled separatory funnel. **DO NOT RINSE** the sample bottle with an aliquot of solvent at this time.
- 7.2.8 **Alternative procedure for samples with high solids content.**

The entire contents of the sample bottle should be analyzed for aqueous samples, including any solids that may have been collected. However, high levels of solids in the sample can create heavy emulsions that cannot be broken down by the various mechanical means.

The solids will normally settle out during storage. If the sample bottle contains more than an inch of solids, it may be necessary to decant the water phase rather than extracting the entire sample. The decision to decant a water sample should be based on the experience and judgement of the extraction technician or the department supervisor. If the sample is decanted, it must be noted on the prep sheet.

Pour the sample into a 1000ml-graduated cylinder taking care to minimize the amount of solids that are transferred. Record the actual sample volume that is transferred. Add the appropriate surrogate as per 7.2.5. Add the appropriate spike solutions as per 7.2.6 if the decanted sample is to be used for MS or MSD. **DO NOT RINSE** the graduated cylinder with an aliquot of solvent at this time.

The graduated cylinder must be rinsed with tap water, reagent water, and diethyl ether or acetone between samples in order to prevent cross contamination.

- 7.3 **NOTE:** SGS Orlando does not add NaCl to each sample. Historical data shows that omitting this step does not adversely affect the recoveries. This is considered a method modification.
- 7.4 Check the pH of each sample by dipping a disposable transfer pipette into the sample and touching it to the pH paper. Record the pH on the prep sheet.
- 7.5 If hydrolysis is not required, then proceed to Section 7.7. Otherwise, proceed to Section 7.6 for hydrolysis.
- 7.6 **Use this step only if herbicide esters, in addition to herbicide acids, are to be determined. If herbicide esters are not to be determined, proceed to step 7.10.**
- 7.6.1 Add 2 ml of 10N NaOH to each sample, seal, and shake. Check the pH of the sample with pH paper. If the sample does not have a pH greater than or equal to 12, adjust the pH by adding more NaOH. Let the sample sit at room temperature for 1-2 hours, shaking the separatory funnel and contents periodically.
- 7.6.2 Rinse the sample bottle or graduated cylinder with a 15-20ml aliquot of methylene chloride and transfer it to the appropriate separatory funnel.
- CAUTION: ALL SOLVENT ADDITIONS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.**
- After the bottle has been solvent rinsed, fill the bottle to the sample mark with tap water. Transfer the water to a 250ml graduated cylinder and record the sample volume. Discard the tap water.
- 7.6.3 Cap and shake each separatory funnel for two minutes. **CAUTION:** The separatory funnels must be vented frequently to avoid an excessive buildup in pressure.
- 7.6.4 After shaking, allow the layers to separate for at least 10 minutes. Discard the methylene chloride (bottom) phase.
- 7.6.5 **NOTE:** Some samples may form emulsions. If emulsions are present, the technician must take steps to breakdown the emulsion. This may include filtering the emulsion through a smaller separatory funnel, centrifuging, or filtering through sodium sulfate.
- 7.6.6 Repeat steps 7.6.3 and 7.6.5 two additional times using 15 to 20ml of methylene chloride. Discard the methylene chloride (bottom) phase.
- 7.6.7 Add 4 ml of cold 1:1 H₂SO₄ to the hydrolyzed sample, seal, and shake. Check the pH of the sample with pH paper. If the sample does not have a pH less than or equal to 2, adjust the pH by adding more acid.
- 7.6.8 Add 25-30ml of diethyl ether to each separatory funnel and proceed to Section 7.9.

**CONTROLLED COPY
DO NOT DUPLICATE**

- 7.7 Adjust the pH of each sample to <2 by adding 2ml aliquots of 1:1 H₂SO₄. Swirl the sample and recheck the pH after each aliquot is added.
- 7.8 Rinse the sample bottle or graduated cylinder with a 25-30ml aliquot of diethyl ether and transfer it to the appropriate separatory funnel.

CAUTION: ALL SOLVENT ADDITIONS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.

After the bottle has been solvent rinsed, fill the bottle to the sample mark with tap water. Transfer the water to a 250ml graduated cylinder and record the sample volume. Discard the tap water.

- 7.9 Cap and shake each separatory funnel for two minutes.

CAUTION: THE SEPARATORY FUNNELS MUST BE PERIODICALLY VENTED TO AVOID AN EXCESSIVE BUILDUP IN PRESSURE. THIS SHOULD BE DONE IN A HOOD.

- 7.10 After shaking, allow the layers to separate for at least 10 minutes. Drain the sample into an appropriately labeled 500ml Erlenmeyer flask. Collect the solvent layer (top) in a labeled 250ml Erlenmeyer flask.

NOTE: Some samples may form emulsions. If emulsions are present, the technician must take steps to breakdown the emulsion. This may include filtering the emulsion through a smaller separatory funnel, centrifuging, or filtering through acidified sodium sulfate.

- 7.11 Return the aqueous phase to the separatory funnel.
- 7.12 Repeat steps 7.9 and 7.11 two additional times using 15 to 20ml of diethyl ether. Combine the extract in the Erlenmeyer flask.
- 7.13 Place approximately 5 grams of acidified sodium sulfate in the Erlenmeyer flasks. Swirl the flask and allow the extract to remain in contact with the acidified sodium sulfate for at least 2 hours.

The drying step is critical to ensuring complete esterification. Any moisture remaining in the ether will result in low recoveries. The sodium sulfate should be free flowing. If all of the sodium sulfate solidifies in a cake, add a few additional grams and test again. The 2-hour drying time is a minimum; however, the extracts may be held in contact with the sodium sulfate overnight.

- 7.14 Label the TurboVap tubes and place them in the metal support rack.
- 7.15 Transfer the extracts to the appropriately labelled TurboVap tubes.

CAUTION: ALL EXTRACT TRANSFERS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.

- 7.16 Set the water bath temperature for the TurboVap to 45 - 55 °C. Place the tube in the TurboVap. **NOTE:** If the bath is too hot, the more volatile compounds may be lost during this step. Concentrate the extract to approximately 5ml.
- 7.17 Remove the TurboVap Tube from the bath and allow it to cool.
- 7.18 Transfer the extract to a 10ml concentrator tube. Rinse the TurboVap tube with diethyl ether and transfer it to the tube
- 7.19 Use a steady stream of nitrogen to concentrate the extract to approximately 4ml.
- 7.20 Diazomethane Esterification Bubbler method.

The diazomethane esterification procedure described below will react efficiently with all of the chlorinated herbicides described in this method and should be used only by experienced analysts, due to the potential hazards associated with its use.

CAUTION: DIAZOMETHANE IS A CARCINOGEN AND CAN EXPLODE UNDER CERTAIN CONDITIONS. PROCEDURE MUST BE PERFORMED IN A HOOD.

- 7.20.1 Add 0.5ml of methanol to each extract.
- 7.20.2 Assemble a diazomethane bubbler as shown in Figure 1. Teflon tubing may be used instead of glass tubing.
- 7.20.3 Add 5 ml of diethyl ether to the first test tube. Add 1 ml of diethyl ether, 1 ml of Carbitol, 1.5 ml of 37% KOH, and 0.1 - 0.2 g of Diazald to the second test tube. Immediately place the exit tube into the concentrator tube containing the sample extract. Apply nitrogen flow (10 ml/min) to bubble diazomethane through the extract for 2-3 minutes or until the yellow color of diazomethane persists. The amount of Diazald used is sufficient for esterification of approximately three sample extracts. An additional 0.1 - 0.2 g of Diazald may be added (after the initial Diazald is consumed) to extend the generation of the diazomethane. There is sufficient KOH present in the original solution to perform a maximum of approximately 20 minutes of total esterification.
- 7.20.4 Remove the concentrator tube and seal it with a Neoprene or PTFE stopper. **DO NOT USE GROUND GLASS STOPPERS.** Store at room temperature in a hood for 20 minutes.
- 7.20.5 After 20 minutes, remove the stopper and place the concentrator tube back in the rack for the nitrogen evaporator.
- 7.20.6 Use a steady stream of nitrogen to concentrate the extract to approximately 1ml. This will destroy any unreacted diazomethane.

7.20.7 Proceed to section 7.22.

7.21 Diazomethane Esterification TMSD method.

The Trimethylsilyldiazomethane (TMSD) esterification procedure described below will react efficiently with all of the chlorinated herbicides described in this method and should be used only by experienced analysts, due to the potential hazards associated with its use. TMSD will increase the chromatographic background when compared to generated diazomethane. Although no method analytes are affected by this increased background.

CAUTION: TRIMETHYLSILYLDIAZOMETHANE IS HIGHLY TOXIC. TMSD IS CONVERTED TO DIAZOMETHANE DURING THE ESTERIFICATION PROCESS. PROCEDURE MUST BE PERFORMED IN A HOOD.

7.21.1 Add 100ul of methanol and 150ul of TMSD to every concentrator tube containing the sample extracts. Mix each extract.

7.21.2 Seal each concentrator tube with a Neoprene or PTFE stopper. **DO NOT USE GROUND GLASS STOPPERS.** Store at room temperature in a hood for 30 minutes.

7.21.3 Destroy any unreacted diazomethane by adding 50ul of acetic acid to the concentrator tube. Allow the extract to stand until the evolution of nitrogen gas has stopped.

7.21.4 Remove the stopper and place the concentrator tube back in the rack for the nitrogen evaporator.

7.21.5 Use a steady stream of nitrogen to concentrate the extract to approximately 1ml.

7.22 Adjust the final volume to 5.0ml with hexane. Use a transfer pipet to thoroughly mix the extract. Be sure to record the final volume on the prep sheet.

7.23 Transfer the extract to an appropriately labeled amber 8.0ml screw cap vial. Store the extracts in the "extract refrigerator" until they are needed for analysis.

8.0 QUALITY ASSURANCE AND QUALITY CONTROL

8.1 An extraction batch is defined as samples of a similar matrix that are prepared for a particular parameter. The batch size is limited to 20 samples. A batch may be held open for up to 12 hours; however, samples should not be added after the QC set has been completed. **NOTE:** Some project plans may require different batch definitions.

8.2 A method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD) must be extracted with each new batch of samples.

9.0 SAFETY AND WASTE DISPOSAL

9.1 Safety

- 9.1.1 Safety glasses, gloves and lab coats should be worn when handling samples, standards or solvents.
- 9.1.2 Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and solvents used in the lab. Technicians should review the MSDS or SDS prior to using any new reagents or solvents.
- 9.1.3 Methylene chloride is an inhalation hazard and a suspected carcinogen. Fume hoods must be used to minimize exposure to vapors.
- 9.1.4 Diazomethane is a carcinogen and can explode under certain conditions.
- 9.1.5 Trimethylsilyldiazomethane is highly toxic.

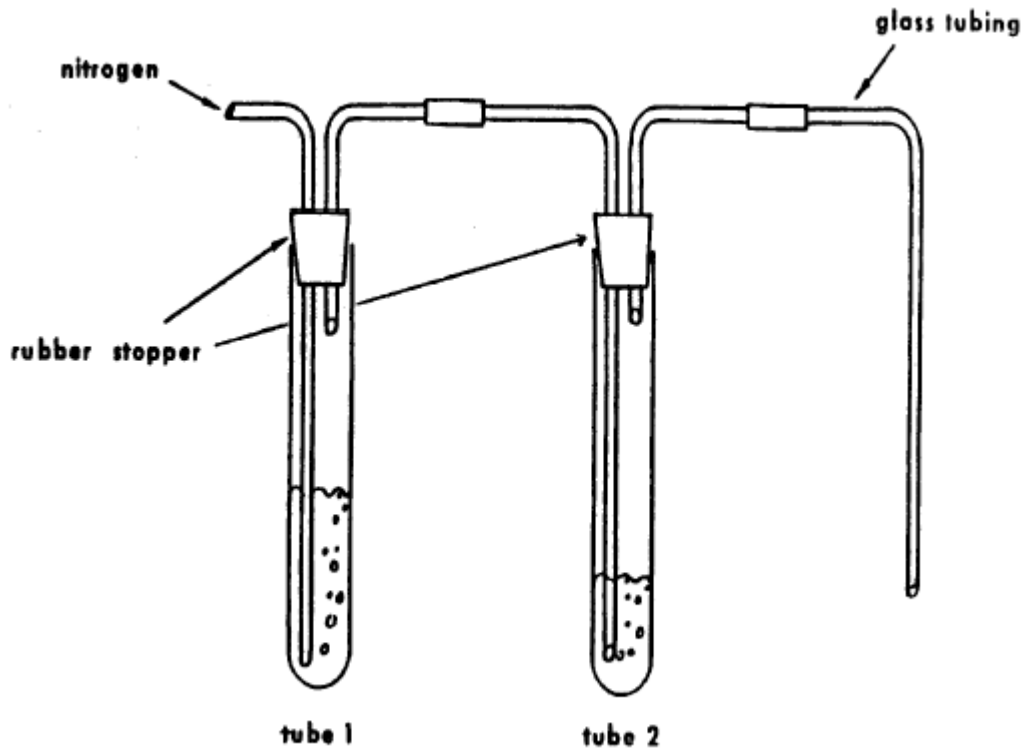
9.2 Waste Disposal

- 9.2.1 Waste methylene chloride is placed in the "chlorinated waste" container.
- 9.2.2 Waste acetone and ether is placed in the "non-chlorinated waste" container.
- 9.2.3 Waste sodium sulfate is placed in a waste container after the solvent has drained.
- 9.2.4 Extracted water samples are rinsed down the drain with large amounts of water.
- 9.2.5 Samples are archived and stored for 30 days after analysis. After the storage time has elapsed, the remaining aqueous samples are transferred to the appropriate drums for disposal.

10.0 REFERENCES

- SW-846 Method 3500C, Rev. 3, 02/07
- SW-846 Method 3510C, Rev. 3, 12/96
- SW-846 Method 8151A, Rev. 1, 12/96
- EPA Method 515.2 Rev 1.1, 1995

Figure 1.





STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF PER- and POLYFLUORINATED ALKYL SUBSTANCES FROM WATER SAMPLES FOR LC/MS/MS ANALYSIS

Prepared by: Norm Farmer Date: 04/07/2022

Approved by: Mike Eger Date: 04/08/2022

Annual Review

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Document Control

Issued to: QA Department - digital Date: 04/08/2022

Issued to: Organics Prep Department - digital Date: * 04/11/2022

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Effective 7 days after "*" date

**CONTROLLED COPY
DO NOT DUPLICATE**

TITLE: STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF PER- and POLYFLUORINATED ALKYL SUBSTANCES FROM WATER SAMPLES FOR LC/MS/MS ANALYSIS

REFERENCES: EPA draft Method 1633 and QSM 5.4 Table B-24

REVISED SECTIONS: 2.0, 3.1.2, 4.3, 7.2.10, 7.2.17 and 7.2.25

1.0 SUMMARY, SCOPE AND APPLICATION

1.1 Summary

A 500ml aliquot of sample (entire bottle) is extracted utilizing a solid phase extraction cartridge. The cartridge is eluted with basic methanol. The extract is carbon cleaned, filtered and the final volume is adjusted to 5.0ml, and then transferred to a centrifuge tube for storage.

1.2 Scope and Application

This procedure is applicable to low level aqueous samples submitted for Per- and Polyfluorinated Alkyl Substances (PFAS) analysis by LC/MS/MS using Isotope Dilution technique.

NOTE: For aqueous sample prep by in-house LCMSMS method see SOP OP069.

NOTE: For Drinking Water sample prep see SOP OP064 or OP072.

NOTE: This SOP was written to be compliant with QSM 5.4.

2.0 DISCUSSION AND COMMENTS

This method is adapted from draft EPA method 1633. Additions and modifications have been added for compliance with QSM 5.4 Table B-24.

Samples expected to contain high levels of PFAS compounds should be screened prior to extraction.

The analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) or Teflon products, HPLC solvent lines, methanol, aluminum foil, SPE transfer lines, bottle caps, etc. All materials used for this method must be demonstrated to be free from interferences.

Contact with glass containers, pipettes, or syringes should be minimized since the PFAS compounds can potentially adsorb (stick) to glass surfaces.

**CONTROLLED COPY
DO NOT DUPLICATE**

SPE cartridges can be a source of interferences. The analysis of method and field blanks can provide important information regarding the presence or absence of such interferences. Brands and lots of SPE devices should be tested to ensure that contamination does not preclude analyte identification and quantitation.

Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the water. Humic and/or fulvic material can be co-extracted during SPE and high levels can cause enhancement and/or suppression in the electrospray ionization source or low recoveries on the SPE sorbent.

3.0 PRESERVATION AND HOLDING TIMES

3.1 Preservation

- 3.1.1 Samples shall be collected in 500ml HDPE bottles fitted with a polyethylene screw cap. Alternate size HDPE bottles may be used depending on project requirements. **Glass bottles with Teflon lined caps can NOT be used.**
- 3.1.2 The samples must be chilled to $\leq 6^{\circ}\text{C}$ from the time of collection until arrival at the laboratory. The samples must be refrigerated at $\leq 6^{\circ}\text{C}$ or frozen at $\leq -20^{\circ}\text{C}$ from the time of receipt until extraction.
- 3.1.3 The extracts should be stored at $\leq 4^{\circ}\text{C}$. They must be allowed to come to room temperature prior to analysis. All extracts should be vortexed just prior to transfer to the autosampler vials.

3.2 Holding Time

- 3.2.1 Aqueous samples must be extracted within 28 days of collection if stored at $\leq 6^{\circ}\text{C}$ or within 90 days of collection if stored at $\leq -20^{\circ}\text{C}$. The Date/Time that the extraction is started and completed must be recorded on the prep sheet.
- 3.2.2 Extracts should be analyzed within 28 days of extraction but must be analyzed within 90 days of extraction.

4.0 DEFINITIONS

- 4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 12 hours whichever comes first.
- 4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a

given method. This may also be called a Laboratory Control Sample (LCS) or the Ongoing Precision and Recovery Standard (OPR).

- 4.3 Low Level Blank Spike (LLBS): An analyte-free matrix spiked with a known amount of analyte(s) at 2x LLOQ, processed simultaneously with the samples through all the steps of the analytical procedure. Low-Level Blank Spike Recoveries are used to document laboratory performance at the LLOQ for a given method. This may also be called a Low-Level Laboratory Control Sample (LLLCS) or the Low-Level Ongoing Precision and Recovery Standard (LLOPR).
- 4.4 Extracted Internal Standards (EIS): A standard containing isotopically labelled versions of the native target analytes. These isotopes are usually labelled with C13, d2, or O18 atoms. Isotope Dilution Standards are used to measure the extraction efficiency and to correct the concentrations of the native analytes based on the recovery of their isotopically labelled analogs.
- 4.5 Field Blank (FB): An aliquot of reagent water that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, preservation, and all analytical procedures. The purpose of the FB is to determine if method analytes or other interferences are present in the field environment.
- 4.6 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and are still considered valid.
- 4.7 Matrix Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.
- 4.8 Matrix Spike (MS): A sample spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.
- 4.9 Matrix Spike Duplicate (MSD): A replicate sample spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.
- 4.10 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.
- 4.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

5.0 REAGENTS

- 5.1 Methanol – HPLC grade or equivalent
- 5.2 Reagent water – HPLC grade or equivalent - free of interference
- 5.3 SPE Cartridges – Wax (weak anion exchange) or equivalent
- 5.4 Acetic Acid - HPLC grade or equivalent
- 5.5 Ammonium Hydroxide – Fisher A669-212 or equivalent (28-30% Aqueous Ammonia)
- 5.6 3% v:v Ammonium Hydroxide Solution – add 10ml of 30% Ammonium Hydroxide to 90ml of reagent water. Store at room temperature for up to 1 month.
- 5.7 1% v:v Ammonium Hydroxide in Methanol Solution – mix 3.3ml NH₄OH and 97ml Methanol (based off 30%).
- 5.8 Dilution Mix - Methanol with 4% water, 1% ammonium hydroxide and 0.625% acetic acid
- 5.9 Formic Acid – ACS grade or equivalent
 - 5.9.1 0.1M Formic acid – add 4.6g formic acid to 1L of reagent water. Store at room temperature for up to a year.
 - 5.9.2 0.3M Formic acid – add 13.8g formic acid to 1L of reagent water. Store at room temperature for up to a year.
 - 5.9.3 5% v:v Formic acid – mix 5ml formic acid and 95ml of reagent water. Store at room temperature for up to a year.
 - 5.9.4 50% v:v Formic acid – mix 50ml formic acid and 50ml of reagent water. Store at room temperature for up to a year.
 - 5.9.5 1:1 Formic Acid in Methanol Solution – mix 50ml 0.1M formic acid and 50ml of methanol. Store at room temperature for up to a year.
- 5.10 ENVI-carb – graphitized carbon powder
- 5.11 PFAS EIS Mix – prepared in methanol at various concentrations by the vendor. All EIS solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.
- 5.12 PFAS Spike Solution – prepared in methanol at various concentration by the LC/MS/MS analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

- 5.13 PFAS NIS Mix - prepared in methanol at various concentrations by the vendor. All EIS solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

6.0 GLASSWARE AND APPARATUS

- 6.1 Solid-phase cartridge extraction system – suitable for use with extraction cartridges
- 6.2 Vacuum pump
- 6.3 Vacuum Flasks – or equivalent
- 6.4 SPE reservoirs – various sizes
- 6.5 SPE cartridges – Weak Anion Exchange – must have pKa of >8 and 150mg bedsize
- 6.6 15ml and 50ml Polyethylene Centrifuge tubes with caps
- 6.7 10ml, 25ml, 250ml, and 1000ml Polyethylene graduated cylinder
- 6.8 250ml or 500ml Class A graduated cylinder (for sample volume determination only)
- 6.9 10ul, 25ul, 50ul, 250ul and 500ul syringes
- 6.10 Volumetric Pipettors and tips
- 6.11 1ml and 5ml Disposable polyethylene luer lock syringes
- 6.12 0.2um Nylon syringe filter 13mm and 25mm
- 6.13 10ml, 25ml, and 100ml Polyethylene or Polypropylene volumetric flasks
- 6.14 Disposable polyethylene transfer pipettes
- 6.15 Deactivated glass wool.
- 6.16 2.0ml polyethylene screw cap vials
- 6.17 HDPE Wash Bottles
- 6.18 Nitrogen Evaporator, TurboVap LV or ExcelVap
- 6.19 Balance +/- 0.1 gram
- 6.20 Centrifuge - 3000 rpm minimum speed
- 6.21 Micro-scoop 10mg

7.0 PROCEDURE

- 7.1 The extraction of all samples must be documented on a "prep sheet". The prep sheet will include such items as: batch number, sample ID, bottle number, initial amount, final volume, solvent lot numbers, spike and surrogate lot numbers, batch numbers, extraction dates and times, and extraction technician.

The extraction technician is responsible for filling out all the required information on the prep sheet. A copy of the prep sheet will be submitted to the LC/MS/MS analyst with the extracts. The Batch number, extraction technician, and extraction start Date and Time are entered into LIMS.

- 7.2 The 150mg WAX (weak anion exchange) SPE cartridge is considered the default cartridge for this method. Other bed sizes may be used if they have been fully validated.

7.2.1 Assemble the solid-phase extraction system.

7.2.2 Label the side of each cartridge with the sample ID.

7.2.3 Loosely pack deactivated glass wool to half the height of the SPE cartridge and attach each of them to the SPE manifold.

7.2.4 Condition each SPE cartridge with 15ml of 1% ammonium hydroxide in methanol solution followed by 5ml of 0.3M formic acid. Use gravity flow if possible or a 1 to 2 ml/min flow rate. Stop the flow just before the cartridge goes dry.

Do not allow the cartridge to go dry.

7.2.5 Using a reservoir adaptor, attach the sample reservoir to the top of the SPE cartridge.

7.2.6 Mark the level of the sample (upper edge) on the bottle with a marker. The entire contents of the sample bottle should be extracted, including any solids that may have been collected.

The volume may also be determined by weighing the sample, bottle, and cap and recording the weight to 0.1g. If determining the sample volume by weight, record the weight of the sample, bottle and cap.

7.2.7 Use 500ml HDPE bottles for the method blank (MB), blank spike (BS) and Low-Level Blank Spike (LLBS). Fill each of these bottles with 500ml of reagent water. Use 100ml HDPE bottles for MB, BS, LLBS if the project required smaller sample volumes.

7.2.8 Use separate bottles for the matrix spike (MS) and the matrix spike duplicate (MSD). **NOTE: Bottles must NOT be split.** If there are no samples with two extra bottles for the MS/MSD, then prepare a matrix spike (MS) and a duplicate

(DUP) from separate samples. Record the sample ID, bottle number, and volume on the prep sheet.

- 7.2.9 Using the dedicated surrogate syringe add **25ul** of isotope dilution standard to each of the samples including the QC samples. Record the isotope dilution standard lot number on the prep sheet. Cap and invert the samples to mix.
- 7.2.10 Using the dedicated spike syringe or volumetric pipettor add **32ul** of PFAS spike solution to the LLBS. Record the spike lot numbers on the prep sheet. Cap and invert the samples to mix.
- 7.2.11 Using the dedicated spike syringe or volumetric pipettor add **200ul** of PFAS spike solution to the BS, MS, and MSD. Record the spike lot numbers on the prep sheet. Cap and invert the samples to mix.
- 7.2.12 Check the pH of each sample by dipping a disposable polyethylene transfer pipette into the sample and touching it to the pH paper. Record the pH on the prep sheet.
- 7.2.13 The pH should be 6.5 +/- 0.5. If necessary, adjust the pH with 50% formic acid or 30% ammonium hydroxide solution OR with 5% formic acid or 3% ammonium hydroxide solution. Record this on the prep sheet.
- 7.2.14 Transfer an aliquot of each sample including the QC samples to the appropriate sample reservoirs.
- 7.2.15 Turn on the vacuum and draw the sample through the cartridge at a rate of about 5 ml/min. Add additional sample aliquots to the sample reservoirs until the entire sample has passed through the cartridge. As particulate clogs the cartridge, increase the vacuum to maintain a reasonable flow rate.
- 7.2.16 Once the entire sample has been pulled through the cartridge, shut off the vacuum. Rinse each sample bottle and reservoir with 2 x 5ml aliquots of reagent water. Draw the reagent water through the cartridge. Shut off the vacuum once the water has passed through the cartridge.
- 7.2.17 Rinse each sample bottle and reservoir with 5ml of the 1:1 0.1M Formic Acid/methanol solution. Turn on the vacuum. Draw the solution through the cartridge. Dry the cartridge by pulling air through the cartridge for another 15 seconds. Shut off the vacuum.
- 7.2.18 Open the SPE manifold and place an appropriately labeled 15.0ml centrifuge tube in the rack under the position for SPE cartridge.
- 7.2.19 Set the manifold top back on the system, make sure that each of the delivery tubes goes into the appropriate centrifuge tube.
- 7.2.20 Rinse each sample bottle and reservoir with 5ml of 1% ammonium hydroxide in methanol solution. Use a pipet to transfer the solution to the SPE cartridge. Allow

it to pass through the cartridge under gravity flow, then apply a slight vacuum to draw the remaining solution through the cartridge.

7.2.21 Retain the sample bottle and cap for Initial Volume determination.

Fill each sample bottle to the sample mark with tap water. Transfer the water to a Class A graduated cylinder and record the sample volume. Discard the tap water.

If determining the sample volume by weight, record the weight of the empty sample bottle and cap. The volume in ml is equal to the difference in grams. Record the weights.

7.2.22 Open the SPE manifold and remove all the centrifuge tubes. If necessary, adjust the volume to 5ml with 1% ammonium hydroxide in methanol solution. Add 25ul of concentrated acetic acid to each centrifuge tube, cap and vortex to mix.

7.2.23 Using a 10mg micro-scoop, add 10mg of ENVI-Carb powder to each sample and QC extract. Cap and vortex each sample to thoroughly mix the contents.

Excessive contact time with the carbon (more than 5 minutes) may cause low recoveries.

7.2.24 Centrifuge the samples for 10 minutes at 2800 rpm to separate the ENVI-Carb from the extract.

7.2.25 Label another 15ml centrifuge tube for each sample and QC extract. Add 25ul of NIS solution to each centrifuge tube.

7.2.26 Attach 0.2um syringe filters to 5ml polypropylene syringes. Remove the barrel and pour the entire 5ml extract into the syringe. Insert the barrel and filter each extract into the appropriately labeled centrifuge tube.

7.2.27 Cap each centrifuge tube. Transfer the extracts to the LCMSMS lab for storage.

7.2.28 Store the extracts at $\leq 4^{\circ}\text{C}$. Extracts must be allowed to come to room temperature prior to analysis. All extracts should be vortexed just prior to transfer to the autosampler vials.

8.0 QUALITY ASSURANCE AND QUALITY CONTROL

8.1 An extraction batch is defined as samples of a similar matrix that are prepared for a particular parameter. The batch size is limited to 20 samples. A batch may be held open for up to 12 hours; however, samples should not be added after the QC set has been completed. **NOTE:** Some project plans may require different batch definitions.

- 8.2 A method blank (MB), blank spike (BS), low-level blank spike (LLBS), matrix spike (MS), and matrix spike duplicate (MSD) must be extracted with each new batch of samples. If there is insufficient sample to extract a matrix spike duplicate (MSD) then a sample duplicate (DUP) should be extracted.

9.0 SAFETY AND WASTE DISPOSAL

9.1 Safety

- 9.1.1 Safety glasses, gloves and lab coats must be worn when handling samples, standards or solvents.
- 9.1.2 Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and solvents used in the lab. Technicians should review the MSDS or SDS prior to using any new reagents or solvents.
- 9.1.3 Methanol is an inhalation hazard. Use in well ventilated area.

9.2 Waste Disposal

- 9.2.1 Waste methanol is placed in the “non-chlorinated waste” container.
- 9.2.2 Spent solid-phase extraction cartridges may be disposed of in the trash.
- 9.2.3 Extracted water samples are rinsed down the drain with large amounts of water.
- 9.2.4 Samples are archived and stored for 30 days after analysis. After the storage time has elapsed, the remaining aqueous samples are transferred to the appropriate drums for disposal.

10.0 REFERENCES

Draft EPA Method 1633, Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS, August 2021

Revised Errata Sheet for Draft Method 1633, February 2022

DOD QSM 5.4, November 2021

STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF PER- and POLYFLUORINATED ALKYL SUBSTANCES FROM WATER SAMPLES FOR LC/MS/MS ANALYSIS

SOP Acknowledgement Form

I have read and understand this SOP. I will not knowingly deviate from this approved SOP without approval of the Department Supervisor, QA Officer, or Technical Director. If I notice any discrepancies between this SOP and the routine procedure, I will notify the Department Supervisor so that either the SOP or procedure can be changed. Furthermore, I understand that this SOP is property of SGS North America Inc. – Orlando and may not be printed nor duplicated in any manner.

Internal SOPs referenced within this SOP: na

Print Name	Signature	Date

Print the SOP Acknowledgement Form, sign, and submit to the SGS Orlando QA department.

CONTROLLED COPY
DO NOT DUPLICATE

APPENDIX D: FIELD STANDARD OPERATING PROCEDURES

This page was intentionally left blank.

FC 1000. CLEANING / DECONTAMINATION PROCEDURES

1. PERFORMANCE CRITERIA

- 1.1. The cleaning/decontamination procedures must ensure that all equipment that contacts a sample during sample collection is free from the analytes of interest and constituents that would interfere with the analytes of interest.
- 1.2. The detergents and other cleaning supplies cannot contribute analytes of interest or interfering constituents unless these are effectively removed during a subsequent step in the cleaning procedure.
- 1.3. The effectiveness of any cleaning procedure (including all cleaning reagents) must be supported by equipment blanks with reported non-detected values.
- 1.4. For toxicity tests, the effectiveness of any cleaning procedure must be supported by control samples with acceptable survival and reproduction or growth.

The cleaning procedures outlined in this SOP are designed to meet the above-mentioned performance criteria. Alternative cleaning reagents or procedures may be used. However, the organization must be prepared to demonstrate through documentation (i.e., company-written protocols and analytical records) and historical data (i.e., absence of analytes of interest in equipment blanks) that it consistently meets these performance criteria. Field quality control measures (see FQ 1210) must support the use of alternative reagents or procedures.

FC 1001. *Cleaning Reagents*

Recommendations for the types and grades of various cleaning supplies are outlined below. The recommended reagent types or grades were selected to ensure that the cleaned equipment is free from any detectable contamination.

1. **DETERGENTS:** Use Luminox (or a non-phosphate solvent based equivalent), Liqui-Nox (or a non-phosphate equivalent) or Alconox (or equivalent). EPA recommends Luminox (or equivalent) since solvent rinses can be eliminated from the cleaning process. Liquinox (or equivalent) may be substituted (solvent rinses, when applicable, must be performed), and Alconox (or equivalent) may be substituted if the sampling equipment will not be used to collect phosphorus or phosphorus-containing compounds.

2. SOLVENTS

Note: If the detergent Luminox (or equivalent) is used, solvent rinses are not required.

- 2.1. Use pesticide grade isopropanol as the rinse solvent in routine equipment cleaning procedures. This grade of alcohol must be purchased from a laboratory supply vendor.
- 2.2. Other solvents, such as acetone or methanol, may be used as the final rinse solvent if they are pesticide grade. However, methanol is more toxic to the environment and acetone may be an analyte of interest for volatile organics. Do not use acetone if volatile organics are of interest.
- 2.3. Properly dispose of all wastes according to applicable regulations. Containerize all solvents (including rinsates) for on-site remediation or off-site disposal, as required.
- 2.4. Pre-clean equipment that is heavily contaminated (see FC 1120, section 3) with organic analytes with reagent grade acetone and hexane or other suitable solvents.
- 2.5. Use pesticide grade methylene chloride when cleaning sample containers.

2.6. Store all solvents away from potential sources of contamination (gas, copier supplies, etc.).

3. ANALYTE-FREE WATER SOURCES

3.1. Analyte-free water is water in which all analytes of interest and all interferences are below method detection limits.

3.2. Maintain documentation (such as results from equipment blanks) to demonstrate the reliability and purity of analyte-free water source(s).

3.3. The source of the water must meet the requirements of the analytical method and must be free from the analytes of interest. In general, the following water types are associated with specific analyte groups:

- Milli-Q (or equivalent polished water): suitable for all analyses.
- Organic-free: suitable for volatile and extractable organics.
- Deionized water: not suitable for volatile and extractable organics if the analytes of interest are present in concentrations that affect the result.
- Distilled water: not suitable for volatile and extractable organics, metals or ultra-trace metals.

3.4. Use analyte-free water for blank preparation and the final decontamination water rinse.

3.5. In order to minimize long-term storage and potential leaching problems, obtain or purchase analyte-free water just prior to the sampling event. If obtained from a source (such as a laboratory), fill the transport containers and use the contents for a single sampling event. Empty the transport container(s) at the end of the sampling event. If long-term storage of analyte-free water is necessary, see FC 1002, section 3.3.

3.6. Discard any analyte-free water that is transferred to a dispensing container (such as a wash bottle) at the end of each sampling day.

4. ACIDS

4.1. Reagent Grade Nitric Acid: 10 - 15% (one volume concentrated nitric acid and five volumes deionized water).

4.1.1. Use for the acid rinse unless nitrogen components (e.g., nitrate, nitrite, etc.) are to be sampled.

4.1.2. If sampling for ultra-trace levels of metals, use an ultra-pure grade acid.

4.2. Reagent Grade Hydrochloric Acid: 10% hydrochloric acid (one volume concentrated hydrochloric and three volumes deionized water). Use when nitrogen components are to be sampled.

4.3. If samples for both metals and the nitrogen-containing components (see FC 1001, section 4.1.1 above) are collected with the equipment, use the hydrochloric acid rinse, or thoroughly rinse with hydrochloric acid after a nitric acid rinse.

4.4. If sampling for ultra trace levels of metals, use an ultra-pure grade acid.

4.5. Freshly prepared acid solutions may be recycled during the sampling event or cleaning process. Dispose appropriately at the end of the sampling event, cleaning process or if acid is discolored or appears otherwise contaminated (e.g., floating particulates). Transport only the quantity necessary to complete the sampling event.

4.6. Dispose of any unused acids according to FDEP and local ordinances.

FC 1002. *Reagent Storage Containers*

The contents of all containers must be clearly marked.

1. DETERGENTS: Store in the original container or in a high density polyethylene (HDPE) or polypropylene (PP) container.
2. SOLVENTS
 - 2.1. Store solvents to be used for cleaning or decontamination in the original container until use in the field. If transferred to another container for field use, the container must be either glass or fluoropolymer (FP).
 - 2.2. Use dispensing containers constructed of glass, FP, or stainless steel. Note: if stainless steel sprayers are used, any components (including gaskets and transfer lines) that contact the solvents must be constructed of inert materials.
3. ANALYTE-FREE WATER: Transport in containers appropriate to the type of water to be stored. If the water is commercially purchased (e.g., grocery store), use the original containers when transporting the water to the field. Containers made of glass, FP, polypropylene, or Polyethylene (PE) are acceptable.
 - 3.1. Use glass, FP, polypropylene or PE to transport organic-free sources of water on-site.
 - 3.2. Dispense water from containers made of glass, FP, PE or polypropylene.
 - 3.3. Do not store water in transport containers before beginning a sampling event, unless satisfactory long-term storage of analyte-free water for a specified maximum storage time has been documented for the analytes of interest. The water should be replaced and the maximum storage time shortened if it is determined that the analyte-free water has been contaminated, e.g., by the analysis of field-QC blanks or other QC blanks that have been composed using the water stored in the container.
 - 3.4. Store and dispense acids using containers made of glass, FP, PE or polypropylene.

FC 1003. *General Requirements*

1. Before using any equipment, clean/decontaminate all sampling equipment (pumps, tubing, lanyards, split spoons, etc.) that are exposed to the sample.
 - 1.1. Before installing, clean (or obtain as certified precleaned) all equipment that is dedicated to a single sampling point and remains in contact with the sample medium (e.g., permanently installed groundwater pump (see FS 2220, section 3.3.4).
 - 1.2. Clean this equipment any time it is removed for maintenance or repair.
 - 1.3. Replace dedicated tubing if discolored or damaged.
2. Clean all equipment in a designated area having a controlled environment (house, laboratory, or base of field operations) and transport to the field precleaned and ready to use, unless otherwise justified.
3. Rinse all equipment with water after use, even if it is to be field-cleaned for other sites. Rinse equipment used at contaminated sites or used to collect in-process (e.g., untreated or partially treated wastewater) samples immediately with water.
4. Whenever possible, transport sufficient clean equipment to the field so that an entire sampling event can be conducted without the need for cleaning equipment in the field.
5. Segregate equipment that is only used once (i.e., not cleaned in the field) from clean equipment and return to the in-house cleaning facility to be cleaned in a controlled environment.
6. Protect decontaminated field equipment (including well sounders) from environmental contamination by securely wrapping and sealing with one of the following:

- 6.1. Aluminum foil (commercial grade is acceptable);
- 6.2. Untreated butcher paper; or
- 6.3. Clean, untreated, disposable plastic bags. Plastic bags may be used:
 - For all analyte groups except volatile and extractable organics;
 - For volatile and extractable organics, if the equipment is first wrapped in foil or butcher paper or if the equipment is completely dry.
7. Containerize all solvent rinsing wastes, detergent wastes and other chemical wastes requiring off-site or regulated disposal. Dispose of all wastes in conformance with applicable regulations.

FC 1100. Cleaning Sample Collection Equipment

FC 1110. ON-SITE/IN-FIELD CLEANING

1. Cleaning equipment on-site is not recommended because:
 - 1.1. Environmental conditions cannot be controlled.
 - 1.2. Wastes (solvents and acids) must be containerized for proper disposal.
2. If performed, follow the appropriate cleaning procedure as outlined in FC 1130. Ambient temperature water may be substituted in the hot, sudsy water bath, and hot water rinses.

Note: Properly dispose of all solvents and acids.

3. Rinse all equipment with water after use, even if it is to be field-cleaned for other sites. Rinse equipment used at contaminated sites or used to collect in-process (e.g., untreated or partially treated wastewater) samples immediately with water.

FC 1120. HEAVILY CONTAMINATED EQUIPMENT

In order to avoid contaminating other samples, isolate heavily contaminated equipment from other equipment and thoroughly decontaminate the equipment before further use. Equipment is considered heavily contaminated if it:

- Has been used to collect samples from a source known to contain significantly higher levels than background;
 - Has been used to collect free product; or
 - Has been used to collect industrial products (e.g., pesticides or solvents) or their by-products.
1. Cleaning heavily contaminated equipment in the field is not recommended.
 2. ON-SITE PROCEDURES
 - 2.1. Protect all other equipment, personnel and samples from exposure by isolating the equipment immediately after use.
 - 2.2. At a minimum, place the equipment in a tightly sealed untreated plastic bag.
 - 2.3. Do not store or ship the contaminated equipment next to clean, decontaminated equipment, unused sample containers, or filled sample containers.
 - 2.4. Transport the equipment back to the base of operations for thorough decontamination.
 - 2.5. If cleaning must occur in the field, and in order to document the effectiveness of the procedure, collect and analyze blanks on the cleaned equipment (see FQ 1000).
 3. CLEANING PROCEDURES

- 3.1. If organic contamination cannot be readily removed with scrubbing and a detergent solution, prerinse equipment by thoroughly rinsing or soaking the equipment in acetone.
 - 3.1.1. Do not use solvent soaks or rinses if the material is clear acrylic.
 - 3.1.2. Use hexane only if preceded and followed by acetone.
- 3.2. In extreme cases, it may be necessary to steam clean the field equipment before proceeding with routine cleaning procedures.
- 3.3. After the solvent rinses (and/or steam cleaning), use the appropriate cleaning procedure (see FC 1130).
 - 3.3.1. Scrub, rather than soak all equipment with sudsy water.
 - 3.3.2. If high levels of metals are suspected and the equipment cannot be cleaned without acid rinsing, soak the equipment in the appropriate acid. Do not use stainless steel equipment when heavy metal contamination is suspected or present, since stainless steel cannot be exposed to prolonged acid soaks.
- 3.4. If the field equipment cannot be cleaned utilizing these procedures, discard unless further cleaning with stronger solvents and/or oxidizing solutions is effective as evidenced by visual observation and blanks.
- 3.5. Clearly mark or disable all discarded equipment to discourage use.

FC 1130. GENERAL CLEANING

Follow these procedures when cleaning equipment under controlled conditions. See FC 1110 for modifications if cleaning is performed on-site. Check manufacturer's instructions for cleaning restrictions and/or recommendations.

FC 1131. Procedure for FP, Stainless Steel and Glass Sampling Equipment

This procedure must be used when sampling for **ALL** analyte groups: extractable organics, metals, nutrients, etc. or if a single decontamination protocol is desired to clean all **FP**, stainless steel and glass equipment.

1. Rinse equipment with hot tap water.
2. Soak equipment in a hot, sudsy water solution (Liqui-Nox or equivalent - see FC 1001, section 1).
3. If necessary, use a brush to remove particulate matter or surface film.
4. Rinse thoroughly with hot tap water.
5. If samples for trace metals or inorganic analytes will be collected with the equipment and the equipment **is not** stainless steel, thoroughly rinse (wet all surfaces) with the appropriate acid solution (see FC 1001, section 4).
6. Rinse thoroughly with analyte-free water. Use enough water to ensure that all equipment surfaces are thoroughly flushed with water.
7. If samples for volatile or extractable organics will be collected, rinse with isopropanol. Wet equipment surfaces thoroughly with free-flowing solvent. Rinse thoroughly with analyte-free water (see FC 1001, section 3).
8. Allow to air dry. Wrap and seal according to FC 1003, section 6 as soon as the equipment is air-dried.
9. If isopropanol is used, the equipment may be air-dried without the final analyte-free water rinse (see FC 1131, section 8 above); however, **the equipment must be completely dry before wrapping or use.**
10. Wrap clean sampling equipment per the procedure described in FC 1003, section 6.

FC 1132. *General Cleaning Procedure for Plastic Sampling Equipment*

1. Rinse equipment with hot tap water.
2. Soak equipment in a hot, sudsy water solution (Liqui-Nox or equivalent - see FC 1001, section 1).
3. If necessary, use a brush to remove particulate matter or surface film.
4. Rinse thoroughly with hot tap water.
5. Thoroughly rinse (wet all surfaces) with the appropriate acid solution (see FC 1001, section 4).
6. Rinse thoroughly with analyte-free water. Use enough water to ensure that all equipment surfaces are thoroughly flushed with water. Allow to air dry as long as possible.
7. Wrap clean sampling equipment per the procedure described in FC 1003, section 6.

FC 1133. *Cleaning Procedure by Analyte Group*

See Table FC 1000-1 for the procedures to be used to decontaminate equipment based on construction of sampling equipment, and analyte groups to be sampled.

FC 1140. **AUTOMATIC SAMPLERS, SAMPLING TRAINS AND BOTTLES**

1. When automatic samplers are deployed for extended time periods, clean the sampler using the following procedures when routine maintenance is performed. Inspect deployed samplers prior to each use. At a minimum, change the tubing if it has become discolored or has lost elasticity (FC 1140, section 2.3 below).
2. Clean all automatic samplers (such as ISCO) as follows:
 - 2.1. Wash the exterior and accessible interior portions of the automatic samplers (excluding the waterproof timing mechanisms) with laboratory detergent (see FC 1001, section 1) and rinse with tap water.
 - 2.2. Clean the face of the timing case mechanisms with a clean, damp cloth.
 - 2.3. Check all tubing (sample intake and pump tubing). Change the tubing every six months (if used frequently) or if it has become discolored (i.e., affected by mold and algae) or if it has lost its elasticity.
 - 2.4. See FC 1160, section 4 for the procedures associated with cleaning the tubing in the pump head.
3. AUTOMATIC SAMPLER ROTARY FUNNEL AND DISTRIBUTOR
 - 3.1. Clean with hot sudsy water and a brush (see FC 1001, section 1 for appropriate detergent type).
 - 3.2. Rinse thoroughly with analyte-free water.
 - 3.3. Air dry.
 - 3.4. Replace in sampler.
4. SAMPLER METAL TUBE: Clean as outlined in FC 1160, section 5.
5. REUSABLE GLASS COMPOSITE SAMPLE CONTAINERS
 - 5.1. If containers are used to collect samples that contain oil, grease or other hard to remove materials, it may be necessary to rinse the container several times with reagent-grade acetone before the detergent wash. If material cannot be removed with acetone, discard the container.
 - 5.2. Wash containers following the procedure outlined in FC 1131 above. End with a final solvent rinse if organics are to be sampled.

- 5.3. Invert containers to drain and air dry for at least 24 hours.
- 5.4. Cap with aluminum foil, FP film or the decontaminated FP-lined lid.
- 5.5. After use, rinse with water in the field, seal with aluminum foil to keep the interior of the container wet, and return to the laboratory or base of operations.
- 5.6. **Do not recycle or reuse containers if:**
 - 5.6.1. They were used to collect in-process (i.e., untreated or partially treated) wastewater samples at industrial facilities;
 - 5.6.2. A visible film, scale or discoloration remains in the container after the cleaning procedures have been used; or
 - 5.6.3. The containers were used to collect samples at pesticide, herbicide or other chemical manufacturing facilities that produce toxic or noxious compounds. Such containers must be properly disposed of (preferably at the facility) at the conclusion of the sampling activities.
 - 5.6.4. If the containers described above are reused, check no less than 10% of the cleaned containers for the analytes of interest **before** use. If found to be contaminated, (i.e., constituents of interest are found at method detection levels or higher), then **discard the containers**.
6. REUSABLE PLASTIC COMPOSITE SAMPLE CONTAINERS
 - 6.1. Follow FC 1132.
 - 6.2. Inspect the containers. Determine if the containers can be reused by the criteria in FC 1140, section 5 above.
7. GLASS SEQUENTIAL SAMPLE BOTTLES FOR AUTOMATIC SAMPLER BASED FOR SEQUENTIAL MODE
 - 7.1. Clean glass sequential sample bottles to be used for collecting inorganic samples by using a laboratory dishwasher (see FC 1140, sections 7.1.1 through 7.1.3 below) or manually following the procedures in FC 1131.
 - 7.1.1. Rinse with appropriate acid solution (see FC 1001, section 4).
 - 7.1.2. Rinse thoroughly with tap water.
 - 7.1.3. Wash in dishwasher at wash cycle, using laboratory detergent cycle, followed by tap and analyte-free water rinse cycles.
 - 7.2. Replace bottles in covered, automatic sampler base; cover with aluminum foil for storage.
 - 7.3. Rinse bottles in the field with water as soon as possible after sampling event.
8. Glass Sequential Sample Bottles (Automatic Sampler based for Sequential Mode) to be used for Collecting Samples for Organic Compounds
 - 8.1. Use cleaning procedures outlined in FC 1131. Allow containers to thoroughly air dry before use.
 - 8.2. Replace bottles in covered, automatic sampler base; cover with aluminum foil for storage.
9. BOTTLE SIPHONS USED TO TRANSFER SAMPLES FROM COMPOSITE CONTAINERS
 - 9.1. Rinse tubing with solvent and dry overnight in a drying oven.
 - 9.2. Cap ends with aluminum foil and/or FP film for storage.
 - 9.3. Seal in plastic for storage and transport.
 - 9.4. Flush siphon thoroughly with sample before use.
10. REUSABLE FP COMPOSITE MIXER RODS

- 10.1. Follow procedures outlined in FC 1131.
- 10.2. Wrap in aluminum foil for storage.

FC 1150. FILTRATION EQUIPMENT

1. Dissolved Constituents using in-line, Molded and Disposable Filter Units
 - 1.1. Peristaltic Pump
 - 1.1.1. Clean the pump following procedures in FC 1170, section 2.2.
 - 1.1.2. Clean the pump head tubing following FC 1160, section 4.
 - 1.1.3. If FP tubing is used, clean following the procedures in FC 1160, section 3.
 - 1.1.4. Clean other tubing types such as polyethylene according to the appropriate procedures listed in FC 1160, section 7.
 - 1.2. Other Equipment Types (e.g., pressurized FP bailer)
 - 1.2.1. Follow the appropriate cleaning regimen specified in FC 1131 through FC 1132 for other types of equipment that utilize in-line, molded and disposable filters.
2. Dissolved Constituents using Non-disposable Filtration Units (e.g., syringes, "tripod assembly")
 - 2.1. Stainless Steel or Glass Units
 - 2.1.1. Follow FC 1131, assembling and applying pressure to the apparatus after each rinse step (water and acid) to drive rinsing solution through the porous filter holder in the bottom of the apparatus.
 - 2.1.2. Remove and clean any transfer tubing according to the appropriate cleaning procedures (see FC 1160).
 - 2.1.3. Assemble the unit and cap both the pressure inlet and sample discharge lines (or whole unit if a syringe) with aluminum foil to prevent contamination during storage.
 - 2.1.4. If the unit will **not** be used to filter volatile or extractable organics, seal the unit in an untreated plastic bag to prevent contamination.
 - 2.2. Reusable In-Line Filter Holders
 - 2.2.1. Clean, using FC 1131, (if **FP**, glass or stainless steel) or FC 1132 (if plastic) assembling and applying pressure to the apparatus after each rinse step (water and acid) to drive rinsing solution through the porous filter holder in the bottom of the apparatus.
 - 2.2.2. Assemble the unit and wrap with aluminum foil to prevent contamination during storage.
 - 2.2.3. If the unit will **not** be used to filter volatile or extractable organics, seal the unit in an untreated plastic bag to prevent contamination.
3. FILTERS
 - 3.1. Do not clean filters. Instructions for rinsing the filters prior to use are discussed in the applicable sampling SOPs (FS 2000 - FS 8000).

FC 1160. SAMPLE TUBING DECONTAMINATION

1. Check tubing:
 - 1.1. For discoloration: Remove discolored tubing from use until it can be cleaned. If the discoloration cannot be removed, discard the tubing.
 - 1.2. For elasticity (if used in a peristaltic-type pump): Discard any tubing that has lost its elasticity.

2. Transport all tubing to the field in precut, **precleaned** sections.
3. FLUOROPOLYMER, POLYETHYLENE AND POLYPROPYLENE TUBING
 - 3.1. New Tubing: Follow this procedure unless the manufacturer/supplier provides certification that the tubing is clean.
 - 3.1.1. Fluoropolymer
 - 3.1.1.1. Rinse outside of tubing with pesticide-grade solvent (see FC 1001, section 2).
 - 3.1.1.2. Flush inside of tubing with pesticide-grade solvent.
 - 3.1.1.3. Dry overnight in drying oven or equivalent (zero air, nitrogen, etc.).
 - 3.1.2. Polyethylene and Polypropylene
 - 3.1.2.1. Clean the exterior and interior of the tubing by soaking in hot, sudsy water.
 - 3.1.2.2. Thoroughly rinse the exterior and interior of the tubing with tap water, followed by analyte-free water.
 - 3.2. Reused Tubing

Use the following procedure for in-lab cleaning. **Field cleaning is not recommended:**

 - 3.2.1. Clean the exterior of the tubing by soaking in hot, sudsy water (see FC 1001, section 1) in a stainless steel sink (or equivalent non-contaminating material). Use a brush to remove any particulates, if necessary.
 - 3.2.2. Use a small bottle brush and clean the inside of the tubing ends where the barbs are to be inserted or cut 1-2 inches from the ends of the tubing after cleaning.
 - 3.2.3. Rinse tubing exterior and ends liberally with tap water.
 - 3.2.4. Rinse tubing surfaces and ends with the appropriate acid solution (see FC 1001, section 4), tap water, isopropanol (see FC 1001, section 2), and finally analyte-free water. Note: Eliminate the isopropanol rinse for polyethylene or polypropylene tubing.
 - 3.2.5. Place tubing on fresh aluminum foil or clean polyethylene sheeting. Connect all of the precut lengths of tubing with FP inserts or barbs.
 - 3.2.6. Cleaning configuration:
 - 3.2.6.1. Place cleaning reagents: [sudsy water (see FC 1001, section 1); acid (see FC 1001, section 4); isopropanol (see FC 1001, section 2)] in an appropriately cleaned container (2-liter glass jar is recommended).
 - 3.2.6.2. Place one end of the FP tubing into the cleaning solution.
 - 3.2.6.3. Attach the other end of the FP tubing set to the influent end of a pump.
 - 3.2.6.4. Recycle the effluent from the pump by connecting a length of FP tubing from the effluent to the glass jar with the cleaning reagents.
 - 3.2.6.5. Recycling as described above may be done for all reagents listed in FC 1160, section 3.2.6.1 above, **except** the final isopropanol rinse and the final analyte-free water rinse. Disconnect the tubing between the effluent end of the pump and the jar of cleaning reagents.
 - 3.2.6.6. Containerize isopropanol in a waste container for proper disposal.
 - 3.2.6.7. Analyte-free water may be discarded down the drain.
 - 3.2.7. Using the above configuration described in FS 1160, section 3.2.6 above:
 - 3.2.7.1. Pump hot, sudsy water through the connected lengths. Allow the pump to run long enough to pump at least three complete tubing volumes through the tubing set.

3.2.7.2. Using the same procedure, successively pump tap water, the acid solution(s), tap water, isopropanol, and finally analyte-free water through the system.

3.2.7.3. Leave the FP inserts or barbs between the precut lengths and cap or connect the remaining ends.

3.2.8. After the interior has been cleaned as described in FC 1160, section 3.2.7 above, rinse the exterior of the tubing with analyte-free water.

3.2.9. Wrap the connected lengths in aluminum foil or untreated butcher paper and store in a clean, dry area until use.

4. Flexible Tubing used in Pump Heads of Automatic Samplers and other Peristaltic Pumps

Replace tubing after each sampling point if samples are collected through the tubing. Unless the pump is deployed to collect samples from the same location over a long period of time, remove and wash the tubing after each sampling event (see FC 1140, section 1).

4.1. Flush tubing with hot tap water then sudsy water (see FC 1001, section 1).

4.2. Rinse thoroughly with hot tap water.

4.3. Rinse thoroughly with analyte-free water.

4.4. If used to collect metals samples, flush the tubing with an appropriate acid solution (see FC 1001, section 4), followed by thorough rinsing with analyte-free water. If used to collect both metals and nitrogen components use hydrochloric acid (see FC 1001, section 4.1.1).

4.5. Install tubing in peristaltic pump or automatic sampler.

4.6. Cap both ends with aluminum foil or equivalent.

Note: Change tubing at specified frequencies as part of routine preventative maintenance.

5. STAINLESS STEEL TUBING

Clean the exterior and interior of stainless steel tubing as follows:

5.1. Using sudsy water (see FC 1001, section 1), scrub the interior and exterior surfaces.

5.2. Rinse with hot tap water.

5.3. Rinse with analyte-free water.

5.4. If volatile or extractable organics are to be sampled, rinse all surfaces with isopropanol (see FC 1001, section 2). Use enough solvent to wet all surfaces with free flowing solvent.

5.5. Allow to air dry or thoroughly rinse with analyte-free water.

6. GLASS TUBING

6.1. Use new glass tubing.

6.2. If volatile or extractable organics are to be sampled, rinse with isopropanol (see FC 1001, section 2).

6.3. Air dry for at least 24 hours.

6.4. Wrap in aluminum foil or untreated butcher paper to prevent contamination during storage.

6.5. Discard tubing after use.

7. MISCELLANEOUS NON-INERT TUBING TYPES (TYGON, RUBBER, PVC, ETC.)

7.1. New Tubing

7.1.1. As a general rule, new tubing may be used without preliminary cleaning.

7.1.2. Protect new tubing from potential environmental contamination by wrapping in aluminum foil and sealing in untreated plastic bags or keep in the original sealed packaging until use.

7.1.3. If new tubing is exposed to potential contamination, rinse the exterior and interior tubing surfaces with hot tap water followed by a thorough rinse with analyte-free water.

7.1.4. If new tubing is to be used to collect samples, thoroughly rinse the tubing with sample water (i.e., pump sample water through the tubing) before collecting samples.

7.2. Reused Tubing

7.2.1. Flush tubing with sudsy solution of hot tap water and laboratory detergent (see FC 1001, section 1).

7.2.2. Rinse exterior and interior thoroughly with hot tap water.

7.2.3. Rinse exterior and interior thoroughly with analyte-free water.

7.2.4. If used to collect only metals samples, flush the tubing with nitric acid (see FC 1001, section 4.1), followed by a thorough rinse with analyte-free water.

7.2.5. If used to collect metals and nitrogen-containing compounds, see FC 1001, section 4.3.

7.2.6. Cap ends in aluminum foil and store in clean, untreated plastic bags to prevent contamination during storage and transport.

FC 1170. PUMPS

1. SUBMERSIBLE PUMPS

1.1. Pumps used for Purging and Sampling Metals and/or Volatile and Extractable Organics

1.1.1. Construction of pump body and internal mechanisms (bladders, impellers, etc.), including seals and connections, must follow Tables FS 1000-1, FS 1000-2 and FS 1000-3.

1.1.2. Tubing material must follow Tables FS 1000-1, FS 1000-2 and FS 1000-3.

1.1.3. Clean pump exterior following FC 1132. Note: omit the solvent rinse if the pump body is constructed of plastic (e.g., ABS, PVC, etc.).

1.1.4. Clean the pump internal cavity and mechanism as follows:

1.1.4.1. If used only for purging, thoroughly flush the pump with water before purging the next well.

1.1.4.2. When used for purging and sampling, completely disassemble the pump (if practical) and decontaminate between each well.

1.1.4.3. When used for purging and sampling and the pump cannot be (practicably) disassembled, then clean the internal cavity/mechanism by pumping several gallons of sudsy water (see FC 1001, section 1), followed by several gallons of tap water, and finally, several gallons of analyte-free water.

1.1.4.4. If multiple sampling points are located in an area that is not accessible by a vehicle, and it is difficult to return to the vehicle for cleaning or to transport all cleaning materials to the staging location, at a minimum thoroughly rinse the pump with water.

1.1.5. Refer to FC 1160, section 3 to clean FP tubing.

1.1.6. Refer to FC 1160, section 5 for stainless steel tubing.

1.1.7. Clean other types of tubing according to FC 1160, sections 6 and 7.

1.2. Pumps used for Purging and Sampling all Analytes except Metals, Volatile and Extractable Organics

- 1.2.1. Pump construction: no restrictions.
- 1.2.2. Pump tubing material: no restrictions.
- 1.2.3. Scrub the exterior of the pump with appropriate metal-free, phosphate-free or ammonia-free detergent solution.
- 1.2.4. Rinse the exterior with tap water and analyte-free water.
- 1.2.5. Rinse the interior of the pump and tubing by pumping tap or analyte-free water through the system using a clean bucket or drum.

2. ABOVE-GROUND PUMPS USED FOR PURGING AND SAMPLING

2.1. Pumps used only for Purging

- 2.1.1. The exterior of the pump must be free of oil and grease.
- 2.1.2. Select tubing according to Tables FS 1000-1, FS 1000-2 and FS 1000-3.
- 2.1.3. Clean the tubing that contacts the formation water according to the appropriate protocol for construction materials specified in FC 1160.

2.2. Pumps used for Sampling

- 2.2.1. Clean the exterior of the pump with a detergent solution followed by a tap water rinse. Use clean cloths or unbleached paper towels that have been moistened with the appropriate solution to wipe down the pump.
- 2.2.2. Select tubing according to Tables FS 1000-1, FS 1000-2 and FS 1000-3.
- 2.2.3. Clean the tubing that contacts the formation water according to the appropriate protocol for construction materials specified in FC 1160.

FC 1180. ANALYTE-FREE WATER CONTAINERS

This section pertains to containers that are purchased to transport, store and dispense analyte-free water. It does not apply to water that has been purchased in containers. See FC 1002, section 3 for appropriate construction materials.

1. NEW CONTAINERS

- 1.1. Wash containers and caps according to FC 1131, omitting the solvent rinse if plastic (polyethylene or polypropylene) containers are being cleaned.
- 1.2. Cap with FP film or the bottle cap. The bottle cap must be composed of the same material as the container and cannot be lined.

2. REUSED CONTAINERS

- 2.1. Immediately after emptying, cap with aluminum foil, FP film or the container cap.
- 2.2. Wash the exterior of the container with lab-grade detergent solution (see FC 1001, section 1) and rinse with analyte-free water.
- 2.3. Rinse the interior thoroughly with analyte-free water.
- 2.4. Invert and allow to drain and dry.

FC 1190. ICE CHESTS AND SHIPPING CONTAINERS

- 1. Wash the exterior and interior of all ice chests with laboratory detergent (see FC 1001, section 1) after each use.
- 2. Rinse with tap water and air dry before storing.

3. If the ice chest becomes severely contaminated with concentrated waste or other toxic or hazardous materials clean as thoroughly as possible, render unusable, and properly dispose.

FC 1200. Field Instruments and Drilling Equipment

FC 1210. FIELD INSTRUMENTS (TAPES, METERS, ETC.)

Follow manufacturer's recommendations for cleaning instruments. At a minimum:

1. Wipe down equipment body, probes, and cables with lab-grade detergent solution (see FC 1001, section 1). Check manufacturer's instructions for recommendations and/or restrictions on cleaning.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with analyte-free water.
4. Store equipment according to the manufacturer's recommendation or wrap equipment in aluminum foil, untreated butcher paper or untreated plastic bags to eliminate potential environmental contamination.

FC 1220. SOIL BORING EQUIPMENT

This section pertains only to equipment that is not used to collect samples. Clean split spoons, bucket augers and other sampling devices according to FC 1131.

1. Remove oil, grease, and hydraulic fluid from the exterior of the engine and power head, auger stems, bits and other associated equipment with a power washer or steam jenny or wash by hand with a brush and sudsy waster (no degreasers).
2. Rinse thoroughly with tap water.

FC 1230. WELL CASING CLEANING

These are recommended procedures for cleaning well casing and riser pipes. Use procedures specified by a FDEP contract, order, permit, or rule, if different or more stringent than the procedures outlined below.

1. FDEP recommends only using casing that is designed for subsurface environmental groundwater monitoring.
2. Casing that has been contaminated with grease, hydraulic fluid, petroleum fuel, etc. may require additional cleaning or deemed unusable.
3. All casings and riser pipes should be cleaned before installation, unless the casing is received wrapped and ready for installation:
 - 3.1. Steam clean all casings and riser pipes except PVC. Steam cleaning criteria shall meet the following: water pressure - 2500 psi; water temperature - 200°F.
 - 3.2. Rinse thoroughly with tap (potable) water. This tap water must be free of the analytes of interest.

FC 1300. Sample Containers

FC 1310. OBTAINING CLEAN CONTAINERS

1. Obtain clean sample containers in one of three ways:
 - 1.1. From commercial vendors as precleaned containers. The cleaning grades must meet EPA analyte specific requirements. Keep all records for these containers (lot

numbers, certification statements, date of receipt, etc.) and document the container's intended uses;

1.2. From internal groups within the organization that are responsible for cleaning and maintaining containers according to the procedures outlined in FC 1320; or

1.3. From a subcontracted laboratory that is accredited under the National Environmental Laboratory Accreditation Program (NELAP).

1.3.1. The contractor must verify that the laboratory follows the container cleaning procedures outlined in FC 1320.

1.3.2. If the laboratory cleaning procedures are different, the contractor must require that the laboratory use the following cleaning procedures or provide documentation and historical records to show that their in-house procedure produces containers that are free from the analytes of interest.

FC 1320. CONTAINER CLEANING PROCEDURES

1. Refer to Table FC 1000-2. Follow the cleaning steps in the order specified in the chart.

2. Cleaning procedures that are different from those outlined in FC 1320 may be used as long as blanks collected in the containers are free from the analytes of interest and any analytical interferences and the cleaning procedures are supported by historical and continuing documentation.

3. Inspect all containers before cleaning. **Do not recycle or reuse containers if:**

3.1. Containers were used to collect in-process (i.e., untreated or partially treated) wastewater samples at industrial facilities;

3.2. A visible film, scale or discoloration remains in the container after the cleaning procedures have been used; or

3.3. Containers were used to collect samples at pesticide, herbicide or other chemical manufacturing facilities that produce toxic or noxious compounds. Such containers shall be properly disposed of (preferably at the facility) at the conclusion of the sampling activities.

3.4. If the containers described above are reused, check no less than 10% of the cleaned containers for the analytes of interest before use. If found to be contaminated (i.e., analytes of interest are found at MDL levels or higher), discard the containers.

FC 1400. Documentation

Document cleaning procedures described below for the indicated activities. See FD 1000 for additional information about required records and retention of documents.

FC 1410. FIELD EQUIPMENT

1. IN-FIELD CLEANING

1.1. Initially identify the procedures that are used to clean equipment in the field by SOP numbers and dates of usage.

1.2. Record the date and time that equipment was cleaned.

2. IN-HOUSE CLEANING

2.1. Retain any cleaning certificates, whether from a laboratory or commercial vendor.

2.2. Identify the procedure(s) that are used to clean equipment by the SOP number and dates of usage.

2.3. Record the date that the equipment was cleaned.

FC 1420. SAMPLE CONTAINERS

1. Organizations that order precleaned containers must retain the packing slips, and lot numbers of each shipment, any certification statements provided by the vendor and the vendor cleaning procedures.
2. Organizations that clean containers must maintain permanent records of the following:
 - 2.1. Procedure(s) used to clean containers by SOP number and dates of usage.
 - 2.2. If containers are certified clean by the laboratory the laboratory must record:
 - Type of container;
 - Date cleaned;
 - SOP used;
 - Person responsible for cleaning;
 - Lot number (date of cleaning may be used) of the batch of containers that were cleaned using the same reagent lots and the same procedure;
 - The results of quality control tests that were run on lot numbers; and
 - Any additional cleaning or problems that were encountered with a specific lot.

FC 1430. REAGENTS AND OTHER CLEANING SUPPLIES

Maintain a record of the lot number with the inclusive dates of use for all acids, solvents, and other cleaning supplies.

Appendix FC 1000
Tables, Figures and Forms

Table FC 1000-1 Procedures for Decontamination at the Base of Operations or On-site

Table FC 1000-2 Container Cleaning Procedures

Table FC 1000-1
Procedures for Decontamination at the Base of Operations or On-Site

Construction Material	Analyte Group Sampled	SOP Reference	Base of Operations	On-Site
FP or Glass	All	FC 1131	Follow as written	May substitute ambient temperature water for the hot water rinses and hot detergent solution
FP or Glass	Extractable & Volatile Organics Petroleum Hydrocarbons	FC 1131	May omit acid rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution May omit acid rinse
FP or Glass	Metals ⁱ Radionuclides For ultra trace metals, refer to FS 8200	FC 1131	May omit solvent rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution May omit solvent rinse
FP or Glass	Inorganic Nonmetallics Physical & Aggregate Properties Aggregate Organics Biologicals Volatile Inorganics	FC 1131	May omit solvent rinse	Rinse several times with water Rinse several times with sample water from the next sampling location
FP or Glass	Microbiological – Viruses Microbiological - Bacteria	FC 1131	Omit solvent and acid rinses	Rinse several times with water Rinse several times with sample water from the next sampling location
Metallic (stainless steel, brass, etc.)	All Extractable & Volatile Organics Petroleum Hydrocarbons	FC 1131	Omit the acid rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution Omit the acid rinse
Metallic (stainless steel, brass, etc.)	Metals Radionuclides	FC 1131	Omit the acid rinse May omit the solvent rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution Omit the acid rinse May omit the solvent rinse
Metallic (stainless steel, brass, etc.)	Inorganic Nonmetallics Physical & Aggregate Properties Aggregate Organics Biologicals Volatile Inorganics	FC 1131	Omit solvent rinse May omit the acid rinse	Rinse several times with water Rinse several times with sample water from the next sampling location

Table FC 1000-1
Procedures for Decontamination at the Base of Operations or On-Site

Construction Material	Analyte Group Sampled	SOP Reference	Base of Operations	On-Site
Metallic (stainless steel, brass etc.)	Microbiological – Viruses Microbiological - Bacteria	FC 1131	Omit solvent and acid rinses	Rinse several times with water Rinse several times with sample water from the next sampling location
Plastic (Polyethylene, polypropylene, PVC, silicone, acrylic)	Volatile and Extractable Organics;	FC 1132	Follow as written.	May substitute ambient temperature water for the hot water rinses and hot detergent solution
Plastic (Polyethylene, polypropylene, PVC, silicone, acrylic)	Inorganic Nonmetallics Physical & Aggregate Properties Aggregate Organics Biologicals Volatile Inorganics	FC 1132	May omit the acid rinse	Rinse several times with water Rinse several times with sample water from the next sampling location
Plastic (Polyethylene, polypropylene, PVC, silicone, acrylic)	Microbiological – Viruses Microbiological - Bacteria	FC 1132	Omit acid rinse	Rinse several times with water Rinse several times with sample water from the next sampling location

ⁱ Do not use glass if collecting samples for boron or silica.

Table FC 1000-2
Container Cleaning Procedures

ANALYSIS / ANALYTE GROUP	CLEANING STEPS See Description Below
Extractable Organics	1, 2, 4, 6 (not required if Luminox (or equivalent is used), (5 and 7 optional), 11
Volatile Organics	1, 2, 4, (6 optional, methanol only), 7
Metals	1, 2, 3, 4, 8, 11 ** **Procedures to clean containers for ultra-trace metals are found in FS 8200
Inorganic Nonmetallics, Radionuclides, Physical and Aggregate Properties, Aggregate Inorganics, and Volatile Inorganics	1, 2, 3*, 4, 8, 11 * For nutrients, replace nitric acid with hydrochloric acid, or use a hydrochloric acid rinse after the nitric acid rinse. See FC 1001, section 4
Petroleum Hydrocarbons, and Oil and Grease	1, 2, 3, 4, (5, 6, 7 optional), 11
Microbiological (all)	1, 2, 4, 8, 9, 11
Toxicity Tests (Includes Bioassays)	1, 2, 10, 2, 4, 6.1, (10 optional), 11

NOTE: Steps 1 and 2 may be omitted when cleaning new, uncertified containers.

1. Wash with hot tap water and a brush using a suitable laboratory-grade detergent:
 - 1.1. Volatile and Extractable Organics, Petroleum Hydrocarbon, Oil and Grease: Luminox, Liqui-Nox, Alconox or equivalent;
 - 1.2. Inorganic nonmetallics: Liqui-Nox or equivalent;
 - 1.3. Metals: Liqui-Nox, Acationox, Micro or equivalents;
 - 1.4. Microbiologicals (all): Must pass an inhibitory residue test.
2. Rinse thoroughly with hot tap water.
3. Rinse with 10% nitric acid solution.
4. Rinse thoroughly with analyte-free water (deionized or better).
5. Rinse thoroughly with pesticide-grade methylene chloride.
6. Rinse thoroughly with pesticide-grade isopropanol, acetone or methanol.
 - 6.1. For bioassays, use only acetone, and only when containers are glass.
7. Oven dry at 103°C to 125°C for at least 1 hour.
 - 7.1. VOC vials and containers must remain in the oven in a contaminant-free environment until needed. They should be capped in a contaminant-free environment just prior to dispatch to the field.
8. Invert and air-dry in a contaminant-free environment.
9. Sterilize containers:
 - 9.1. Plastic: 60 min at 170°C, loosen caps to prevent distortion.
 - 9.2. Glass: 15 min at 121°C.
10. Rinse with 10% hydrochloric acid.
11. Cap tightly and store in a contaminant-free environment until use. Do not use glass if collecting samples for boron or silica.

FD 1000. DOCUMENTATION PROCEDURES

This SOP must be used in conjunction with all other DEP SOPs applicable to the field sampling event, project or program.

1. INTRODUCTION:

1.1. For the creation of clear, accurate and methodical records to document all field activities affecting sample data, implement the following standard operating procedures for sample collection, sample handling and field-testing activities.

2. SCOPE AND APPLICABILITY

2.1. This SOP provides a detailed listing of the information required for documentation of specific sampling and field testing procedures found in the DEP SOPs contained in the collection DEP-SOP-001. See the DEP SOPs in collection DEP-SOP-003/11 for additional documentation requirements.

2.2. Refer to the associated sampling or field testing SOP for any requirements for the chronological or sequential documentation of data.

3. QUALITY ASSURANCE

3.1. Implement review procedures to monitor and verify accurate manual and automated data entry and recordkeeping for all documentation tasks outlined in this SOP.

FD 1100. Universal Documentation Requirements

Incorporate efficient archival design and concise documentation schemes for all record systems. Ensure that the history of a sample is clearly evident in the retained records and documentation and can be independently reconstructed.

1. CRITERIA FOR ALL DOCUMENTS

1.1. Keep all applicable documentation available for inspection. Keep records of all original data as well as records of all reduced or manipulated forms of the original data.

1.1.1. Original records consist of documentation that is produced by the person or organization responsible for the original generation of the documentation. Original records are the source from which copies are made.

1.1.2. Original data is information generated at the time of or as the result of performing field procedures or tests, e.g., "raw" data automatically reported or logged from field-testing instrumentation, handwritten field notes or drawings, completed field forms or sheets, photographs, etc.

1.1.3. Manipulated data is information that has been reformatted from original data for the purpose of organizing, analyzing, reporting or presenting the data, e.g., lists or tables of results, reports of field sampling and testing results, analyzed or reduced forms of data that present statistical information, calculations or other evaluations and manipulations of the original data, etc.

1.2. Specific requirements for documentation for projects may be included in quality assurance plans, sampling and analysis plans, monitoring plans or other planning documents that have been approved by DEP.

1.3. According to the DEP Quality Assurance rule 62-160.650, F.A.C, authorized representatives of DEP shall inspect and request copies of any records using paper, electronic media, or other media during any DEP audit of physical facilities or on-site sampling events, and for any data validations conducted for applicable project data

DEP-SOP-001/01
FD 1000 Documentation Procedures

submitted to DEP (see 62-160.670, F.A.C.), as needed for DEP data usability assessments or other quality assurance purposes.

1.4. Electronic records are acceptable as documentation and are considered to be equivalent in status and function to original records, documents or papers, unless otherwise specified in a DEP contract, order, permit or Title 62 rule.

1.4.1. All documentation requirements in the DEP SOPs (DEP-SOP-001/01, DEP-SOP-002/01 and DEP-SOP-003/11) shall apply equally to paper and electronic records. See part FD 1200, below for additional requirements.

1.4.2. Electronic copies of original records can be designated as master copies for storage purposes. Electronic copies designated as master copies can serve the same function as original records.

1.4.3. Electronic copies intended to replace original records must contain the same information as the original records, regardless of whether the electronic copies are designated as master or duplicate records.

1.5. Record enough information so that clarifications, interpretations, or explanations of the data are not required from the originator of the documentation.

1.6. Clearly indicate the nature and intent of all documentation and all record entries.

1.7. Link citations to SOPs and other documents by the complete name, reference or publication number, revision number, and revision date for the cited document, when applicable. Also, assign this information to internally generated SOPs.

1.8. Retain copies of all revisions of all cited documents as part of the documentation archives.

2. PROCEDURES

2.1. Sign, initial or encode all documentation entries made to paper, electronic or other records with a link indicating the name and responsibility of the author making the data entry, clearly indicating the reason for the signature, initials or code (e.g., “sampled by”; “released by”; “prepared by”; “reviewed by”).

2.2. In order to abbreviate record entries, make references to procedures written in internal SOPs or methodology and procedures promulgated by external sources.

2.2.1. Document the intent to use SOPs other than the DEP SOPs, or to use allowable modifications to the DEP SOPs by recording the effective date of use for all such SOPs or modifications. Retain any correspondence with DEP regarding approval to use alternative procedures for any projects.

2.2.2. Authorize all internal SOPs with the signatures of the quality assurance officer(s) and manager(s) responsible for implementation of the SOPs. Record the dates of signature.

2.3. Employ straightforward procedures for the storage of records to facilitate documentation tracking and retrieval of all current records and archives for purposes of inspection, verification, and historical reconstruction of all procedures and measurement data.

2.4. Keep copies or original records of all documentation, including documentation sent to or received from external parties.

2.5. Use waterproof ink for all paper documentation.

2.5.1. Some situations may require the use of pencil for handwritten records. For example, pencils are often the best choice for writing on waterproof paper in wet conditions. Consider making copies of handwritten records (e.g., scanning or photocopying) as soon as possible to ensure preservation of the original data.

- 2.6. Do not erase or obliterate entry errors on paper records. Make corrections by marking a line through the error so that it is still legible. Initial or sign the marked error and its correction.
- 2.7. Maintain electronic audit trails for all edited electronic records, if possible. Utilize software that allows tracking of users and data edits, if available. Software that prompts the user to double-check edits before execution is also preferred. See FD 1200.
- 2.8. Clearly link all documentation associated with a sample or measurement. Make cross-references to specific documentation when necessary.
- 2.9. Link final reports, data summaries, or other condensed versions of data to the original sample data, including those prepared by external parties.

3. RETENTION REQUIREMENTS

- 3.1. Per the DEP QA Rule, 62-160.240 & .340, F.A.C., keep all documentation archives for a minimum of 5 years after the date of generation or completion of the records unless otherwise specified in a Department contract, order, permit, or Title 62 rules.

FD 1200. Electronic Documentation

Handle electronic (digital) data as with any data according to applicable provisions of FD 1100.

1. RETENTION OF AUTOMATIC DATA RECORDING PRODUCTS

- 1.1. For data not directly read from the instrument display and manually recorded, retain all products or outputs from automatic data recording devices, such as strip chart recorders, integrators, data loggers, field measurement devices, computers, etc. Store records in electronic, magnetic, optical, or paper form, as necessary. Retain all original, raw output data. Ensure archiving of these data prior to subsequent reduction or other manipulation of the data.
- 1.2. Identify output records as to purpose, analysis date and time, field sample identification number, etc. Maintain clear linkage with the associated sample, other data source or measured medium and specific instrument used to make the measurement.

2. ELECTRONIC DATA SECURITY

- 2.1. Control levels of access to electronic data systems as required to maintain system security and to prevent unauthorized editing of data.
- 2.2. Do not alter raw instrumentation data or original manual data records in any fashion without retention of the original raw data.
- 2.3. Maintain secure computer networks and appropriate virus protection as warranted for each system design.

3. ELECTRONIC DATA STORAGE AND DOCUMENTATION

- 3.1. Store all electronic, magnetic, and optical media for easy retrieval of records.
 - 3.1.1. Ensure that all records can be printed to paper if needed for audit or verification purposes.
 - 3.1.2. If it is anticipated that the documentation archive will become unreadable due to obsolescence of a particular storage technology, retain a paper archive of the data or transfer to other suitable media.
- 3.2. For easy retrieval of records, link all stored data to the associated sample data or other data source.
- 3.3. Back up all data at a copy rate commensurate with the level of vulnerability of the data. Consider replicating all original data as soon as possible after origination.

4. SOFTWARE VERIFICATION

- 4.1. Ensure that any software used to perform automatic calculations conforms to required formulas or protocols.
- 4.2. Document all software problems and their resolution in detail, where these problems have irretrievably affected data records or linkage. Record the calendar date, time, responsible personnel, and relevant technical details of all affected data and software files. Note all software changes, updates, installations, etc. per the above concerns. File and link all associated service records supplied by vendors or other service personnel.
5. PROTECTION OF EQUIPMENT AND STORAGE MEDIA
 - 5.1. Place stationary computers, instrumentation, and peripheral devices in locations of controlled temperature and humidity and away from areas where the potential for fluid leaks, fire, falling objects, or other hazards may exist. In the field, protect portable equipment from weather, excess heat or freezing, storage in closed vehicles, spillage from reagents and samples, etc.
 - 5.2. Protect storage media from deteriorating conditions such as temperature, humidity, magnetic fields, or other environmental hazards as above.
6. ELECTRONIC SIGNATURES – Documents signed with electronic signatures must be consistent with the requirements of 62-160.405, F.A.C.:
 - 6.1. the integrity of the electronic signature can be assured;
 - 6.2. the signature is unique to the individual;
 - 6.3. the organization using electronic signatures has written policies for the generation and use of electronic signatures; and
 - 6.4. the organization using electronic signatures has written procedures for ensuring the security, confidentiality, integrity and auditability of each signature.

FD 1300. Documentation Using Other Media

1. UNIVERSAL REQUIREMENTS
 - 1.1. Handle documentation prepared using other media according to FD 1100.
2. PROTECTION OF STORED MEDIA
 - 2.1. Store media such as photographs, photographic negatives, microfilm, videotape, etc. under conditions generally prescribed for these media by manufacturers and conducive to long-term storage and protection from deterioration. See also FD 1200, section 5, above.

FD 2000. DOCUMENTATION OF CLEANED EQUIPMENT, SAMPLE CONTAINERS, REAGENTS AND SUPPLIES

When providing sample containers, preservation reagents, analyte-free water or sampling equipment, document certain aspects of these preparations.

1. EQUIPMENT CLEANING DOCUMENTATION
 - 1.1. Document all cleaning procedures by stepwise description in an internal SOP if cleaning procedures in the DEP SOP have been modified for use. Alternatively, cite the DEP SOP procedures in the cleaning record for the applicable equipment.
 - 1.2. Record the date of cleaning.
 - 1.2.1. If items are cleaned in the field during sampling activities for a site, document the date and time when the affected equipment was cleaned. Link this information with the site and the cleaning location at the site.

DEP-SOP-001/01
FD 1000 Documentation Procedures

1.3. Retain or make accessible any certificates of cleanliness issued by vendors supplying cleaned equipment or sample containers.

1.3.1. Retain from the vendor or document for internal cleaning the following information for sample containers, as applicable:

- Packing slip and cleanliness certificates from vendors
- Container types and intended uses
- Lot numbers or other designations for groups of containers cleaned together using the same reagents and procedures
- Dates of cleaning
- Cleaning procedures or reference to internal cleaning SOPs or DEP SOPs
- Cleaning personnel names
- Results of quality control analyses associated with container lots
- Comments about problems or other information associated with container lots

2. SAMPLING KIT DOCUMENTATION

If supplied to a party other than internal staff, transmit to the recipient the following information pertaining to sampling equipment or other implements, sample containers, reagent containers, analyte-free water containers, reagents or analyte-free water supplied to the recipient.

- Quantity, description and material composition of all containers, container caps or closures or liners for caps or closures
- Intended application for each sample container type indicated by approved analytical method or analyte group(s)
- Type, lot number, amount and concentration of preservative added to clean sample containers and/or shipped as additional preservative
- Intended use for any additional preservatives or reagents provided
- Description of any analyte-free water (i.e., deionized, organic-free, etc.)
- Date of analyte-free water containerization
- Date of sampling kit preparation
- Description and material composition of all reagent transfer implements (e.g., pipets) shipped in the sampling kit and the analyte groups for which the implements have been cleaned or supplied
- Quantity, description and material composition of all sampling equipment and pump tubing (including equipment supplied for filtration) and the analyte groups for which the equipment has been cleaned or supplied
- Tare weight of VOC vials, as applicable (this item is necessary when EPA Method 5035 VOC sample vials are provided for soil samples)

3. DOCUMENTATION FOR REAGENTS AND OTHER CHEMICALS

3.1. Keep a record of the lot numbers and inclusive dates of use for all reagents, detergents, solvents and other chemicals used for cleaning and sample preservation.

3.1.1. See FD 4000 below for documentation requirements for reagents used for field testing.

FD 3000. DOCUMENTATION OF EQUIPMENT MAINTENANCE

1. Log all maintenance and repair performed for each instrument unit, including routine cleaning procedures, corrective actions performed during calibrations or verifications, and solution or parts replacement for instrument probes.
 - 1.1. Include the calendar date for the procedures performed.
 - 1.2. Record names of personnel performing the maintenance or repair tasks.
 - 1.2.1. Describe any malfunctions necessitating repair or service.
2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit employed. This identifier may include a manufacturer name, model number, serial number, inventory number, or other unique identification.
3. Retain vendor service records for all affected instruments.
4. Record the following for rented equipment:
 - Rental date(s)
 - Equipment type and model or inventory number or other description
5. Retain the manufacturer's operating and maintenance instructions.

FD 4000. DOCUMENTATION FOR CALIBRATION OF FIELD-TESTING INSTRUMENTS AND FIELD ANALYSES

Document acceptable instrument or measuring system calibration for each field test or analysis of a sample or other measurement medium.

FD 4100. General Documentation for all Field Testing

1. STANDARD AND REAGENT DOCUMENTATION: Document information about standards and reagents used for calibrations, verifications, and sample measurements.
 - 1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.
 - 1.1.1. Document acceptable verification of any standard used after its expiration date.
 - 1.2. Record the concentration or other value for the standard in the appropriate measurement units.
 - 1.2.1. Note vendor catalog number and description for preformulated solutions as well as for neat liquids and powdered standards.
 - 1.2.2. Retain vendor assay specifications for standards as part of the calibration record.
 - 1.2.2.1. Record the grade of standard or reagent used.
 - 1.3. When formulated in-house, document all calculations used to formulate calibration standards.
 - 1.3.1. Record the date of preparation for all in-house formulations.
 - 1.4. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).
2. FIELD INSTRUMENT CALIBRATION DOCUMENTATION: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.
 - 2.1. Retain vendor certifications of all factory-calibrated instrumentation.

DEP-SOP-001/01
FD 1000 Documentation Procedures

- 2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.
 - 2.2.1. Record manufacturer name, model number, and identifying number such as a serial number for each instrument unit.
 - 2.3. Record the time and date of all initial calibrations and all calibration verifications.
 - 2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications to the resolution stated by the instrument manufacturer for the measurement range.
 - 2.5. Record the name of the analyst(s) performing the calibration or verification.
 - 2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:
 - Type of standard or standard name (e.g., pH buffer)
 - Value of standard, including correct units (e.g., pH = 7.0 SU)
 - Link to information recorded according to section 1 above
 - 2.7. Retain manufacturers' instrument specifications.
 - 2.8. Document whether successful initial calibration occurred.
 - 2.9. Document whether each calibration verification passed or failed.
 - 2.10. Document, according to records requirements of FD 3000, any corrective actions taken to modify instrument performance.
 - 2.10.1. Document date and time of any corrective actions.
 - 2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.
 - 2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).
 - 2.12. Document acceptance criteria used for all verifications or cite relevant DEP FT SOP or internal SOP.
3. Record all field-testing measurement data, to include the following:
 - Project name
 - Date and time of measurement or test (including time zone, if applicable)
 - Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
 - Latitude and longitude of sampling source location (if required)
 - Analyte or parameter measured
 - Measurement or test sample value, recorded to the resolution stated by the instrument manufacturer for the measurement range.
 - "J" data qualifier code and explanatory comment if the sample measurement is not chronologically and quantitatively bracketed by acceptable calibrations and verification per requirements in FT 1000, section 2.2.
 - Reporting units for the measurement
 - Initials or name of analyst performing the measurement
 - Unique identification of the specific instrument unit used for the test (see 2.2 above)

FD 4200. Documentation for Field Measurement of Stage, Surface Water Velocity, and Discharge (Flow) and Computation of Streamflow (FT 1800)

Documentation specified in the TWRI and TM references cited in this SOP must be included in the records for all measurements and calculations performed according to this SOP. Record information and retain documentation for all stage, velocity and discharge determinations in a manner that allows unequivocal reconstruction of the essential details of field measurement events, discharge calculations, and any other treatments or manipulations of data. The following documentation shall be provided, if applicable to the site:

1. Site Information

- Source and location of the measurement (e.g., identification number, station number or other description);
- Latitude and longitude of cross-section(s) measurement location (if required for the project, monitoring program, etc.);
- Number of channels measured and observed;
- Length of reach measured (if applicable);
- Date and time site was measured;
- Personnel who visited the site and their duties;
- Description or name of project, or monitoring program, associated with the measurements; and
- Description of site conditions during visit.

2. Instrumentation

- Vendor certificates of all factory-calibrated instrumentation;
- Manufacturers' instrumentation manual and specifications;
- Identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used;
- Date and time of all quality control activities prescribed by manufacturers' instructions based on instrument type;
- Identity of the quality control activities performed;
- Description of the performance of instrumentation during quality control activities (e.g., spin test results or on-board quality control of ADCP);
- Date and time of corrective actions taken to correct instrument performance according to records requirements of FD 3000; and
- Names of personnel performing corrective actions.

3. Field measurements

- Method used for determination of discharge;
- Analyst(s) performing measurements;
- Date and time of measurements; and
- Measurement value and unit for each measurement.

4. Describe and document the rationale for any modifications made to the standard reference procedures cited in this SOP that are used for the project. Include specific listings and descriptions of modifications made and link the modifications to the applicable sections of the standard reference procedures cited in this SOP.

5. Calculations

- Raw information used for calculations;
- Analyst(s) who conducted all calculations;
- Method by which discharge was calculated;
- Result and units of calculated discharge;
- Rating curve to which calculated discharge is compared;
- Reasoning for deviating from prescribed calculation methods indicated in the applicable sections of the standard reference procedures cited in this SOP; and
- Provide enough information so that the discharge can be recalculated by an independent party and obtain the same result for verification purposes.

6. Rating Curves

- Status of the rating curve as determined by a hydrographer (e.g., under development, established);
- Date the curve was last reviewed;
- Hydrographer(s) responsible for latest review of the rating curve;
- Entity responsible for the maintenance of the rating curve;
- Location associated with the rating curve; and
- All notes associated with the quality of the rating curve and its status.

FD 5000. DOCUMENTATION OF SAMPLE COLLECTION, PRESERVATION AND TRANSPORT

Follow these procedures for all samples. See FD 5100 - FD 5427 below for additional documentation for specific sampling activities. See the list of required and optional Forms in FD 9000 below for documenting specific sampling and testing procedures.

1. SAMPLE IDENTIFICATION REQUIREMENTS

1.1. Ensure that labels are waterproof and will not disintegrate or detach from the sample container when wet, especially under conditions of extended submersion in ice water typically accumulating in ice chests or other transport containers.

1.2. Label or tag each sample container with a unique field identification code that adequately distinguishes each sample according to the following criteria. The code must adequately link the sample container with all of the information about the sample contained in the permanent field record. A code or unique ID can include descriptors such as site name and date, as long as the descriptor(s) alone or in combination uniquely identify the sample and container, and link the sample and container to other field records.

1.2.1. Link the unique field identification code to the sample source or sampling point identification, the date of sample collection, the time of sample collection (if required, see below), the analytes of interest and the preservation technique.

1.2.1.1. Record the time of sample collection for each sample with a holding time ≤ 72 hours.

1.2.1.2. A time of collection is required for data to be entered into the Florida Watershed Information Network (WIN), regardless of holding time.

DEP-SOP-001/01
FD 1000 Documentation Procedures

1.2.2. Label or tag each sample container for the following types of samples with a unique field identification code:

- Quality control samples such as duplicate samples, other replicate samples or split samples collected for the same analyte or group of analytes
- Field samples or quality control samples collected using a different sample collection technique for the same analyte or group of analytes (for example, if both a bailer and a pump are used to collect samples for metals analysis, label the bailer sample to distinguish it from the pump sample)

1.2.3. The color, size, shape, or material composition of sample containers, labels and caps cannot substitute for the information required in 1.2.1. – 1.2.2. Above.

1.2.4. The unique field identification code and any other information included on the container label or tag must allow the analyzing laboratory to independently determine the sample collection date, the sample collection time (if required, see 2.2 below), the sample preservation and the analytical tests to be performed on each container or group of containers.

1.3. Attach the label or tag so that it does not contact any portion of the sample that is removed or poured from the container.

1.4. Record the unique field identification code on all other documentation associated with the specific sample container or group of containers.

2. GENERAL REQUIREMENTS FOR SAMPLING DOCUMENTATION: Record the following information for all sampling:

2.1. Names of all sampling team personnel on site during sampling

2.2. Date and time of sample collection, if required (indicate hours and minutes). Use 24-hour clock or indicate A.M. and P.M.

2.2.1. Record the time of sample collection for each sample with a holding time ≤ 72 hours.

2.2.2. A time of collection is required for data to be entered into the Florida Watershed Information Network (WIN), regardless of holding time.

2.3. Ambient field conditions, to include, but not limited to information such as weather, tides, etc.

2.4. Comments about samples or conditions associated with the sample source (e.g., turbidity, sulfide odor, insufficient amount of sample collected)

2.5. Specific description of sample location, including site name and address

2.5.1. Describe the specific sampling point (e.g., monitoring well identification number, outfall number, station number, etc.).

2.5.2. Determine latitude and longitude of sampling source location (if required).

2.5.3. Locate sampling points on scaled maps or drawings where applicable.

2.6. Record the unique field identification code for each sample container and parameters to be analyzed, per section 1 above. The code must adequately link the sample container or group of containers with all of the information about the sample contained in the permanent field record.

2.7. Number of containers collected for each unique field identification code

2.8. Analytes/analyte groups collected

2.9. Matrix sampled

DEP-SOP-001/01
FD 1000 Documentation Procedures

- 2.10. Type of field sample collected, such as grab, composite or other applicable designation.
- 2.11. Method of sample access (e.g. wading, from shore, from a bridge, from a motorized or non-motorized boat, intermediate device).
- 2.12. Field-testing measurement data:
 - 2.12.1. See FD 4000 above for specific details.
- 2.13. Calibration records for field-testing equipment
 - 2.13.1. See FD 4000 above for specific details.
- 2.14. Preservation for each container
 - 2.14.1. Indicate whether samples are chemically preserved on-site by the sampling team or, alternatively, were collected in prepreserved (predosed) containers.
 - 2.14.2. Indication of any tests performed in the field to determine the presence of analytical interferences in the sample.
 - 2.14.3. Indication of any treatments of samples performed in the field to eliminate or minimize analytical interferences in the sample.
 - 2.14.4. See FD 5100, section 1.
- 2.15. Purging and sampling equipment used, including the material composition of the equipment and any expendable items such as tubing.
- 2.16. Types, number, collection location and collection sequence of quality control samples
 - 2.16.1. Include a list of equipment that was rinsed to collect any equipment blanks.
- 2.17. Use of fuel powered vehicles and equipment
- 2.18. Number of subsamples and amount of each subsample in any composite samples
 - 2.18.1. Include sufficient location information for the composite subsamples per 2.4 above.
- 2.19. Depth of all samples or subsamples
- 2.20. Signature(s) or initials of sampler(s)
3. SAMPLE TRANSMITTAL RECORDS: Transmit the following information to the analytical laboratory or other receiving party. Link transmittal records with a given project and retain all transmittal records.
 - Site name and address – Note: Client code is acceptable if samples are considered sensitive information and if the field records clearly trace the code to a specified site and address.
 - Date and time of sample collection
 - Name of sampler responsible for sample transmittal
 - Unique field identification codes for each sample container
 - Total number of samples
 - Required analyses
 - Preservation protocol
 - Comments about sample or sample conditions
 - Identification of common carrier (if used)
4. SAMPLE TRANSPORT

- 4.1. If shipping transmittal forms in the transport containers with the samples, place the forms in a waterproof enclosure and seal.
- 4.2. For common carrier shipping, seal transport containers securely with strapping tape or other means to prevent lids from accidentally opening.

4.2.1. Keep all shipping bills from common carriers with archived transmittal records.

5. ANCILLARY FIELD RECORDS: Link any miscellaneous or ancillary records (photographs, videotapes, maps, etc.) to specific sampling events such that these records are easily traceable in the data archives associated with the project, sampling date and sample source(s).

FD 5100. Documentation Specific To Aqueous Chemistry Sampling

1. SAMPLE PRESERVATION: Document preservation of all samples according to the following instructions.

- 1.1. List the chemical preservatives added to the sample (e.g., H_2SO_4 , NaOH, sodium thiosulfate).
- 1.2. Record the results of pH verification performed in the field, including the pH value of the sample (if applicable). Note any observations about changes in the sample as a result of adding preservative to the sample or mixing the sample with the preservative.
- 1.3. Record the amount of preservative added to samples and the amount of any additional preservative added. The amount dosed into sample containers supplied with premeasured preservatives must also be recorded.
 - 1.3.1. For documentation of procedures for preservation for routine samples, cite DEP SOPs or internal SOPs for this information.
 - 1.3.2. Record instances of deviation from preservation protocols found in SOPs when non-routine or problematic samples are collected.
- 1.4. Record the use of ice or other cooling method, when applicable.
- 1.5. Record the filtration of the sample, if applicable, and include:
 - Design type and material construction of filter
 - Filter pore size
 - Date and time of filtration of the sample

2. GROUNDWATER SAMPLING

2.1. Record or establish a documentation link to the following information for all samples. See form FD 9000-24 for an example documentation format. See section 3 below for in-place plumbing:

- Well casing composition and diameter of well casing
- A description of the process and the data used to design the well
- The equipment and procedure used to install the well
- The well development procedure
- Pertinent lithologic or hydrogeologic information
- Ambient conditions at the wellhead or sampling point that are potential sources of unrepresentative sample contamination
- Water table depth and well depth
- Calculations used to determine purge volume

DEP-SOP-001/01
FD 1000 Documentation Procedures

- Total amount of water purged
 - Date well was purged
 - Purging equipment used
 - Sampling equipment used
 - Well diameter
 - Total depth of well
 - Depth to groundwater
 - Volume of water in the well
 - Purging method
 - Placement depth of tubing or pump intake
 - Depth and length of screened interval
 - Times for beginning and ending of purging
 - Total volume purged
 - Times of stabilization parameter measurements
 - Purging rate, including any changes in rate
 - Temperature measurements
 - pH measurements
 - Specific conductance measurements
 - Dissolved oxygen measurements
 - Turbidity measurements
 - Site or monitoring well conditions impacting observed dissolved oxygen and turbidity measurements
 - Color of groundwater
 - Odor of groundwater
- 2.2. Record the following for Water Level and Purge Volume Determination (FS 2211):
- Depth to groundwater
 - Total depth of well
 - Length of water column
 - Well diameter
 - Volume of water in the well
 - Volume of pump
 - Tubing diameter
 - Length of tubing
 - Volume of flow cell
 - Volume in the pumping system
- 2.3. Record the following for Well Purging (FS 2212)
- Calculations for pumping rates, including any changes in rates
 - Flow meter readings
 - Volume of water purged

DEP-SOP-001/01
FD 1000 Documentation Procedures

- Placement depth of tubing or pump intake
 - Depth and length of screened interval
 - Time needed to purge one (1) well volume or purging equipment volume
 - Well volumes or purging equipment volumes purged
 - Temperature measurements
 - pH measurements
 - Specific conductance measurements
 - Dissolved oxygen measurements
 - Turbidity measurements
 - Purging rate, including any changes in rate
 - Drawdown in the well
3. IN-PLACE PLUMBING SOURCES INCLUDING DRINKING WATER SYSTEMS
- 3.1. Record the following for all samples:
- Plumbing and tap material construction (if known)
 - Flow rate at which well was purged
 - Amount of time well was allowed to purge
 - Flow rate at time of sample collection
 - Public water system identification number (if applicable)
 - Name and address of water supply system and an emergency phone number for notification of sample results (if applicable)
4. SURFACE WATER SAMPLING
- Sample collection depth
 - Beginning and ending times (24 hr) for timed composite sampling
 - Type of composite (e.g., flow-proportioned, continuous, etc.)
 - Method of sample access (e.g. wading, from shore, from a bridge, from a motorized or non-motorized boat, intermediate device).
5. WASTEWATER SAMPLING
- Beginning and ending times (24 hr) for timed composite sampling
 - Type of composite (e.g. flow-proportioned, continuous, etc.)

FD 5120. RECORDS FOR NON-AQUEOUS ENVIRONMENTAL SAMPLES

Document the following information for all samples when using the indicated procedures.

FD 5130. DOCUMENTATION SPECIFIC TO SOIL SAMPLING (FS 3000)

1. GENERAL SOIL SAMPLING
- Sample collection depth
 - Areal location of sample
 - Sample collection device
2. Sampling for Volatile Organic Compounds (VOC) per EPA Method 5035
- Tare weight of VOC sample vial (if applicable)
 - Weight of sample (if applicable)

FD 5140. DOCUMENTATION SPECIFIC TO SEDIMENT SAMPLING (FS 4000)

1. General Sediment Sampling
 - Sample collection depth
 - Areal location of sample
 - Sample collection device
2. Sampling for Volatile Organic Compounds (VOC) per EPA Method 5035
 - Tare weight of VOC sample vial (if applicable)
 - Weight of sample (if applicable)

FD 5200. Documentation Specific to Waste Sampling (FS 5000)

1. DRUM SAMPLING
 - 1.1. Record the following information for each drum:
 - Type of drum and description of contents
 - Drum number, if applicable
 - Terrain and drainage condition
 - Shape, size and dimensions of drum
 - Label wording or other markings
 - Dimensional extent of leaks or spills associated with the drum
 - Drum location (or location map)
 - 1.2. Record the following information for the drum sample(s):
 - Description of phases, colors, crystals, powders, sludges, etc.
 - Stratified layers sampled, including aliquot amounts for composites, if applicable
 - 1.3. Record the following for field testing results on opened drums and drum samples:
 - Background readings for OVA meters
 - Sample readings for OVA meters
 - Type of OVA probe
 - Radiation background reading and sample radiation reading
 - Type of radiation monitor used
 - Oxygen and LEL readings from container opening
 - Water reactivity results
 - Specific gravity
 - PCB test results
 - Water solubility results
 - pH of aqueous wastes
 - Results of chemical test strips
 - Ignitability results
 - Results of other chemical hazard test kits
 - Miscellaneous comments for any tests
2. Documentation for Tanks
 - 2.1. Record the following information for the tank:

DEP-SOP-001/01
FD 1000 Documentation Procedures

- Type of tank, tank design and material of construction of tank
 - Description of tank contents and markings
 - Tank number or other designation, if applicable
 - Terrain and drainage condition
 - Shape, size and dimensions of tank
 - Label or placard wording or other markings
 - Dimensional extent of leaks or spills associated with the tank
 - Tank location (or location map)
- 2.2. Record the following information for the tank sample(s):
- Description of phases, colors, crystals, powders, sludges, etc.
 - Stratified layers sampled, including aliquot amounts for composites, if applicable
- 2.3. Record the following for field testing results on opened tanks and tank samples:
- Background readings for OVA meters
 - Sample readings for OVA meters
 - Type of OVA probe
 - Radiation background reading and sample radiation reading
 - Type of radiation monitor used
 - Oxygen and LEL level from container opening
 - Water reactivity results
 - Specific gravity
 - PCB test results
 - Water solubility results
 - pH of aqueous wastes
 - Results of chemical test strips
 - Ignitability results
 - Results of other chemical hazard test kits
 - Miscellaneous comments for any tests
3. DOCUMENTATION FOR WASTE LEACHATE AND WASTE SUMP SAMPLES
- 3.1. Document information specific to leachate and sump sampling according to the documentation requirements for the respective DEP SOPs employed to collect samples (FS 2100, FS 2200, FS 4000, FS 5100 and FS 5200).
4. DOCUMENTATION FOR WASTE PILE SAMPLES
- 4.1. Document information specific to waste pile sampling according to associated regulatory requirements for the project.
5. DOCUMENTATION FOR WASTE IMPOUNDMENT AND WASTE LAGOON SAMPLES
- 5.1. Document information specific to impoundment and lagoon sampling according to the documentation requirements for the respective DEP SOPs employed to collect samples (FS 2100, FS 4000, FS 5100, and FS 5200).

FD 5300. Documentation for Biological Sampling

The following SOP sections list required documentation items for specific biological sampling procedures, as indicated.

FD 5310. DOCUMENTATION FOR BIOLOGICAL AQUATIC HABITAT CHARACTERIZATION

Minimum documentation required for biological habitat characterization and sampling is listed below according to requirements as specified in the indicated sampling and field-testing DEP SOPs.

FD 5320. PHYSICAL/CHEMICAL CHARACTERIZATION FOR BIOLOGICAL SAMPLING (FT 3001)

1. Record the following information or use the optional Physical/Chemical Characterization Field Sheet (Form FD 9000-3). Note that some items may not apply to all water body types:

- Submitting agency code
- Submitting agency name
- STORET station number
- Sample date
- Sample location including county
- Field identification
- Receiving body of water
- Time of sampling
- Percentage of land-use types in the watershed that drain to the site
- Potential for erosion within the portion of the watershed that affects the site
- Local non-point-source pollution potential and obvious sources
- Typical width of 100-meter section of river or stream
- Size of the system or the size of the sample area within the system (lake, wetland, or estuary)
- Three measurements of water depth across the typical width transect
- Three measurements of water velocity, one at each of the locations where water depth was measured
- Vegetated riparian buffer zone width on each side of the stream or river or at the least buffered point of the lake, wetland or estuary
- Presence of artificial channelization in the vicinity of the sampling location (stream or river)
- Description of state of recovery from artificial channelization
- Presence or absence of impoundments in the area of the sampling location
- Vertical distance from the current water level to the peak overflow level
- Distance of the high water mark above the stream bed
- Observed water depth at high water mark location
- Percentage range that best describes the degree of shading in the sampling area
- Any odors associated with the bottom sediments
- Presence or absence of oils in the sediment

DEP-SOP-001/01
FD 1000 Documentation Procedures

- Any deposits in the area, including the degree of smothering by sand or silt
- Depth of each water quality measurement
- Temperature
- pH
- Dissolved oxygen
- Specific conductance
- Salinity
- Secchi depth
- Type of aquatic system sampled
- Stream magnitude (order designation)
- Description of any noticeable water odors
- Term that best describes the relative coverage of any oil on the water surface
- Term that best describes the amount of turbidity in the water
- Term that best describes the color of the water
- Weather conditions during the time of sampling
- Any other conditions/observations that are helpful in characterizing the site
- Note any evidence of recent vegetation management
- Relative abundances of periphyton, fish, aquatic macrophytes and iron/sulfur bacteria
- List and map of dominant vegetation observed
- Sampling team designation
- Signature(s) of sampler(s)
- Signature date

2. For streams and rivers, draw a grid sketch of the site (optionally, use Form FD 9000-4), showing the location and amount of each substrate type (as observed by sight or touch). Using the grid sketch, count the number of grid spaces for each substrate type. Divide each of these numbers by the total number of grid spaces contained within the site sketch. Record this percent coverage value for each substrate type. If the substrates are sampled, record the number of times each substrate is sampled by an indicated method.

3. Photographs of the sampling area are also useful tools for documenting habitat conditions and identifying station location.

FD 5330. STREAM AND RIVER BIOLOGICAL HABITAT ASSESSMENT RECORDS (FT 3100)

1. Record the following information, using required Form FD 9000-5, Stream/River Habitat Assessment Field Sheet:

- Submitting organization name and/or code
- STORET station number
- Assessment date
- Sampling location including county
- Field identification
- Receiving body of water

DEP-SOP-001/01
FD 1000 Documentation Procedures

- Time of sampling upon arrival at the site
2. Additionally record the following:
- Substrate diversity score
 - Substrate availability score
 - Water velocity score
 - Habitat smothering score
 - Artificial channelization score
 - Bank stability score for each bank
 - Riparian buffer zone width score for each bank
 - Riparian zone vegetation quality score for each bank
 - Primary habitat components score
 - Secondary habitat components score
 - Habitat assessment total score
 - Additional comments and observations
 - Signatures
3. Record the following information or use optional Form FD 9000-4, Stream/River Habitat Sketch Sheet for each 100-meter segment assessed.
- Link to the waterbody name, location of 100-meter segment, analyst name(s) and date of the assessment
 - Code, symbol or icon used to map each substrate observed in the segment
 - Proportionate sketch or map of the abundance of each habitat (substrate) observed in the 100-meter segment, oriented to the direction of flow
 - Location of velocity measurements taken within the segment
 - Location of habitats smothered by sand or silt
 - Location of unstable, eroding banks
 - Locations along the segment where the natural, riparian vegetation is altered or eliminated
 - Plant taxa observed
 - Additional notes and observations

FD 5332. *Lake Biological Habitat Assessment Records (FT 3200)*

1. Document the following information using required Form FD 9000-6 Lake Habitat Assessment Field Sheet:

- STORET station number
- Sampling date
- Sampling location including lake name
- Eco-region
- Field identification number
- County name
- Lake size
- Features observed

DEP-SOP-001/01
FD 1000 Documentation Procedures

- Description of the hydrology of the system (water residence time)
- Lake water color
- Secchi depth score
- Vegetation quality score
- Stormwater inputs score
- Bottom substrate quality score
- Lakeside adverse human alterations score
- Upland buffer zone score
- Adverse watershed land use score
- Habitat assessment total score
- Additional comments and observations
- Name and Signature of analyst

FD 5340. BIOLOGICAL AQUATIC COMMUNITY SAMPLING RECORDS (FS 7000)

Minimum documentation required for biological sampling for procedures described in FS 7000 is listed below according to requirements as specified in the indicated sampling DEP SOPs.

FD 5341. *Periphyton Sampling Records (FS 7200)*

For each sample, record the following:

- Station sampled
- Date collected
- Sample preservation

FD 5342. *Qualitative Periphyton Sampling Records (FS 7220)*

Complete the Physical/Chemical Characterization Field Sheet (Form FD 9000-3), Stream/River Habitat Sketch Sheet (Form FD 9000-4) or site map and Stream/River Habitat Assessment Field Sheet (Form FD 9000-5), as appropriate for the water body sampled (see FT 3000 – FT 3100). Other customized formats may be used to record the information prompted on forms FD 9000-3 and FD 9000-4.

FD 5343. *Rapid Periphyton Survey Records (FS 7230)*

For each 100-meter reach surveyed, record the following information or use optional Form FD 9000-25, Rapid Periphyton Survey Field Sheet:

DEP-SOP-001/01
FD 1000 Documentation Procedures

- Site or waterbody name
- Survey date
- Name(s) of analyst(s)
- Transect mark number (10-meter segment within the 100-meter reach, 0-100)
- Transect point (1 – 9)
- Algal thickness rank (per FS 7230 procedure)
- Canopy cover (per FS 7230 procedure)
- Indication of whether or not a periphyton sample was collected
- Bottom visibility (Secchi depth)
- Number of points with ranks 4, 5, or 6
- Total number of points assessed (out of 99)
- Percent of points with ranks 4, 5, or 6
- Additional comments or observations

FD 5344. *Lake Vegetation Index Records (FS 7310) [moved to LVI 1110]*

FD 5345. *Rapid Bioassessment (Biorecon) Records (FS 7410) [moved to BRN 1110]*

FD 5346. *Stream Condition Index (D-frame Dipnet) Sampling Records (FS 7420) [moved to SCI 1110]*

FD 5347. *Sediment Core Biological Grab Sampling Records (FS 7440)*

Record the sampling location of site grab core samples.

Record sample preservation.

FD 5348. *Sediment Dredge Biological Grab Sampling Records (FS 7450)*

Record the sampling location of site grab dredge samples.

Record sample preservation.

FD 5349. *Lake Condition Index (Lake Composite) Sediment Dredge Biological Grab Sampling Records (FS 7460)*

Record the following:

- Sampling date
- Lake name
- Sampling equipment used
- Comments and observations
- Dredge drop number (1 – 12)
- Sampling depth for each drop number
- Sampling location of site grab dredge sample for each drop (include lake sector map)
- Sediment type(s) in grab dredge sample for each drop (typical choices are sand, silt/clay, CPOM [course particulate organic matter], muck, SAV [submerged aquatic vegetation])

DEP-SOP-001/01
FD 1000 Documentation Procedures

- Sample preservation
- Location of any water quality measurements

FD 53410. *Phytoplankton Sampling Records (FS 7100)*

For each sample, record the following (on field sheet and sample container):

- Site or waterbody name
- County
- Date and time collected
- Record the method of collection (direct grab versus with an intermediate sampling device)
- Sample depth
- Indicate whether phytoplankton was collected during bloom conditions.
- If bloom scum sample, indicate if a surface scum sample or a scum sample core is collected.
- If bloom sample, indicate analysis to be conducted (algal enumeration, identification, or biomass, or toxin analysis)
- Sample preservation

FD 53411. *Algal Mat Sampling Records for Taxonomic Identification or Toxin Analysis (FS 7240)*

For each sample, record the following (on field sheet and sample container):

- Site or waterbody name
- County
- Date and time collected
- Thickness of the algal mat from the top of the mat to the surface of the substrate to which it is attached
- Analysis to be conducted (taxonomic identification, toxin analysis, biomass, etc)
- Sample preservation

FD 53412. *Stream and River Linear Vegetation Survey Sampling Records (FS 7320)*

Record the following or use optional DEP Form FD 9000-32 (Linear Stream Vegetation Survey sheet)

- Sampling date
- Waterbody name
- County
- STORET number
- Name of sampler(s)
- List of the plant species observed in the water for each 10m sampling unit.
- Notation of dominant taxa or lack of dominant for each 10m sampling unit.
- Total macrophyte abundance for each 10m sampling unit, using the following categories: 0-5%, >5<10%, >10<25%, >25<50%, >50%.

FD 53413. *Vegetation Wetland Condition Index Sampling Records (FS 7330)*

Record the information required in FD 5311 and complete a site map/sketch for the wetland sampled.

Record the following or use optional DEP Form FD 9000-33 (Vegetation Wetland Condition Index Field Sheet)

- Sampling date
- Wetland name and wetland type
- Transect name for each transect (direction-N,S, E, or W)
- Geographic coordinates (latitude, longitude) for starting and ending points of the 4 transects
- County
- Name(s) of samplers
- A list of the plant species identified for each 5 m quadrat within each transect
- An indication, included on the list of species, for each plant species for which a specimen was collected.
- A unique code for each unknown, included on the list of species. Fill in the correct name once the plant has been identified.

FD 53414. *Macroinvertebrate Wetland Condition Index Sampling Records (FS 7470)*

Record the information required in FD 5311 and complete a site map/sketch for the wetland sampled. Record the following for each sample:

- Sampling date
- Wetland name and wetland type
- County
- Name(s) of samplers
- Number of sweeps for each major vegetation zone
- Total number of containers per sample
- Sample preservation

FD 6000. QUALITY CONTROL DOCUMENTATION

1. Document all field quality control samples in the permanent field records.
2. At a minimum, record the following information:
 - The type, time and date that the quality control sample was collected; and
 - The preservative(s) (premeasured or added amount) and preservation checks performed.
3. If blanks are collected/prepared by the field organization, maintain records of the following:
 - Type of analyte-free water used;
 - Source of analyte-free water (include lot number if commercially purchased);
 - A list of the sampling equipment used to prepare the blank.

If items above are specified in an internal SOP, you may reference the SOP number and revision date in the field notes. Note any deviations to the procedure in the field notes.
4. For trip blanks, record the following:
 - Date and time of preparation

- Date and time of collection, using the date and time of the first sample collection associated with the trip blank.
 - Storage conditions prior to release to the sample collecting organization
 - Type of analyte-free water used
 - Source and lot number (if applicable) of analyte-free water
 - Specific transport container (e.g. ice chest, cooler) used to transport empty VOC vials and field samples.
- 4.1. Include trip blank information in the sampling kit documentation per FD 2000, section 2.
5. For duplicates, record the technique that was used to collect the sample.
6. For split samples, identify the method used to collect the samples and the source(s) of the sample containers and preservatives.

FD 7000. LEGAL OR EVIDENTIARY DOCUMENTATION

1. Scope: The use of legal or evidentiary Chain-of-Custody (COC) protocols is not usually required by DEP, except for cases involving civil or criminal enforcement. Do not use these procedures for routine sampling for compliance, for example, unless evidentiary custody protocols are specifically mandated in a permit or other legal order or when required for enforcement actions.
2. General Procedural Instructions
- 2.1. Follow applicable requirements in FD 1000 – FD 5000 for all evidence samples.
- 2.2. Establish and maintain the evidentiary integrity of samples and/or sample containers. Demonstrate that the samples and/or sample containers were handled and transferred in such a manner as to eliminate possible tampering.
- 2.2.1. Document and track all time periods and the physical possession and storage of sample containers and samples from point of origin through the final analytical result and sample disposal.

FD 7100. General Requirements for Evidentiary Documentation

1. CHAIN OF CUSTODY RECORDS: Use the Chain-of-Custody (COC) records to establish an intact, contiguous record of the physical possession, storage, and disposal of sample containers, collected samples, sample aliquots, and sample extracts or digestates. For ease of discussion, the above-mentioned items are referred to as “samples”.
- 1.1. Account for all time periods associated with the physical samples.
- 1.2. Include signatures of all individuals who physically handle the samples.
- 1.2.1. The signature of any individual on any record that is designated as part of the Chain-of-Custody is their assertion that they personally handled or processed the samples identified on the record.
- 1.2.2. Denote each signature with a short statement that describes the activity of the signatory (e.g., “sampled by”, “received by”, “relinquished by”, etc.).
- 1.2.3. In order to simplify recordkeeping, minimize the number of people who physically handle the samples.
2. CONSOLIDATION OF RECORDS: The COC records need not be limited to a single form or document. However, limit the number of documents required to establish COC, where practical, by grouping information for related activities in a single record. For example, a sample

DEP-SOP-001/01
FD 1000 Documentation Procedures

transmittal form may contain both certain field information and the necessary transfer information and signatures for establishing delivery and receipt at the laboratory.

3. LIABILITY FOR CUSTODY DOCUMENTATION: Ensure appropriate personnel initiate and maintain sample chain-of-custody at specified times.

3.1. Begin legal chain-of-custody when the precleaned sample containers are dispatched to the field.

3.1.1. Omit the transmittal record for precleaned sample containers if the same party provides the containers and collects the samples.

3.2. Sign the COC record upon relinquishing the prepared sample kits or containers.

3.3. Sign the COC record upon receipt of the sample kits or containers.

3.4. Thereafter, ensure that all parties handling the samples maintain sample custody (i.e., relinquishing and receiving) and documentation until the samples or sampling kits are relinquished to a common carrier.

3.4.1. The common carrier should not sign COC forms.

3.4.2. Indicate the name of the common carrier in the COC record, when used. Retain shipping bills and related documents as part of the record.

3.4.3. Ensure that all other transferors and transferees releasing or accepting materials from the common carrier sign the custody record.

3.5. Chain-of-custody is relinquished by the party who seals the shipping container and is accepted by the party who opens it.

3.5.1. Indicate the date and time of sealing of the transport container for shipment.

3.5.2. See FD 7200, section 3 below regarding the use of custody seals.

4. SAMPLE SHIPPING OR TRANSPORTING

4.1. Affix tamper-indicating custody seals or evidence tape before shipping samples.

4.1.1. Seal sample container caps with tamper-indicating custody seals or evidence tape before packing for shipping or transport.

4.1.2. Seal sample transport or shipping containers with strapping tape and tamper-indicating custody seals or evidence tape.

4.1.3. If the same party collects then possesses (or securely stores), packs and transports the samples from time of collection, omit any use of custody seals or evidence tape.

4.2. Keep the COC forms with the samples during transport or shipment. Place the COC records in a waterproof closure inside the sealed ice chest or shipping container.

FD 7200. Required Documentation for Evidentiary Custody

1. GENERAL CONTENT REQUIREMENTS: Document the following in COC tracking records by direct entry or linkage to other records:

- Time of day and calendar date of each transfer or handling procedure
- Signatures of transferors, transferees and other personnel handling samples
- Location of samples (if stored in a secured area)
- Description of all handling procedures performed on the samples for each time and date entry recorded above
- Storage conditions for the samples, including chemical preservation and refrigeration or other cooling

DEP-SOP-001/01
FD 1000 Documentation Procedures

- Unique identification for all samples
- Final disposition of the physical samples
- Common carrier identity and related shipping documents

2. DOCUMENTATION CONTENT FOR SAMPLE TRANSMITTAL

Provide a Chain-of-Custody record for all evidentiary samples and subsamples that are transmitted or received by any party. Include the following information in the COC record of transmittal:

- Sampling site name and address
- Date and time of sample collection
- Unique field identification code for each sample source and each sample container
- Names of personnel collecting samples
- Signatures of all transferors and transferees
- Time of day and calendar date of all custody transfers
- Clear indication of number of sample containers
- Required analyses by approved method number or other description
- Common carrier usage
- Sample container/preservation kit documentation, if applicable

3. CHAIN-OF-CUSTODY SEALS: If required, affix tamper-indicating evidence tape or seals to all sample, storage and shipping container closures when transferring or shipping sample container kits or samples to another party.

- 3.1. Place the seal so that the closure cannot be opened without breaking the seal.
- 3.2. Record the time, calendar date, and signatures of responsible personnel affixing and breaking all seals for each sample container and shipping container.
- 3.3. Affix new seals every time a seal is broken until continuation of evidentiary custody is no longer required.

FD 7300. Documenting Controlled Access to Evidence Samples

Control and document access to all evidentiary samples and subsamples with adequate tracking. Documentation must include records about each of the activities and situations listed below, when applicable to sample evidence, and must track the location and physical handling of all samples by all persons at all times. See FS 1000 for additional discussion about procedures for handling evidence samples.

1. Limit the number of individuals who physically handle the samples as much as practicable.
2. When storing samples and subsamples, place samples in locked storage (e.g., locked vehicle, locked storeroom, etc.) at all times when not in the possession or view of authorized personnel.
3. Alternatively, maintain restricted access to facilities where samples are stored. Ensure that unauthorized personnel are not able to gain access to the samples at any time.
4. Do not leave samples in unoccupied motel or hotel rooms or other areas where access cannot be controlled by the person(s) responsible for custody without first securing samples and shipping or storage containers with tamper-indicating evidence tape or custody seals.

FD 7400. Documenting Disposal of Evidence Samples

1. Dispose of the physical samples only with the concurrence of the affected legal authority, sample data user, and/or submitter/owner of the samples.
2. Record all conditions of disposal and retain correspondence between all parties concerning the final disposition of the physical samples.
3. Record the date of disposal, the nature of disposal (i.e., sample depleted, sample flushed into sewer, sample returned to client, etc.), and the name of the individual who performed the disposal. If samples are transferred to another party, document custody transfer in the same manner as other transfers (see FD 7000 – FD 7200).

FD 8000. (RESERVED)

FD 9000. FORMS

The following forms to facilitate documentation of sampling and field-testing are incorporated at 62-160.800, F.A.C. These forms are presented in both required and optional, example formats (see below). *The forms do not include all documentation required by FD 1000 or other DEP SOPs. The use of certain forms is required, as indicated below.* Customize the indicated optional forms as needed. These forms are available as separate document files at the DEP website. Instructions for completing forms are found in the DEP SOPs indicated in parentheses after the listed form.

The following required forms must be used to record information associated with specific DEP SOPs:

- Form FD 9000-5 Stream/River Habitat Assessment Field Sheet (FT 3000)
- Form FD 9000-6 Lake Habitat Assessment Field Sheet (FT 3000)
- Form FD 9000-34 Stream Habitat Assessment Training Checklist and Event Log (FA 1000 & FT 3000)
- Form FD 9000-35 Stream Condition Index Training Checklist and Event Log (SCI 1000)

The following forms are not required, but provide example formats that can be used to record information associated with specific DEP SOPs:

- Form FD 9000-1 Biorecon Field Sheet (FS 7000)
- Form FD 9000-3 Physical/Chemical Characterization Field Sheet (FT 3000)
- Form FD 9000-4 Stream/River Habitat Sketch Sheet (FT 3000)
- Form FD 9000-24 Groundwater Sampling Log (FS 2200)
- Form FD 9000-25 Rapid Periphyton Survey Field Sheet (FS 7000)
- Form FD 9000-27 Lake Vegetation Index Data Field Sheet (LVI 1000)
- Form FD 9000-31 Lake Observation Field Sheet (FT 3000)
- Form FD 9000-32 Linear Stream Vegetation Survey Form (FS 7000)
- Form FD 9000-33 Wetland Condition Index Vegetation Field Form (FS 7000)

FM 1000. FIELD PLANNING AND MOBILIZATION

This SOP is advisory; however, the following procedures are designed as best management practices, for use as guidance for designing and implementing a field sampling program and when selecting a laboratory. This SOP may be used in conjunction with all other DEP SOPs applicable to the field sampling event, project or program.

FM 2000. LABORATORY SCHEDULING

FM 2100. Selecting a Laboratory

1. CONSUMER RESPONSIBILITIES

Each organization that uses laboratory services has certain responsibilities to ensure that the laboratory has the appropriate credentials and that the data are useable for the intended needs, and acceptable to DEP. A consumer's responsibilities include:

1.1. Evaluating the Laboratory

1.1.1. Ensure that the laboratory has the proper credentials.

1.1.2. Ensure that the laboratory can produce data of a quality that will be acceptable to DEP.

1.2. Thinking in Terms of Quality not Dollars: A laboratory that produces data that are not acceptable to DEP usually means that the laboratory will need to repeat the work. It is more cost effective to select a laboratory that will meet the quality needs of the project even if that laboratory is not the lowest bidder.

1.3. Continuing Evaluation: In order to ensure that the laboratory provides data of a consistent quality, do not rely on just the initial evaluation of a laboratory. Other quality control measures will provide the ability to continuously evaluate the laboratory data quality.

1.4. Evaluating the Reported Data: Review the final laboratory reports against the original expectations and acceptable quality control measures.

1.5. Asking Questions: The consumer has the right to question laboratory results and receive a logical and clear response.

An informed client increases the probability of quality data and data acceptability.

FM 2110. IDENTIFYING LABORATORY NEEDS

The consumer should be able to identify these critical needs before considering any laboratory:

1. The purpose for which the data are needed.

1.1. The consumer must determine DEP's expectations for data quality in terms of the precision, accuracy, and detection limit (reporting level or criteria) for each reported value.

1.2. Examples include: permit compliance at some specified concentration levels; compliance monitoring at specified reporting levels; and site cleanup to specified soil and water criteria levels.

2. The benefits of using contracted or in-house analytical services.

3. The specific laboratory services that are required:

3.1. Are sample collection and sample analysis required, or just sample analysis.

3.2. Types of samples (groundwater, drinking water, soils, sediments, hazardous wastes, etc.).

- 3.3. The sample delivery schedule including:
 - 3.3.1. The number of samples to be collected.
 - 3.3.2. The frequency with which samples will be submitted to the laboratory.
 - 3.3.3. The types of matrices to be analyzed.
- 3.4. The test methods that must be used (normally found in the permit requirements, consent orders, contracts, or relevant rules).
- 3.5. The expected quality based on DEP's requirements.
- 3.6. The expected turnaround time for laboratory analysis.
- 3.7. The deliverables including the report format.
- 3.8. Field related services such as:
 - 3.8.1. Sample collection
 - 3.8.2. Sample containers
 - 3.8.3. Sample preservation
 - 3.8.4. Equipment rental or cleaning services; or
 - 3.8.5. Instrument calibration services.
4. Any required laboratory credentials such as certification.
5. Identifying key personnel in the consumer's organization that will be interfacing with the laboratory:
 - 5.1. Administrative contact: Usually responsible for obtaining laboratory services.
 - 5.2. Technical contact: Usually a person who will be evaluating the laboratory's performance.
 - 5.3. Sample control contact: Usually a person who will be scheduling services with the laboratory.
6. Have an understanding of the current market price for the tests to be performed.
 - 6.1. Gather information on pricing from several laboratories.
 - 6.2. Request current and historical pricing schedules.

FM 2120. EVALUATING THE LABORATORY

1. LABORATORY CREDENTIALS

- 1.1. The laboratory must hold National Environmental Laboratory Accreditation Program (NELAP) certification from the Florida Department of Health's Environmental Laboratory Certification Program (DoH ELCP).
- 1.2. Out-of-state laboratories must be either certified by DoH, or be NELAP-certified by another state **with secondary accreditation** by DoH.
- 1.3. The laboratory must be certified for the test technology, analyte, and matrices that will be requested. This does not apply to analysis being done for drinking water.
- 1.4. Request a copy of the Current Certification and Analyte Sheets (must be for the current fiscal year which runs July 1 to June 30).
- 1.5. Verify the certification through the DEP Web Site, or the DoH offices.

2. ON-SITE VISIT

Conduct an on-site visit to verify the laboratory's capabilities and to determine if the laboratory has the equipment and personnel resources necessary for proposed services.

- 2.1. The laboratory must show a willingness to meet the client's needs.

- 2.2. The laboratory (both the analytical and administrative areas) should appear organized.
- 2.3. The analytical staff must be knowledgeable about the services to be provided. At least one person (supervisor or analyst) must be experienced in performing all activities on the proposed scope of work.
- 2.4. The administrative staff must appear organized.
- 2.5. The laboratory must have the capacity to accommodate the proposed scope of work in terms of personnel and equipment.
3. LABORATORY PERFORMANCE EVALUATION
 - 3.1. Blind Check Samples: Prior to contract signing or any agreement, submit a set of blind check samples to the laboratory.
 - 3.1.1. A blind check sample is a sample in a real matrix (water, soil, sediment, etc.) that appears to be a real sample, except that the submitter has a list of the components and their known concentration values.
 - 3.1.2. Submit the sample(s) to the laboratory as a routine sample(s).
 - 3.1.3. Evaluate the results of the reported values against the certified values in the sample(s).
 - 3.1.4. The values must be within the laboratory's stated precision for the measurement.
4. CUSTOMER SATISFACTION
 - 4.1. Obtain a list of current and previous clients.
 - 4.2. Call several of the clients to determine:
 - Satisfaction with laboratory
 - Were problems resolved satisfactorily?
 - Reasons for not using the laboratory (if applicable)
 - Reasons for using the laboratory
5. FISCAL STABILITY
 - 5.1. Request a copy of the current financial statement.

FM 2130. CONTRACTING

1. PURPOSE
 - 1.1. Provide a detailed list of the scope of services to be contracted.
 - 1.2. Include the purpose for which the data are to be used (permit, compliance, etc.).
2. KEY CONTACTS: Identify key contacts for both laboratory and client:
 - 2.1. Administrative: Dealing with billing, contract writing, invoicing, etc.
 - 2.2. Technical: Dealing with data, and quality control issues and problems.
 - 2.3. Sample Control: Dealing with scheduling, shipping supplies, sample receipt.
3. ANTICIPATED NEEDS: Specify:
 - 3.1. The schedule of activities;
 - 3.2. The expected number of samples, analytes, matrices and tests; and
 - 3.3. Field support services, including containers, preservatives, cleaning and calibration services.
4. EXPECTATIONS
 - 4.1. Certification

- 4.1.1. The laboratory must maintain certification for the analyte, technology, and matrices to be performed.
- 4.1.2. The laboratory must immediately notify its clients if the certification status for any analyte changes.
- 4.1.3. The laboratory must state that it will generate all results in strict compliance with the National Environmental Laboratory Accreditation Conference (NELAC) Standards.
- 4.1.4. The laboratory must flag and justify any results that were not generated in accordance with NELAC.
- 4.2. Analytical Expectations
 - 4.2.1. Provide a list of analytical methods to be performed and the matrices for each method.
 - 4.2.2. Provide a copy of the permit, QAPP, Sampling Plan or other document that outlines DEP's requirements.
 - 4.2.3. Specify the expected turn-around time for the analyses.
 - 4.2.4. Specify the shipping schedule if sample containers or supplies are to be provided.
- 4.3. Container/Equipment Services: State the scope of container and equipment services:
 - 4.3.1. Precleaned Containers: Types and Numbers
 - 4.3.1.1. Must be cleaned according to DEP SOP procedures (see FC 1000) or purchased precleaned from a vendor.
 - 4.3.1.2. Provide copy of procedures, if the laboratory does not follow the DEP SOP procedures.
 - 4.3.1.3. Determine if containers must be certified clean by either the laboratory or the vendor.
 - 4.3.2. Preservatives
 - 4.3.2.1. Premeasured into containers, where appropriate.
 - 4.3.2.2. Provided in appropriate containers with dispensing implement.
 - 4.3.3. Equipment
 - 4.3.3.1. Type and numbers.
 - 4.3.3.2. Condition of equipment (precleaned, etc.).
 - 4.3.3.3. Equipment must be cleaned according to DEP SOP procedures (see FC 1000). Obtain a copy of the laboratory procedures if the laboratory does not follow the DEP SOP procedures.
 - 4.3.3.4. Determine if equipment must be certified clean by the laboratory.
 - 4.3.4. Equipment Calibration
 - 4.3.4.1. The calibration method;
 - 4.3.4.2. The frequency of calibration;
 - 4.3.4.3. Preventative maintenance on instrument;
 - 4.3.4.4. Certification statement verifying the calibration; and
 - 4.3.4.5. Documentation of all maintenance and calibrations in laboratory records.
- 4.4. Quality Control
 - 4.4.1. State adherence to NELAC quality control requirements.

4.4.2. Specify any additional quality control measures that are required but are different from NELAC.

4.4.3. Specify acceptable ranges for spikes, duplicates, surrogates, and other QC measures if appropriate.

4.5. Custody/Sample Tracking

4.5.1. Specify adherence to NELAP documentation and record keeping requirements.

4.5.2. State a time-period for retaining all records if greater than 5 years.

4.5.3. Make arrangement for transfer of records should the laboratory go out of business or transfer ownership before the records retention time period has lapsed.

4.5.4. Specify the level of custody (routine, legal, etc.).

4.6. Minimum Reporting Levels

4.6.1. Provide the laboratory with the minimum acceptable values to be reported (method detection limit, etc.).

4.6.2. Describe contingencies if these levels cannot be met.

4.7. Reporting Format

4.7.1. All analytical reports issued by the laboratory must comply with DEP and NELAP reporting requirements.

4.7.2. Specify whether the information must be provided as hardcopy, electronic or both. If electronic, specify the format for submission.

4.7.3. The use of appropriate DEP data qualifiers (see 62-160, F.A.C, Table 1) should be specified.

4.8. Deliverables: In addition to the NELAP-compliant report, specify any other deliverables that must be provided with the laboratory report such as:

- Laboratory Quality Control results;
- Field Quality Control results;
- Performance Test results;
- Copies of all raw data and associated records;
- Written narrative of the analytical event; and/or
- Description of any modifications to methods.

4.9. Subcontracting

4.9.1. The laboratory must inform the client **before** any analytical services are subcontracted to another laboratory.

4.9.2. The laboratory must ensure that the subcontracted laboratory meets the same qualifications and requirements as the primary laboratory.

4.9.3. If the results from subcontracted laboratories are incorporated into the final laboratory report, the subcontracted results must be clearly identified.

4.10. Method Modifications

4.10.1. The laboratory must identify any modifications that have been made to the requested analytical methods.

4.10.2. The client must be notified of any method modifications prior to use in the laboratory, and must provide written consent.

4.11. Dilutions

4.11.1. Negotiate how multiple dilutions will be handled. They may be considered a separate analysis and therefore an additional cost.

4.11.2. Agree to pay for the analysis of dilutions only if:

4.11.2.1. The sample concentration exceeds the calibration range and the laboratory was not aware of the expected sample concentration; or

4.11.2.2. A dilution is required to quantitate all required components.

5. PENALTIES AND CONSEQUENCES

5.1. Negotiate penalties or other consequences (no payment) for these problems:

- Failure to provide data or associated (expected) information;
- Failure to meet deadlines;
- Failure to provide acceptable data; and
- Failure to meet contract requirements.

5.2. Consider these consequences:

- Costs of resampling;
- Fines incurred because of unacceptable data;
- Costs associated with having evaluated and/or processed unacceptable data; and
- Reanalysis costs (if reanalysis is due to laboratory error or failed QC).

5.3. Reserve the right to reject data. If any data are used, laboratory should be paid according to negotiated terms.

FM 2140. ON-GOING EVALUATION

1. Monitor laboratory's performance against the specific contract requirements.

2. Continue to use blind QC samples as a measure of routine performance.

2.1. Vendor supplied samples;

2.2. Samples prepared to a known concentration; or

2.3. Split samples with another laboratory.

FM 2150. DATA REVIEW

1. Review the data for logical trends:

1.1. Are the reported concentrations different from the routine (expected) levels?

1.2. Is the same value reported for the same analyte (except non detects) in the same set of samples or over a historical period of time?

1.3. Do the parts add up to the total?

1.3.1. Ortho phosphate must be less than total phosphate.

1.3.2. Total nitrate-nitrite must be equal to nitrate plus nitrite.

1.3.3. Total values must be greater than or equal to dissolved values.

1.4. Are different but related analyses consistent?

1.4.1. High turbidity and high total suspended solids.

1.4.2. High turbidity and increased method detection limits for other tests.

1.5. Do results indicate a sample collection problem?

1.5.1. High dissolved oxygen in groundwater.

- 1.5.2. High turbidity and elevated metals results.
- 1.6. Are the QC check samples within acceptable ranges?
 - 1.6.1. Are the ranges reasonable?
- 1.7. Are non-detects reported correctly (should be a value with a "U")?
- 1.8. Over the history of laboratory use, were any QC problems reported?
- 1.9. Is there any laboratory or field blank contamination?
- 1.10. Do the reports contain all required information?

FM 2160. ASK QUESTIONS

Ask questions if:

- There are problems associated with the data review.
- The QC check sample data are not acceptable.
- The laboratory consistently reports the same QC failure.
- The laboratory uses different methods than requested.
- The laboratory subcontracts analyses without notifying the client.
- The laboratory does not meet contract requirements.
- The laboratory misses holding times.
- The laboratory fails to provide requested resource(s) (containers, calibration, etc.) in a timely manner.
- There are doubts about the acceptability of the data.
- Detection limits are above the expected values and the laboratory provides no reasonable explanation.

FM 2200. Scheduling Services

1. Notify the laboratory about the analytical and equipment needs at least a week in advance of the actual sampling trip.
2. Even if the trip is routine (monthly, weekly, quarterly compliance sampling), provide the laboratory with a written request. Include:
 - Number and types of samples to be collected;
 - Test methods to be performed;
 - Expectations for quality control acceptance criteria (if not already listed in a contract);
 - Estimated numbers of each type of container;
 - Required preservatives, including whether the laboratory will dispense premeasured quantities into the sample containers;
 - Preservation supplies such as graduated, disposable pipets;
 - Additional preservatives (even if the containers are prepreserved);
 - Sampling equipment including material construction;
 - Shipping containers;
 - Forms (both courier and transmittal/custody forms);
 - Any calibration services;
 - Estimated time of delivery;
 - Expected turn-around time;

- Special needs such as "requires legal chain of custody" or "requires 24-hour turn-around time";
- Data processing services (such as completing regulatory forms); and
- Expected contamination levels. This is important if a highly contaminated site is sampled.

FM 3000. TRIP PLANNING

1. Ensure that everyone involved with the event understands the purpose of the trip:
 - 1.1. Review the associated sampling plan, quality assurance project plan or permit requirements.
 - 1.2. Review the applicable safety plans and site files.
2. Determine the number of people that will be required to complete the sampling activities within the allotted time frame. For safety and efficiency, a field team should consist of at least two people.
3. Identify sampling team member(s) and schedule a meeting of the sampling team.
 - 3.1. Develop a detailed itinerary and schedule.
 - 3.1.1. Plan to sample from the least contaminated to the most contaminated sampling point.
 - 3.1.2. Plan to work upstream in flowing water.
 - 3.2. Review personnel training and make assignments based on experience.
 - 3.2.1. Ensure that at least one trained, experienced individual is part of the team.
 - 3.3. Review the SOPs and any associated documents (sampling plan, quality assurance project plan, permit, etc.).
 - 3.4. Review project/site files for unusual procedures or site peculiarities.
 - 3.5. Review the safety plan and discuss contingencies (weather, broken equipment, site access, etc.).
 - 3.5.1. If the sampling event is more than 3 - 5 days, a written contingency plan is recommended.
 - 3.5.2. If a boat will be used, a float plan is highly recommended.
 - 3.5.3. At a minimum discuss and have available:
 - 3.5.3.1. Phone and directions to nearest emergency facility;
 - 3.5.3.2. Phone number(s) of supervisor and/or project manager;
 - 3.5.3.3. Locations of power lines and underground utilities; and
 - 3.5.3.4. Expected environmental hazards.
4. Schedule the date for deployment and the duration of the sampling event.
 - 4.1. Obtain the necessary entry permits, keys, etc.
 - 4.2. Identify name(s) and phone number(s) of landowner, tenant or other responsible party.
5. Assemble any needed maps, directions and site descriptions. Include information on:
 - 5.1. Traffic conditions and/or traffic patterns; and
 - 5.2. Parking areas.
6. Identify the number of sampling points, and for each sampling point:
 - 6.1. Determine the matrices that will be sampled;

- 6.2. Identify the specific analyses to be performed per matrix;
- 6.3. Identify the sampling equipment needs based on the matrix and analytes to be collected. Include tubing, mixing implements and other support equipment;
- 6.4. Based on the analytical tests and the matrices, determine the number and types of sample containers;
- 6.5. Based on the analytical tests and the matrices, determine the types of preservatives that will be needed;
- 6.6. Determine what field measurements must be made; and
- 6.7. Identify transportation mode to reach the location (boat, truck, etc.).
7. Calculate the total number of each container types (both preserved and unpreserved).
8. Determine the total number of sampling equipment sets (tubing, mixing trays, coring devices, etc.) that will be needed for the sampling event.
9. Notify the laboratory of the trip and arrange for necessary containers, preservatives and other supplies (see FM 2200).
10. Reserve appropriate vehicles.
11. Assemble all field records (notebooks, forms, transmittal forms, etc.).

FM 4000. EQUIPMENT AND SUPPLY PREPARATION

1. SAMPLING EQUIPMENT: Assemble all equipment identified in FM 3000, section 8.
 - 1.1. Inspect equipment for cracks, breaks, and other signs of wear.
 - 1.2. If necessary, repair any equipment and document the repairs in appropriate maintenance logs.
 - 1.3. Reclean any equipment that was cleaned but not protected from the environment (stored on dusty shelves).
 - 1.3.1. If not already clean, decontaminate equipment according to FC 1000.
 - 1.3.2. Clean all transport ice chests and water transport containers (see FC 1190 and FC 1180, respectively).
 - 1.4. Check to make sure fuel and battery powered pumps are working.
 - 1.5. See "Field Sample Collection Equipment Checklist".
2. FIELD MEASUREMENTS: Assemble field instruments to make the measurements identified in FM 3000, section 6.6.
 - 2.1. Inspect instruments for damage.
 - 2.1.1. Repair and/or replace parts as necessary, and document in appropriate maintenance logs.
 - 2.1.2. Assemble the appropriate calibration standards and supplies.
 - 2.1.3. Determine the accuracy of the instruments by either performing an initial calibration or checking the calibration before leaving the base of operations. Document the calibration check.
 - 2.2. See "General Field Support Equipment Checklist", item 7.
3. DOCUMENTATION: Assemble field record supplies:

- Notebooks, and/or forms
 - Indelible/waterproof pens
 - Clipboards
 - Cameras
 - GPS unit, if needed
 - See "General Field Support Equipment Checklist ".
4. SAMPLE CONTAINERS: Assemble the appropriate types of sample containers or obtain them from the contracted laboratory. See "General Field Support Equipment Checklist", item 8.
 5. PRESERVATIVES: Assemble preservation supplies if not provided by the laboratory.
 - 5.1. Discard any old solutions; clean containers; and prepare fresh solutions.
 - 5.2. See "General Field Support Equipment Checklist", item 2.
 6. FIELD DECONTAMINATION SUPPLIES: Assemble field decontamination supplies.
 - 6.1. Discard any old solutions; clean containers; and prepare fresh solutions.
 - 6.2. Discard analyte-free water and obtain fresh water.
 - 6.3. See "General Field Support Equipment Checklist", item 1.
 7. SHIPPING SUPPLIES: Assemble shipping supplies:
 - 7.1. Determine nearest point to obtain ice;
 - 7.2. Marking pens, shipping labels, tape, custody seals (if required);
 - 7.3. See "General Field Support Equipment Checklist", item 3.
 8. VEHICLES:
 - 8.1. Make sure vehicle maintenance is up-to-date.
 - 8.2. Check fluids.
 - 8.3. Check tire pressure.
 - 8.4. Check fuel and fuel supply.
 - 8.5. See "General Field Support Equipment Checklist", item 10.
 9. SAFETY EQUIPMENT: Assemble any needed safety equipment:
 - Protective gloves.
 - Protective clothing including boots.
 - SCUBA gear or other supplied air supply.
 - First aid kit.
 - Drinking water.
 - Float plan.
 - Address and phone numbers for nearest emergency room.
 - See "General Field Support Equipment Checklist", item 6.

Appendix FM 1000

Tables, Figures and Checklists

General Field Support Equipment Checklist
Field Sample Collection Equipment Checklist

General Field Support Equipment Checklist

DECONTAMINATION SUPPLIES

- ☐ Basins, buckets or bowls to hold wash water and various rinse waters
- ☐ Brushes or other implements to clean equipment
- ☐ Detergents
 - ☐ Liqui-Nox or equivalent
 - ☐ Alconox or equivalent
- ☐ Acids
 - ☐ Nitric
 - ☐ Hydrochloric
- ☐ Solvents
 - ☐ Pesticide grade
 - ☐ isopropanol
 - ☐ Other:
- ☐ Protective wrapping
 - ☐ Foil
 - ☐ Untreated Plastic bags
 - ☐ Bubble wrap
- ☐ Analyte-free water
 - ☐ Distilled in HDPE
 - ☐ Deionized in HDPE
 - ☐ Organic-free in HDPE, Teflon or glass
- ☐ Dispensing bottles
 - ☐ HDPE for acids and detergents
 - ☐ Teflon for solvents and organic-free water
- ☐ Paper towels or other absorbent material
- ☐ Containers for IDW

PRESERVATION SUPPLIES

- ☐ Acids
 - ☐ Nitric
 - ☐ Hydrochloric
 - ☐ Sulfuric
- ☐ Dechlorination reagents
 - ☐ Sodium thiosulfate
 - ☐ Ascorbic acid
- ☐ Sodium hydroxide
- ☐ Dispensing devices
 - ☐ Graduated disposable plastic pipets
 - ☐ Glass Pasteur pipets
 - ☐ Bulbs

- ☐ Premeasured reagents in vials
- ☐ Narrow range pH paper (range of no more than 3 pH units)
 - ☐ pH range of 1 – 3
 - ☐ pH range of 11 – 14
 - ☐ pH range of 6 – 8
- ☐ Cyanide processing
 - ☐ Sulfide test paper
 - ☐ Precipitating Chemical
 - ☐ Cadmium nitrate or Cadmium carbonate or
 - ☐ Lead nitrate or Lead carbonate
 - ☐ KI starch paper
 - ☐ Ascorbic acid
 - ☐ Filter paper

SAMPLE TRANSPORTATION SUPPLIES

- ☐ Ice chests
- ☐ Wet ice
- ☐ Sealing tape
- ☐ Shipping labels
- ☐ Shipping forms
- ☐ Bubble wrap
- ☐ Plastic bags
- ☐ Vermiculite
- ☐ Custody seals

DOCUMENTATION SUPPLIES

- ☐ Notebooks/logs/field forms
- ☐ Pens and markers (waterproof)
- ☐ Sample container labels/tags
- ☐ Custody tags
- ☐ Custody/transmittal forms
- ☐ Clipboard
- ☐ Camera
 - ☐ Battery
 - ☐ Memory card

- ☐ GPS equipment
- ☐ Calculator

REFERENCE MATERIALS

- ☐ Site maps and directions
- ☐ QAPP
- ☐ Sampling plan
- ☐ SOPs
- ☐ Itinerary
- ☐ Float plan
- ☐ Contingency plan

HEALTH & SAFETY SUPPLIES

- ☐ Cell phone
- ☐ First aid kit
- ☐ Drinking water
- ☐ Protective gloves
- ☐ Insect repellent
- ☐ Sunscreen
- ☐ Numbers for nearest emergency facilities
- ☐ Safety goggles
- ☐ Applicable MSDS sheets
- ☐ Respirators
- ☐ Fire extinguisher
- ☐ Hard hats
- ☐ Flotation jackets
- ☐ Cable cutters
- ☐ Traffic cones
- ☐ SCUBA gear
- ☐ SCBA gear
- ☐ Other personal protection gear

FIELD MEASUREMENT EQUIPMENT

- ☐ Lint-free tissues
- ☐ Flow-through cells
- ☐ pH meter
 - ☐ 4, 7 & 10 buffers
- ☐ Conductivity meter
 - ☐ Solution at expected conductivity
- ☐ DO meter
- ☐ Turbidimeter
 - ☐ Gel or Formazin standards
- ☐ Residual chlorine
 - ☐ Secondary or primary standards
- ☐ Secchi disk

General Field Support Equipment Checklist

☐ MultiProbe meter

SAMPLE CONTAINERS

☐ Extractable Organics

☐ Volatile Organics

☐ Nutrients

☐ Glass

☐ Plastic

☐ Inorganic Non-metallics

☐ Glass

☐ Plastic

☐ Physical Parameters

☐ Glass

☐ Plastic

☐ Metals

☐ Glass

☐ Plastic

☐ Microbiology

☐ Glass

☐ Plastic

☐ Whole Effluent Toxicity

☐ Tissues

☐ Macrobenthic

invertebrates

☐ Periphyton

☐ Sediment/Soil volatiles

☐ Sediment/Soil

Remember:

☐ Extra containers

☐ Extra VOC septa

FILTRATION EQUIPMENT

☐ 1 µm filter units

☐ 0.45 µm filters

☐ Peristaltic pump

☐ Pressurized bailers

☐ Syringe with Luer-Lok

fitting

☐ Tripod filter with
pressure/vacuum source

☐ Forceps for handling
filters

VEHICLES

☐ Truck

☐ Fuel

☐ Boat

☐ Fuel

☐ Motor

☐ Paddles/oars

☐ Safety vests

MISCELLANEOUS SUPPLIES

☐ Hip boots

☐ Chest waders

☐ Rain gear

☐ Tool kit

☐ Extra batteries

☐ Stopwatch

Field Sample Collection Equipment Checklist

GROUNDWATER

Pumps

- ☐ Peristaltic
- ☐ Centrifugal
- ☐ Variable speed submersible
- ☐ Submersible
- ☐ Variable speed bladder
- ☐ Bladder

Tubing

- ☐ Teflon _____ Sets
- ☐ Polyethylene _____ Sets
- ☐ Polypropylene _____ Sets
- ☐ Vinyl _____ Sets
- ☐ Rubber _____ Sets
- ☐ Tygon _____ Sets

Bailers

- ☐ Teflon
- ☐ Stainless steel
- ☐ Polyethylene
- ☐ Acrylic
- ☐ PVC

Support Equipment

- ☐ Graduated containers for measuring purge water
- ☐ Containers for holding purge waters
- ☐ Water level measuring device
- ☐ Plastic sheeting
- ☐ Lanyard material
- ☐ Reels
- ☐ Energy source for pumps

SURFACE WATER

Pumps:

- ☐ Peristaltic
- ☐ Automatic composite sampler
- ☐ Other

Tubing

- ☐ Teflon™ _____ Sets
- ☐ Polyethylene _____ Sets
- ☐ Polypropylene _____ Sets
- ☐ Vinyl _____ Sets
- ☐ Rubber _____ Sets
- ☐ Tygon _____ Sets

Bailers

- ☐ Teflon
- ☐ Stainless Steel

- ☐ Polyethylene

- ☐ Acrylic

- ☐ PVC

Grab Sampling Devices:

- ☐ Dipper
- ☐ Kemmerer
- ☐ Alpha water sampler
- ☐ Niskin
- ☐ Beta sampler
- ☐ Retrieval lines

Mixing Implements

- ☐ Churn splitter

WASTEWATER

- ☐ Pond sampler
- ☐ Dippers
- ☐ Peristaltic pump

Tubing

- ☐ Teflon _____ Sets
- ☐ Polyethylene _____ Sets
- ☐ Polypropylene _____ Sets
- ☐ Vinyl _____ Sets
- ☐ Rubber _____ Sets
- ☐ Tygon _____ Sets

- ☐ Kemmerer

- ☐ Van Dorn

- ☐ Nansen

- ☐ Alpha bottle

- ☐ Beta bottle

- ☐ Niskin

- ☐ DO dunker

- ☐ Automatic composite sampler

Tubing

- ☐ Teflon _____ Sets
- ☐ Polyethylene _____ Sets

- ☐ Polypropylene _____ Sets

- ☐ Vinyl _____ Sets

- ☐ Rubber _____ Sets

- ☐ Tygon _____ Sets

Bailers

- ☐ Plastic
- ☐ Teflon
- ☐ Stainless steel

Scoops

- ☐ Plastic
- ☐ Teflon
- ☐ Stainless steel

Beakers

- ☐ Plastic

- ☐ Teflon

- ☐ Stainless steel

Buckets

- ☐ Plastic
- ☐ Stainless steel

SEDIMENTS

Dredges

- ☐ Petersen
- ☐ Ponar
- ☐ Ekman
- ☐ Young Grab
- ☐ Van Veen
- ☐ Shipek
- ☐ Orange-peel grab
- ☐ Smith-McIntyre grab
- ☐ Drag buckets
- ☐ Winch
- ☐ Cable/line
- ☐ Messenger

Coring Devices

- ☐ Stainless steel
- ☐ Glass
- ☐ Plastic
- ☐ Teflon-lined

SOIL

- ☐ Bucket auger
- ☐ Split spoon sampler
- ☐ Stainless steel shovel
- ☐ Garden shovel
- ☐ Stainless steel trowel or scoop
- ☐ Plastic trowel or scoop
- ☐ Trenching device
- ☐ Coring Devices
- ☐ Stainless steel
- ☐ Glass
- ☐ Plastic
- ☐ Teflon-lined
- ☐ Shelby tube
- ☐ EnCore

WASTE

- ☐ Stainless steel scoop
- ☐ Stainless steel spoons or spatulas
- ☐ Stainless steel push tubes
- ☐ Stainless steel auger

Field Sample Collection Equipment Checklist

- ☐ Stainless steel Ponar dredge
- ☐ Glass colliwasa
- ☐ Drum thief
- ☐ Mucksucker
- ☐ Dipstick
- ☐ Stainless steel bacon bomb
- ☐ Stainless steel bailer
- ☐ Teflon bailer
- ☐ Peristaltic pump
- ☐ Stainless steel split spoon
- ☐ Roto-hammer
- ☐ Glass tubing

SHELLFISH

- ☐ Seine
- ☐ Trawl
- ☐ Bucket type/double pole
- ☐ Tong/Double handed grab
- ☐ Line or cable operated grab bucket
- ☐ Petersen
- ☐ Ponar
- ☐ Ekman
- ☐ Orange-peel grab
- ☐ Biological or hydraulic dredge
- ☐ Scoops/shovels
- ☐ Scrapers
- ☐ Rakes
- ☐ D-traps

Processing Equipment

- ☐ Holding trays
- ☐ Stainless steel shucking knife
- ☐ Calipers or ruler
- ☐ Aluminum foil
- ☐ Plastic bags

FINFISH

- ☐ Electrofishing devices
- ☐ Seines
- ☐ Trawls
- ☐ Angling
- ☐ Gill net
- ☐ Trammel net
- ☐ Hoop, fyke & pound nets
- ☐ D-traps

Processing Equipment

- ☐ Holding trays
- ☐ Measuring board or ruler
- ☐ Stainless steel descaler
- ☐ Stainless steel scalpel
- ☐ Balance
- ☐ Aluminum foil
- ☐ Plastic bags

BIOLOGICAL COMMUNITY

SAMPLING

Phytoplankton

- ☐ Van Dorn
- ☐ Alpha bottle
- ☐ Logol's solution

Periphyton

- ☐ Periphytometer
- ☐ Microscope slides
- ☐ 100% buffered formalin
- ☐ Nylon twine

Qualitative Periphyton

Sampling

- ☐ Stainless steel spatula/spool
- ☐ Stainless steel forceps
- ☐ Suction bulb
- ☐ Preservative
 - ☐ Buffered formalin
 - ☐ Lugol's solution

M3

- ☐ Resealable plastic bags
- ☐ White picking pan

Benthic Macroinvertebrates

- ☐ Forceps
- ☐ Transfer pipettes
- ☐ White picking pans
- ☐ 10X hand lens
- ☐ Alcohol-filled jars
- ☐ Dip net (30 mesh)
- ☐ Hester-Dendy
- ☐ Coring device
- ☐ Dredge

- ☐ Ekman
- ☐ Petite ponar
- ☐ 30 mesh box sieve

MACROPHYTES

- ☐ Resealable plastic bags
- ☐ Permanent marker
- ☐ Aquatic and wetland plant identification manuals

- ☐ Hand lens
- ☐ Binoculars
- ☐ Frotus
- ☐ Cooler with ice
- ☐ Camera
- ☐ GPS unit
- ☐ Compass
- ☐ 100m tape
- ☐ 1m PVC pipe, marked at 0.5m increments

FQ 1000. FIELD QUALITY CONTROL REQUIREMENTS

Use the following SOPs in conjunction with FQ 1000. Note that field quality control blanks are required when using other, specific DEP sampling SOPs to collect samples for certain analytes, as further discussed in this SOP:

- FA 1000 Regulatory Scope & Administration Procedures for Use of DEP SOPs
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000 Documentation Procedures
- FM 1000 Field Planning and Mobilization

Field quality control measures monitor the sampling event to ensure that the collected samples are representative of the sample source.

Field-collected blanks must demonstrate that the collected samples have not been contaminated by:

- The sampling environment
- The sampling equipment
- The sample container
- The sampling preservatives
- Sample transport
- Sample storage

FQ 1100. Sample Containers

Sample containers must be free from contamination by the analytes of interest or any interfering constituents and must be compatible with the sample type.

FQ 1200. Sampling Operations

Sampling operations are monitored through the collection of quality control samples.

1. When collected, analyze all quality control samples for the same parameters as the associated samples. Table FA 1000-2 contains the list of tests in each group.

1.1. When collected, collect blanks for the following parameter groups and tests:

- Volatile Organic Compounds (*e.g.*, volatile organic aromatics)
- Extractable Organics (*e.g.*, PCBs and pesticides)
- Metals
- Ultra-trace Metals (metals collected by “clean-hands” sampling techniques for sub-ppb analyses)
- Inorganic Non-metallics (*e.g.*, nutrients)
- Radionuclides (total Alpha and Beta emitters)
- Petroleum Hydrocarbons (*e.g.*, FL-PRO) and Oil & Grease
- Volatile Inorganics (sulfide, hydrogen sulfide, or sulfite)
- Aggregate Organics except Biochemical Oxygen Demand (*e.g.*, TOX, COD, TOC)

1.2. Blanks are not required for:

- Microbiological - viruses
- Microbiological-bacteria (*e.g.*, total and fecal coliform)

- Microbiological-protozoa (e.g., Giardia)
 - Toxicity (e.g., Whole Effluent Toxicity)
 - Field parameters such as pH, Specific Conductance, Residual Chlorine, Temperature, Light Penetration, Dissolved Oxygen, ORP and Salinity
 - Radon
 - Biologicals (e.g., Chlorophyll)
 - Biological Community (e.g., Stream Condition Index)
 - Physical and Aggregate Properties (e.g., color, hardness, turbidity)
 - Biochemical Oxygen Demand
2. Preserve, transport, document and handle all quality control samples as if they were samples. Once collected, they must remain with the sample set until the laboratory has received them.
 3. Except for trip blanks, prepare all quality control samples **on-site in the field**.
 - 3.1. Do not prepare precleaned equipment blanks in advance at the base of operations.
 - 3.2. Do not prepare field-cleaned equipment blanks after leaving the sampling site.
 4. Perform and document any field QC measures specified by the analytical method (such as trip blanks for volatile organics in each cooler).

FQ 1210. QUALITY CONTROL BLANKS

Collect field quality control blanks to monitor the sample collection process, decontamination procedures, quality of sample preservatives and sample storage and transport conditions, to help ensure that samples are representative of the sampling source and have not been artificially contaminated by the sample collection process.

FQ 1211. *Precleaned Equipment Blanks*

Precleaned equipment blanks monitor the on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions for water, waste, soil, or sediment samples.

1. Collect these blanks using sampling equipment that has been brought to the site precleaned and ready for use. The cleaning procedures used for the blank collection must be identical to those used for the field sample collection.
2. Collect these blanks before the equipment set has been used.
3. Prepare equipment blanks by rinsing the sampling equipment set with the appropriate type of analyte-free water and collecting the rinse water in appropriate sample containers (see FQ 1100).

FQ 1212. *Field-Cleaned Equipment Blanks*

Field-cleaned equipment blanks monitor on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions.

1. Collect these blanks using sampling equipment that has been cleaned in the field (i.e., between sampling points). The cleaning procedures used for the blank collection must be identical to those used for the field sample collection.

2. Prepare field-cleaned equipment blanks immediately after the equipment is cleaned in the field and before leaving the sampling site.
3. Prepare equipment blanks by rinsing the sampling equipment set with the appropriate type of analyte-free water and collecting the rinse water in appropriate sample containers (see FQ 1100).
4. For intermediate sampling devices or equipment, site-water rinsing is defined as the decontamination step, if this is the only cleaning that will be performed on the equipment prior to collecting the sample. In this case, after rinsing the intermediate device 3 times with analyte free water, collect the equipment blank with a subsequent rinse of the device using additional analyte-free water to collect sufficient blank volume.

FQ 1213. *Trip Blanks*

Trip blanks monitor the sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions.

1. The organization that is providing the VOC vials must provide the trip blanks by filling two or more VOC vials with analyte-free water and preservatives (if needed).
 - 1.1. To prevent degradation of the trip blank, long-term storage of prepared trip blanks is not recommended.
2. These aqueous matrix blanks are applicable if samples are to be analyzed for volatile constituents (volatile organics, methyl mercury, etc.) in water, waste, soils, or sediments.
3. Place a set of trip blanks in each transport container used to ship/store empty VOC vials. They must remain with the VOC vials during the sampling episode and must be transported to the analyzing laboratory in the same shipping or transport container(s) as the VOC samples.
4. When samples from more than one site are transported in the same ice chest, the same trip blank may be used for all of the samples, provided all samples and the trip blank are analyzed at the same lab.
5. Trip blanks must be opened **only** by the laboratory after the blank and associated samples have been received for analysis. The trip blank is aqueous and must be analyzed by water sample analytical techniques, even when the collected sample matrix is non-aqueous.

FQ 1214. *Field Blanks*

Field blanks monitor the on-site sampling environment, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions for water, waste, soil or sediment samples.

1. Prepare field blanks by pouring analyte-free water into sample containers for each parameter set to be collected.
2. Field blanks are not required if equipment blanks (FQ 1211 or FQ 1212) are collected.

FQ 1220. **FIELD DUPLICATES**

Field duplicates are designed to measure the variability in the sampling process.

1. GENERAL CONSIDERATIONS: Remember the following when collecting field duplicates.
 - 1.1. Collect duplicates by **repeating** (simultaneously or in rapid succession) the entire sample acquisition technique that was used to obtain the first sample.
 - 1.2. Collect, preserve, transport and document duplicates in the same manner as the samples. **These samples are not considered laboratory duplicates.**
 - 1.3. When collected, analyze field duplicates for the same parameters as the associated samples.

- 1.4. If possible, collect duplicate samples from sampling locations where contamination is present.
- 1.5. Field duplicates must be collected if required by the analytical method and as required by a DEP program.

FQ 1221. *Water Duplicates*

Collect water duplicates by sampling from successively collected volumes (i.e., samples from the next volume of sample water).

FQ 1222. *Soil Duplicates*

Collect soil duplicates from the same sample source (i.e., soil from the same soil sampling device).

FQ 1230. MANDATORY FIELD QUALITY CONTROLS

1. The respondent, permittee or contractor and the sampling organization are responsible for ensuring that blanks (excluding trip blanks) are collected at a minimum of 5% of each reported test result/matrix combination for the life of a project.
 - 1.1. Collect at least one blank for each reported test result/matrix combination each year for each project.
 - 1.2. If a party wishes to claim that a positive result is due to external contamination sources during sample collection, transport or analysis, then at least one field collected blank (excludes trip blanks) must have been collected at the same time the samples were collected and analyzed with the same sample set.
 - 1.3. A project will be defined by the organization responsible for collecting the samples for the project.
 - 1.4. When applicable, define the scope of the project in conjunction with the appropriate DEP authority.
2. When collecting a set of blanks, use the following criteria:
 - 2.1. Equipment Blanks:
 - 2.1.1. Collect field-cleaned equipment blanks if any sample equipment decontamination is performed in the field.
 - 2.1.2. If no decontamination is performed in the field, collect precleaned equipment blanks if the equipment is not certified clean by the vendor or the laboratory providing the equipment.
 - 2.1.3. Equipment blanks are not required for volatile organic compounds.
 - 2.1.4. Collect equipment blanks for autosampler tubing after installing, or, prior to installation in sampler, including bulk tubing lengths later installed in multiple samplers. If tubing is changed during every sampling event, collect equipment blanks for 5% of the tubing changes. If tubing is not changed at every event, collect a blank at each tubing change.
 - 2.2. Field Blanks:
 - 2.2.1. Collect field blanks if no intermediate device is used to collect the samples or if the sampling equipment is certified clean by the vendor or the laboratory providing the equipment.
 - 2.2.1.1. If a sample container is used as an intermediate sample collection device, collect an equipment blank by rinsing the decontaminated collection container as the substitute for the field blank.

2.2.2. Field blanks are not required for volatile organic compounds.

2.3. Trip Blanks:

2.3.1. These blanks are applicable if samples are to be analyzed for volatile organic compounds. See FQ 1213 for frequency, preparation and handling requirements.

3. OPTIONAL QUALITY CONTROL MEASURES

The method or project may require collection of additional quality control measures as outlined in FQ 1210 (Blanks), FQ 1220 (Duplicates) and FQ 1240 (Split Samples).

FQ 1240. SPLIT SAMPLES

The DEP or the client may require split samples as a means of determining compliance or as an added measure of quality control. Unlike duplicate samples that measure the variability of both the sample collection and laboratory procedures, split samples measure only the variability **between** laboratories. Therefore, the laboratory samples must be subsamples of the same parent sample and every attempt must be made to ensure sample homogeneity.

Collect, preserve, transport and document split samples using the same protocols as the related samples. In addition, attempt to use the same preservatives (if required).

If split samples are incorporated as an added quality control measure, the DEP recommends that all involved parties agree on the logistics of collecting the samples, the supplier(s) of the preservatives and containers, the analytical method(s), and the statistics that will be used to evaluate the data.

FQ 1241. Soils, Sediments, Chemical Wastes and Sludges

Collecting split samples for these matrices is not recommended because a true split sample in these matrices is not possible.

FQ 1242. Water

Collect split samples for water in one of two ways:

1. Mix the sample in a large, appropriately precleaned, intermediate vessel (a churn splitter is recommended). This method shall not be used if volatile or extractable organics, oil and grease or total petroleum hydrocarbons are of interest. While continuing to thoroughly mix the sample, pour aliquots of the sample into the appropriate sample containers. Alternatively:

2. Fill the sample containers from consecutive sample volumes **from the same sampling device**. If the sampling device does not hold enough sample to fill the sample containers, use the following procedure:

2.1. Fill the first container with half of the sample, and pour the remaining sample into the second container.

2.2. Obtain an additional sample, pour the first half into the **second** container, and pour the remaining portion into the first container.

2.3. Continue with steps described in sections 2.1 and 2.2 above until both containers are filled.

FQ 1250. QUALITY CONTROL DOCUMENTATION

Document all field quality control samples in the permanent field records.

1. At a minimum, record the following information:

DEP-SOP-001/01
FQ 1000 Field Quality Control Requirements

- The type, time, date and location that the quality control sample was collected; and
 - The preservative(s) (premeasured or added amount) and preservation checks performed.
2. If blanks are collected/prepared by the field organization, maintain records of the following:
- Type of analyte-free water used;
 - Source of analyte-free water (include lot number if commercially purchased);
 - A list of the sampling equipment used to prepare the blank.
- If items above are specified in an internal SOP, you may reference the SOP number and revision date in the field notes. Note any deviations to the procedure in the field notes.
3. For trip blanks, record the following:
- Date and time of preparation
 - Storage conditions prior to release to the sample collecting organization
 - Type of analyte-free water used
 - Source and lot number (if applicable) of analyte-free water
 - Specific transport container (e.g. ice chest, cooler) used to transport empty VOC vials and field samples.
 - Include trip blank information in the sampling kit documentation per FD 2000, section 2.
4. For duplicates, record the technique that was used to collect the sample.
5. For split samples, identify the method used to collect the samples and the source(s) of the sample containers and preservatives.

FS 1000. GENERAL SAMPLING PROCEDURES

See also the following Standard Operating Procedures:

- FA 1000 and 2000 Administrative Procedures
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000-9000 Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FQ 1000 Field Quality Control Requirements

FS 1001. Preliminary Activities

1. Begin each sampling trip with some planning and coordination. Refer to FM 1000 for recommendations and suggestions on laboratory selection and communication, and field mobilization.

1.1. DEP recommends that a minimum of two people be assigned to a field team. In addition to safety concerns, the process of collecting the samples, labeling the containers and completing the field records is much easier if more than one person is present.

1.2. If responding to incidents involving hazardous substances, DEP recommends that four or five people be assigned to the team.

2. EQUIPMENT

2.1. Select appropriate equipment based on the sampling source (see FS 2000 to FS 8200), the analytes of interest and the sampling procedure.

2.1.1. If properly cleaned, sample containers may be used as collection devices or intermediate containers.

2.2. The equipment construction must be consistent with the analytes or analyte groups to be collected (see Tables FS 1000-1 through FS 1000-3).

2.3. Bring precleaned equipment to the field or use equipment that has been certified clean by the vendor or laboratory.

3. DEDICATED EQUIPMENT STORAGE

3.1. Store all dedicated equipment (except dedicated pump systems or dedicated drop pipes) in a controlled environment.

3.2. If possible, store equipment in an area that is located away from the sampling site. If equipment other than dedicated pumps or dedicated drop pipes is stored in monitoring wells, suspend the equipment above the formation water.

3.3. Securely seal the monitoring well in order to prevent tampering between sampling events.

3.4. Decontaminate all equipment (except dedicated pumps or drop pipes) before use according to the applicable procedures in FC 1000.

4. SAMPLE CONTAINERS

4.1. The analyses to be performed on the sample determine the construction of sample containers.

4.2. Inspect all containers and lids for flaws (cracks, chips, etc.) before use. Do not use any container with visible defects or discoloration.

FS 1002. *Contamination Prevention*

1. CONTAMINATION PREVENTION

1.1. Take special effort to prevent cross contamination and contamination of the environment when collecting samples. Protect equipment, sample containers and supplies from accidental contamination.

1.1.1. Do not insert pump tubing, measurement probes, other implements, fingers, etc. into sample containers or into samples that have been collected for laboratory analysis.

1.1.1.1. If it is necessary to insert an item into the container or sample, ensure that the item is adequately decontaminated for the analytes of interest to be analyzed in the sample.

1.1.2. If possible, collect samples from the least contaminated sampling location (or background sampling location) to the most contaminated sampling location.

1.1.2.1. Collect the ambient or background samples first and store them in separate ice chests or shipping containers.

1.1.3. Collect samples in flowing water from downstream to upstream.

1.1.4. Do not store or ship highly contaminated samples (concentrated wastes, free product, etc.) or samples suspected of containing high concentrations of contaminants in the same ice chest or shipping container with other environmental samples.

1.1.4.1. Isolate these sample containers by sealing them in separate, untreated plastic bags immediately after collecting, preserving, labeling, etc.

1.1.4.2. Use a clean, untreated plastic bag to line the ice chest or shipping container.

1.1.5. Segregate reagents such as preservation acids during storage and transport as necessary to prevent cross-contamination of samples or other reagents.

2. COMPOSITE SAMPLES

2.1. Do not collect composite samples unless required by permit or DEP program.

2.2. If compositing is required, use the following procedure:

2.2.1. Select sampling points from which to collect each aliquot.

2.2.2. Using the appropriate sampling technique, collect equal aliquots (same sample size) from each location and place in a properly cleaned container.

2.2.3. Record the approximate amount of each aliquot (volume or weight).

2.2.4. Add preservative(s), if required.

2.2.5. Label container and make appropriate field notes (see FD 1000-9000).

2.2.6. Notify the laboratory that the sample is a composite sample.

2.2.7. When collecting soil or sediment samples, combine the aliquots of the sample directly in the sample container with no pre-mixing. Notify the laboratory that the sample is an unmixed composite sample, and request that the laboratory thoroughly mix the sample before sample preparation or analysis.

2.2.8. When collecting water composites see FS 2000, section 1.3 or pertinent sections of other water matrix SOPs for specific details on collection.

FS 1003. *Protective Gloves*

1. Gloves serve a dual purpose to:

- Protect the sample collector from potential exposure to sample constituents
 - Minimize accidental contamination of samples by the collector
2. The DEP recommends wearing protective gloves when conducting all sampling activities. They must be worn except when:
- The sample source is considered to be non-hazardous
 - The samples will not be analyzed for trace constituents
 - The part of the sampling equipment that is handled without gloves does not contact the sample source
3. Do not let gloves come into contact with the sample or with the interior or lip of the sample container.
4. Use clean, new, unpowdered and disposable gloves.
- 4.1. DEP recommends latex gloves, however, other types of gloves may be used as long as the construction materials do not contaminate the sample or if internal safety protocols require greater protection.
- 4.2. Note that certain materials (as might be potentially present in concentrated effluent) may pass through certain glove types and be absorbed in the skin. Many vendor catalogs provide information about the permeability of different gloves and the circumstances under which the glove material might be applicable.
- 4.3. The powder in powdered gloves can contribute significant contamination and DEP does not recommend wearing powdered gloves unless it can be demonstrated that the powder does not interfere with the sample analysis.
5. If gloves are used, change:
- After preliminary activities such as pump placement;
 - After collecting all the samples at a single sampling point; or
 - If torn, or used to handle extremely dirty or highly contaminated surfaces.
6. Properly dispose of all used gloves.

FS 1004. *Container and Equipment Rinsing*

When collecting aqueous samples, rinse the sample collection equipment with a portion of the sample water before taking the actual sample. Sample containers do not need to be rinsed. In the case of petroleum hydrocarbons, oil & grease or containers with premeasured preservatives, the sample containers cannot be rinsed.

FS 1005. *Fuel-Powered Equipment and Related Activities*

1. Place all fuel-powered equipment away from, and downwind of, any site activities (e.g., purging, sampling, decontamination). If field conditions preclude such placement (i.e., the wind is from the upstream direction in a boat), place the fuel source(s) as far away as possible from the sampling activities and describe the conditions in the field notes.
2. Handle fuel (i.e., filling vehicles and equipment) prior to the sampling day. If such activities must be performed during sampling, the personnel must wear disposable gloves. Dispense all fuels, dispose of gloves downwind, and well away from the sampling activities.
3. If sampling at active gas stations, stop sample collection activities during fuel deliveries.

FS 1006. *Preservation, Holding Times and Container Types*

1. Preserve all samples according to the requirements specified in Tables FS 1000-4 through FS 1000-11.

1.1. The information listed in the above-referenced tables supersedes any preservation techniques, holding time or container type that might be discussed in individual analytical methods.

1.2. If samples are collected only for total phosphorus and are not for NPDES compliance, thermal preservation (ice) is not required if the sample containers are pre-preserved with acid.

2. The preservation procedures in the referenced tables specify immediate preservation. "Immediate" is defined as "within 15 minutes of sample collection." Perform all preservation on-site (in the field).

2.1. Preservation is not required if samples can be transported back to the laboratory within 15 minutes of collecting the sample and

2.1.1. The laboratory begins sample analysis within the 15-minute window and documents the exact time the analysis began, or

2.1.2. The laboratory adds the appropriate preservatives (including thermal preservation) within 15 minutes of sample collection and documents the exact time that the preservation was done.

3. PRESERVING COMPOSITE WATER SAMPLES

3.1. If the sample preservation requires thermal preservation (e.g., <6°C), the samples must be cooled to the specified temperature.

3.1.1. Manually collected samples to be composited must be refrigerated at a temperature equal to or less than the required temperature.

3.1.2. Automatic samplers must be able to maintain the required temperature by packed ice or refrigeration.

3.2. When chemical preservation is also required, begin the preservation process within 15 minutes of the last collected sample.

3.3. Holding Times for Automatic Samplers:

3.3.1. If the collection period is 24 hours or less, the holding time begins at the last scheduled sample collection;

3.3.2. If the collection period exceeds 24 hours, the holding time begins with the time that the first sample is collected.

4. PH ADJUSTED PRESERVATION - Check the pH of pH-adjusted samples according to these frequencies:

4.1. During the first sampling event at a particular site, check **all** samples (e.g. each groundwater monitoring well, surface water location, or influent/effluent sampling location) that are pH-adjusted except volatile organics.

4.2. During subsequent visits to a particular site, check **at least one** sample per parameter group that must be pH-adjusted.

4.2.1. If samples are routinely collected from the same sample location, a pH check is not required each time samples are collected. If the frequency of sample collection at a specified location is greater than once per month (i.e., weekly or daily), check the pH of **at least one sample** per parameter group (except volatile organics) according to the following schedule:

4.2.1.1. Weekly sampling: 1 pH check per month

- 4.2.1.2. Daily sampling: 1 pH check per week
- 4.2.2. If the frequency of sample collection at a specified location is once per month, check the pH of at least one sample per parameter group (except volatile organics) quarterly.
- 4.3. If repeat samplings at the same site are performed less frequently than monthly, or if site conditions vary from sampling event to sampling event, check all the samples per section 4.1 above.
5. THERMAL PRESERVATION
 - 5.1. When preservation requirements indicate cooling to a specific temperature, samples must be immersed in wet ice within 15 minutes of sample collection (see 1006, section 2 above). Frozen ice packs are not acceptable for cooling samples. Unless specified, do not freeze samples.
 - 5.2. All supplies (ice, dry ice, etc.) necessary to meet a thermal preservation requirement must be onsite for immediate use.
 - 5.3. Ship samples in wet ice. If samples are cooled to the required temperature before shipment, samples may be shipped with frozen ice packs if the specified temperature is maintained during shipment. The sample temperature must not exceed the specified temperature.
 - 5.4. If immediate freezing is required, dry ice must be available in the field to begin the freezing process.

FS 1007. *Preventive and Routine Maintenance*

Preventive maintenance activities are necessary to ensure that the equipment can be used to obtain the expected results and to avoid unusable or broken equipment while in the field. Equipment is properly maintained when:

- It functions as expected during mobilization; and
 - It is not a source of sample contamination (e.g., dust).
1. Follow the manufacturer's suggested maintenance activities and document all maintenance. At a minimum, DEP recommends the activities listed on Table FS 1000-12.
 2. Maintain documentation for the following information for each piece of equipment or instrumentation. See FD 3000 also.
 - 2.1. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit employed. This identifier may include a manufacturer name, model number, serial number, inventory number or other unique identification.
 - 2.2. Log all maintenance and repair performed for each instrument unit, including routine cleaning procedures and solution or parts replacement for instrument probes.
 - 2.3. Include the calendar date for the procedures performed.
 - 2.4. Record names of personnel performing the maintenance or repair tasks.
 - 2.5. Describe any malfunctions necessitating repair or service.
 - 2.6. Retain vendor service records for all affected instruments.
 - 2.7. Record the following for rented equipment:
 - Rental date(s)
 - Equipment type and model or inventory number or other description
 - 2.8. Retain the manufacturer's operating and maintenance instructions.

FS 1008. *Documentation and References*

1. REFERENCES: The most current version of all sampling references must be available for consultation in the field. These include:

- DEP SOPs;
- Internal SOPs;
- Sampling and analysis plans; and/or
- Quality Assurance Project Plans.

2. DOCUMENTATION: Complete and sign all documentation (see FD 1000).

FS 1009. *Sample Documentation and Evidentiary Custody*

1. SAMPLE DOCUMENTATION

1.1. Document all activities related to a sampling event, including sample collection, equipment calibration, equipment cleaning and sample transport.

1.2. The required documentation related to each sampling or other field activity is specified in the associated SOPs; i.e., FQ 1000, FC 1000, the FS series, and the FT series.

1.3. The documentation requirements are also summarized in FD 1000, Field Documentation. See FD 9000 for required and optional documentation forms.

2. LEGAL CHAIN OF CUSTODY (COC)

The use of legal or evidentiary Chain-of-Custody (COC) protocols is not usually required by DEP, except for cases involving civil or criminal enforcement. Do not use these procedures for routine sampling for compliance unless evidentiary custody protocols are specifically mandated in a permit or other legal order or when required for enforcement actions.

Evidentiary sample custody protocols are used to demonstrate that the samples and/or sample containers were handled and transferred in such a manner as to eliminate possible tampering.

When a client or situation requires legal COC, use the procedures in FD 7000 to document and track all time periods associated with the physical possession and storage of sample containers, samples, and subsamples from point of origin through the final analytical result and sample disposal.

When legal or evidentiary COC is required, samples must be:

- In the actual possession of a person who is authorized to handle the samples (e.g., sample collector, laboratory technician);
- In the view of the same person after being in their physical possession;
- Secured by the same person to prevent tampering; or
- Stored in a designated secure area.

2.1. Control and document access to all evidentiary samples and subsamples with adequate tracking. Documentation must include records about each of the activities and situations listed below, when applicable to sample evidence, and must track the location and physical handling of all samples by all persons at all times.

2.1.1. Limit the number of individuals who physically handle the samples as much as practicable.

2.1.2. When storing samples and subsamples, place samples in locked storage (e.g., locked vehicle, locked storeroom, etc.) at all times when not in the possession or view of authorized personnel.

2.1.3. Alternatively, maintain restricted access to facilities where samples are stored. Ensure that unauthorized personnel are not able to gain access to the samples at any time.

2.1.4. Do not leave samples in unoccupied motel or hotel rooms or other areas where access cannot be controlled by the person(s) responsible for custody without first securing samples and shipping or storage containers with tamper-indicating evidence tape or custody seals. Ice chests or other storage containers used to store sample containers in hotel rooms may be sealed instead of sealing each sample container stored within.

2.2. Use a Chain of Custody form or other transmittal record to document sample transfers to other parties. Other records and forms may be used to document internal activities if they meet the requirements for legal chain of custody.

2.3. Legal COC begins when the precleaned sample containers are dispatched to the field.

2.3.1. The person who relinquishes the prepared sample kits or containers and the individual who receives the sample kits or containers must sign the COC form unless the same party provides the containers and collects the samples.

2.3.2. All parties handling the empty sample containers and samples are responsible for documenting sample custody, including relinquishing and receiving samples, except commercial common carriers.

2.4. Shipping Samples under Legal COC

2.4.1. Complete all relevant information on the COC transmittal form or record (see FD 7200, section 2).

2.4.2. Internal records must document the handling of the samples and shipping containers in preparation for shipment. The names of all persons who have prepared the shipment must be recorded. All time intervals associated with handling and preparation must be accounted for.

2.4.3. Place the forms in a sealed waterproof bag and place in the shipping container with the samples.

2.4.4. Seal the shipping container with tamper-proof seals (see 2.6 below) so that any tampering can be clearly seen by the individual who receives the samples.

2.4.5. Note: The common carrier does not sign COC records. However, the common carrier (when used) must be identified.

2.5. Delivering Samples to the Laboratory

2.5.1. All individuals who handle and relinquish the sample containers must sign the transmittal form. The legal custody responsibilities of the field operations end when the samples are relinquished to the laboratory.

2.6. Chain of Custody Seals: If required, affix tamper-indicating evidence tape or seals to all sample, storage and shipping container closures when transferring or shipping sample container kits or samples to another party.

2.6.1. Place the seal so that the closure cannot be opened without breaking the seal.

2.6.2. Record the time, calendar date and signatures of responsible personnel affixing and breaking all seals for each sample container and shipping container.

2.6.3. Affix new seals every time a seal is broken until continuation of evidentiary custody is no longer required.

FS 1010. *Health and Safety*

Implement all local, state and federal requirements relating to health and safety.

FS 1011. *Hazardous Wastes*

Investigators and sampling personnel should attempt to follow all local, state and federal requirements pertaining to the storage and disposal of any hazardous or investigation-derived wastes (IDW). The discussion below is not intended to describe these requirements and is provided for informational purposes only.

1. All IDW should be properly managed so that contamination is not spread into previously uncontaminated areas.
 - 1.1. IDW typically includes all water, soil, drilling mud, decontamination wastes, discarded personal protective equipment (PPE), etc. from site investigations, exploratory borings, piezometer and monitoring well installation, refurbishment, and abandonment, and other investigative activities. IDW should be containerized at the time it is generated.
 - 1.2. Investigators and sampling personnel should determine if the IDW must be managed as Resource Conservation and Recovery Act (RCRA) regulated hazardous waste through appropriate testing or generator knowledge. IDW that is determined to be RCRA regulated hazardous waste should be managed according to the applicable local, state and federal requirements.
 - 1.3. IDW that is not a RCRA regulated hazardous waste but is contaminated above the Department's Soil Cleanup Target Levels or the state standards and/or minimum criteria for ground water quality should be properly disposed of according to the applicable local, state and federal requirements.
 - 1.4. IDW that is not contaminated or contains contaminants below the Department's Soil Cleanup Target Levels or the state standards and/or minimum criteria for ground water quality may be disposed of onsite if the IDW will not cause a surface water violation. However, investigators and sampling personnel should first verify that all applicable regulations have been met before disposal of the IDW.
 - 1.5. All containers holding IDW should be maintained in good condition:
 - 1.5.1. Containers should be periodically inspected for damage
 - 1.5.2. Personnel should ensure that all required labeling (DOT, RCRA, etc.) is clearly visible.

Appendix FS 1000
Tables, Figures and Forms

Table FS 1000-1	Equipment Construction Materials
Table FS 1000-2	Construction Material Selection for Equipment and Sample Containers
Table FS 1000-3	Equipment Use and Construction
Table FS 1000-4	40 CFR Part 136 Table II: Required Containers, Preservation Techniques, and Holding Times (Water/Wastewater Samples)
Table FS 1000-5	Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times for Analytes not found in 40 CFR Part 136
Table FS 1000-6	Recommended Sample Containers, Sample Volumes, Preservation Techniques and Holding Times for Residuals, Soil and Sediment Samples.
Table FS 1000-7	Sample Handling, Preservation and Holding Time Table for SW 846 Method 5035
Table FS 1000-8	Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II
Table FS 1000-9	Containers, Preservation and Holding Times for Biosolids Samples and Protozoans
Table FS 1000-10	Container Materials, Preservation, and Holding Times for Fish and Shellfish
Table FS 1000-11	Holding Times for SPLP or TCLP Extraction, Sample Preparation and Determinative Analysis
Table FS 1000-12	Preventive Maintenance Tasks
Figure FS 1000-1	Organic Trap Configuration for Collecting Extractable Organics with a Peristaltic Pump

**Table FS 1000-1
Equipment Construction Materials**

Construction Material¹	Acceptable Analyte Group²	Precautions
316 Stainless Steel (metals)	All analyte groups. Recommended for inorganic nonmetallics, metals, volatile and extractable organics.	Do not use if weathered, corroded or pitted. ³
300-Series Stainless Steel (304, 303, 302) (metals)	Suitable for all analyte groups (if used, check for corrosion before use). Recommended for inorganic nonmetallics, metals, volatile and extractable organics.	Do not use if weathered, corroded or pitted. ³ If corroded, there is a potential for samples to be contaminated with iron, chromium, copper or nickel. Check for compatibility with water chemistry for dedicated applications. Do not use in low pH, high chloride, or high TDS waters.
Low Carbon Steel Galvanized Steel Carbon Steel (metals)	Inorganic nonmetallics only.	Coring devices are acceptable for all analyte groups if appropriate liners are used. Use Teflon liners for organics. Use plastic or Teflon liners for metals. Do not use if weathered, corroded or pitted. ³ If corroded, there is a potential for samples to be contaminated with iron and manganese. Galvanized equipment will also contaminate with zinc and cadmium. If used to collect large samples (e.g., dredges), collect organic and metal samples may be collected from portions of the interior of the collected material.
Brass (metals)	Inorganic nonmetallics only.	Do not use if weathered, corroded or pitted. ³
Teflon and other fluorocarbon polymers (plastics ⁴)	All analyte groups. Especially recommended for trace metals and organics.	Easily scratched. Do not use if scratched or discolored.
Polypropylene Polyethylene (All Types) (plastics ⁴)	All analyte groups.	LDPE may not be used for pump tubing when collecting for VOCs. Easily scratched. Do not use if scratched or discolored.
Polyvinyl chloride (PVC) (plastics ⁴)	All analyte groups except extractable and volatile organics.	Do not use when collecting extractable or volatile organics samples.

DEP-SOP-001/01
FS 1000 General Sampling Procedures

Table FS 1000-1
Equipment Construction Materials

Construction Material¹	Acceptable Analyte Group²	Precautions
Tygon, Silicone, Neoprene (plastics ⁴)	All analyte groups except extractable and volatile organics.	Do not use when collecting extractable or volatile organic samples (see Table FS 1000-3 for silicone tubing exceptions). Do not use silicone if sampling for silica.
Viton (plastics ⁴)	All analyte groups except extractable and volatile organics. ⁵	Minimize contact with sample. Use only if no alternative material exists.
Glass, borosilicate (glass)	All analyte groups except silica and boron.	-

Adapted from USGS Field Manual, Chapter 2, January 2000.

¹ Refers to construction material of the portions of the sampling equipment that come in contact with the sample (e.g., housing of variable speed submersible pump must be stainless steel if extractable organics are sampled; the housing of a variable speed submersible pump used to sample metals may be plastic.)

² Specific container limitations for an individual analyte or parameter outlined in Tables FS 1000-3, FS 1000-4, FS 1000-5, and FS 1000-6 supersede the general considerations for an analyte group given in Table FS 1000-1.

³ Corroded/weathered surfaces are active sorption sites for organic compounds.

⁴ Plastics used in connection with inorganic trace element samples (including metals) must be uncolored or white.

⁵ May be allowable for specialized parts where no alternative material exists (e.g., Viton seals are the best available seal for some dedicated pump systems), however, contact with the sample must be minimized.

Table FS 1000-2
Construction Material Selection for Equipment and Sample Containers

Analyte Group	Acceptable Materials¹
Extractable Organics (see Table FS 1000-3 for silicone tubing exceptions)	Teflon and other fluorocarbon polymers Stainless steel Glass Polypropylene (All types) Polyethylene (All types) All parts of the system including connectors and gaskets must be considered – Viton may be used if no other material is acceptable.
Volatile Organics (see Table FS 1000-3 for silicone tubing exceptions)	Teflon and other fluorocarbon polymers Stainless steel Glass Polypropylene (All types) Polyethylene (All types excluding LDPE) All parts of the system including connectors and gaskets must be considered – Viton may be used if no other material is acceptable.
Metals	Teflon and other fluorocarbon polymers Stainless steel Polyethylene (All types) Polypropylene (All types) Tygon, Viton, Silicone, Neoprene PVC Glass (except silica and boron)
Ultratrace Metals	Teflon and other fluorocarbon polymers Polyethylene (All types) Polypropylene (All types) Polycarbonate Mercury must be in glass or Teflon
Inorganic Nonmetallics	Teflon and other fluorocarbon polymers Stainless steel Low carbon, Galvanized or Carbon steel Polyethylene (All types) Polypropylene (All types) Tygon, Viton, Silicone, Neoprene PVC Glass Brass

Table FS 1000-2
Construction Material Selection for Equipment and Sample Containers

Analyte Group	Acceptable Materials¹
Microbiological samples	Teflon and other fluorocarbon polymers Stainless steel Polyethylene (All types) Polypropylene (All types) Tygon, Viton, Silicone, Neoprene PVC Glass Sterilize all sample containers. Thoroughly clean sampling equipment and rinse several times with sample water before collection. Sampling equipment does not require sterilization Do not rinse sample containers

¹ Specific container limitations for an individual analyte or parameter outlined in Tables FS 1000-3, FS 1000-4, FS 1000-5, and FS 1000-6 supersede the general considerations for an analyte group given in Table FS 1000-2.

DEP-SOP-001/01
FS 1000 General Sampling Procedures

**Table FS 1000-3
Equipment Use and Construction**

<u>¹SAMPLING MATRIX</u>	<u>EQUIPMENT</u>	<u>HOUSING¹</u>	<u>TUBING</u>	<u>USE</u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
Water – Groundwater	Positive displacement pump ² - <i>Submersible (turbine, helical rotor, gear driven)</i>	SS, FP, PE ¹⁴ , PP or PVC if permanently installed	SS, FP, PE ¹⁴ , PP	Purging	All analyte groups	^{3, 4, 5} must be variable speed
Water – Groundwater	Positive displacement pump ² – <i>Submersible (turbine, helical rotor, gear driven)</i>	SS, FP, PE ¹⁴ , PP or PVC if permanently installed	SS, FP, PE ¹⁴ , PP	Sampling	All analyte groups	^{3,4,5} must be variable speed
Water – Groundwater	Positive displacement pump ² – <i>Submersible (turbine, helical rotor, gear driven)</i>	SS, FP	Non-inert ⁶	Purging	All analyte groups	^{3,4,5} must be variable speed; polishing required ⁷
Water – Groundwater	Positive displacement pump ² – <i>Submersible (turbine, helical rotor, gear driven)</i>	SS, FP	Non-inert ⁶	Sampling	All analyte groups <u>except</u> volatile and extractable organics	Must be variable speed If sampling for metals, the tubing must be non-metallic if not SS
Water- Groundwater	Positive displacement pump ² – <i>Submersible (turbine, helical rotor, gear driven)</i>	Non-inert ⁶	Non-inert ⁶	Purging	All analyte groups	^{3,4,5} must be variable speed; polishing required ⁷

DEP-SOP-001/01
FS 1000 General Sampling Procedures

**Table FS 1000-3
Equipment Use and Construction**

<u>¹SAMPLING MATRIX</u>	<u>EQUIPMENT</u>	<u>HOUSING¹</u>	<u>TUBING</u>	<u>USE</u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
Water – Groundwater	Positive displacement pump ² – <i>Submersible (turbine, helical rotor, gear driven)</i>	Non-inert ⁶	Non-inert ⁶	Sampling	All analyte groups except volatile and extractable organics	Must be variable speed If sampling for metals, the tubing must be non-metallic if not SS
Water – Groundwater	Positive displacement pump ² – <i>Bladder pump (no gas contact)</i>	SS, FP, PE, PP or PVC if permanently installed	SS, FP, PE ¹⁴ , PP	Purging	All analyte groups	^{3,4,5} must be variable speed
Water – Groundwater	Positive displacement pump ² – <i>Bladder pump (no gas contact)</i>	SS, FP, PE, PP or PVC if permanently installed	SS, FP, PE ¹⁴ , PP	Sampling	All analyte groups	^{3,4} must be variable speed Bladder must be Teflon if sampling for volatile or extractable organics or PE or PP if used in portable pumps
Water – Groundwater	Positive displacement pump ² – <i>Bladder pump (no gas contact)</i>	SS, FP, PE, PP	Non-inert ⁶	Purging	All analyte groups	^{3,4} must be variable speed; polishing required ⁷ This configuration <u>is not</u> recommended
Water – Groundwater	Positive displacement pump ² – <i>Bladder pump (no gas contact)</i>	SS, FP, PE, PP	Non-inert ⁶	Sampling	All analyte groups <u>except</u> volatile and extractable organics	^{3,4} must be variable speed If sampling for metals, the tubing must be non-metallic if not SS
Water – Groundwater	Positive displacement pump ² – <i>Bladder pump (no gas contact)</i>	Non-inert ⁶	Non-inert ⁶	Purging	All analyte groups	^{3,4} must be variable speed; polishing required ⁷

DEP-SOP-001/01
FS 1000 General Sampling Procedures

**Table FS 1000-3
Equipment Use and Construction**

<u>1 SAMPLING MATRIX</u>	<u>EQUIPMENT</u>	<u>HOUSING¹</u>	<u>TUBING</u>	<u>USE</u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
Water – Groundwater	Positive displacement pump ² – <i>Bladder pump (no gas contact)</i>	Non-inert ⁶	Non-inert ⁶	Sampling	All analyte groups except volatile and extractable organics	^{3,4} must be variable speed; polishing required ⁷ If sampling for metals, the tubing must be non-metallic if not SS
Water - Groundwater	Suction lift pump - Centrifugal	N/A	SS, FP, PE ¹⁴ , PP	Purging	All analyte groups	⁴ foot-valve required Must be variable speed
Water – Groundwater	Suction lift pump – Centrifugal	N/A	Non-inert ⁶	Purging	All analyte groups	⁴ foot-valve required; polishing required ⁷ Must be variable speed
Water – Groundwater	Suction lift pump - Peristaltic	N/A	SS, FP, PE ¹⁴ , PP	Purging	All analyte groups	⁴ foot-valve required; polishing required ⁷ or continuous pumping required Must be variable speed
Water – Groundwater	Suction lift pump – Peristaltic	N/A	SS, FP, PE ¹⁴ , PP	Sampling	All analyte groups	⁴ Silicone tubing in pump head Must be variable speed
Water – Groundwater	Suction lift pump – Peristaltic	N/A	Non-inert ⁶	Purging	All analyte groups	⁴ foot-valve required Must be variable speed
Water – Groundwater	Suction lift pump – Peristaltic	N/A	Non-inert ⁶	Sampling	All analyte groups except <u>volatile and extractable organics</u>	⁴ Silicone tubing in pump head Must be variable speed
Water - Groundwater	Bailers	SS, FP, PE, PP	N/A	Purging	All analyte groups	None; <u>not recommended</u>
Water – Groundwater	Bailers	SS, FP, PE, PP	N/A	Sampling	All analyte groups	None; <u>not recommended</u>
Water – Groundwater	Bailers	Non-inert ⁶	N/A	Purging	All analyte groups except volatile and extractable organics	None; <u>not recommended</u> If sampling for metals, the tubing must be non-metallic if not SS
Water – Groundwater	Bailers	Non-inert ⁶	N/A	Sampling	All analyte groups except volatile and extractable organics	None; <u>not recommended</u> If sampling for metals, the tubing must be non-metallic if not SS

DEP-SOP-001/01
FS 1000 General Sampling Procedures

Table FS 1000-3
Equipment Use and Construction

<u>¹SAMPLING MATRIX</u>	<u>EQUIPMENT</u>	<u>HOUSING¹</u>	<u>TUBING</u>	<u>USE</u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
Water – Surface water	Intermediate containers such as pond sampler, scoops, beakers, buckets, and dippers	SS, FP, FP - coated, PE, PP	N/A	Grab sampling	All analyte groups	None
Water – Surface water	Intermediate containers such as pond sampler, scoops, beakers, buckets, and dippers	Glass	N/A	-	All analyte groups except boron and fluoride	None
Water – Surface water	Intermediate containers such as pond sampler, scoops, beakers, buckets, and dippers	Non-inert ⁶	N/A	-	All analyte groups <u>except</u> volatile and extractable organics	None
Water – Surface water	Nansen, Kemmerer, Van Dorn, Alpha and Beta Samplers, Niskin (or equivalent)	SS, FP, FP - coated, PE, PP	N/A	Specific depth grab sampling	All analyte groups	None

DEP-SOP-001/01
FS 1000 General Sampling Procedures

**Table FS 1000-3
Equipment Use and Construction**

<u>1SAMPLING MATRIX</u>	<u>EQUIPMENT</u>	<u>HOUSING¹</u>	<u>TUBING</u>	<u>USE</u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
Water – Surface water	Nansen, Kemmerer, Van Dorn, Alpha and Beta Samplers, Niskin (or equivalent)	Non-inert ⁶	N/A	-	All analyte groups except volatile and extractable organics	None
Water – Surface water	DO Dunker	SS, FP glass, PE, PP	N/A	Water column composite sampling	All analyte groups	None
Water – Surface water	Bailers – double valve	SS, FP, PE, PP	N/A	Grab sampling	All analyte groups	None
Water – Surface water	Bailers – double valve	Non-inert ⁶	N/A	Grab sampling	All analyte groups <u>except</u> volatile and extractable organics	None If sampling for metals, the tubing must be non-metallic if not SS
Water – Surface water	Peristaltic pump	N/A	SS, FP, PE ¹⁴ , PP	Specific depth sampling	All analyte groups	Silicone tubing in pump head Must be variable speed
Water – Surface water	Peristaltic pump	N/A	Non-inert ⁶	-	All analyte groups <u>except</u> volatile and extractable organics	Silicone tubing in pump head Must be variable speed
Water- Surface water	Field filtration units	N/A	-	Dissolved constituents	Inorganic nonmetallic and metals in surface water	Must use a 0.45 µm filter
Water-Surface water	Field filtration units	N/A	-	Dissolved constituents	Metals in moving surface water (i.e., river/stream)	Must use a 0.45 µm filter

DEP-SOP-001/01
FS 1000 General Sampling Procedures

**Table FS 1000-3
Equipment Use and Construction**

<u>¹SAMPLING MATRIX</u>	<u>EQUIPMENT</u>	<u>HOUSING¹</u>	<u>TUBING</u>	<u>USE</u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
Water-Groundwater	Field filtration units	N/A	-	Dissolved constituents	Inorganic nonmetallic in groundwater	Must use a 0.45 µm filter
Water-Groundwater	Field filtration units	N/A	-	Dissolved constituents	Metals in groundwater and static wastewater and surface water	Must use in-line, high capacity one piece molded filter that is connected to the outlet of a pump; no intermediate vessels; positive pressure PE, PP & FP bailers acceptable Must use a 1 µm filter in groundwater
Solid – Soils	Core barrel (or liner)	SS, FP, glass, FP -coated, aluminum, PE, PP	N/A	Sampling	All analyte groups ⁸	9, 10, 11
Solid – Soils	Core barrel (or liner)	Non-inert ⁶ nonmetallics	N/A	Sampling	All analyte groups	¹²
Solid – Soils	Core barrel (or liner)O	Non-inert ⁶ metals	N/A	Sampling	All analyte groups	¹²
Solid - Soils	Trowel, scoop, spoon or spatula	SS, FP, FP -coated, PE, PP	N/A	Sampling	All analyte groups ⁸	-
Solid – Soils	Trowel, scoop, spoon or spatula	SS, FP, FP -coated, PE, PP	N/A	Compositing	All analyte groups except volatile organics	Samples for volatile organics must be grab samples
Solid – Soils	Trowel, scoop, spoon or spatula	Plastic	N/A	Sampling and compositing	All analyte groups <u>except</u> volatile and extractable organics	None Must be nonmetallic if not SS
Solid - Soils	Mixing tray (pan)	SS, FP, glass, FP -coated, aluminum, PE, PP	N/A	Sampling	All analyte groups ⁸	¹¹
Solid – Soils	Mixing tray (pan)	SS, FP, glass, FP -coated, aluminum, PE, PP	N/A	Compositing or homogenizing	All analyte groups except volatile organics	¹¹

DEP-SOP-001/01
FS 1000 General Sampling Procedures

**Table FS 1000-3
Equipment Use and Construction**

<u>1SAMPLING MATRIX</u>	<u>EQUIPMENT</u>	<u>HOUSING¹</u>	<u>TUBING</u>	<u>USE</u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
Solid – Soils	Mixing tray (pan)	Non-inert ⁶	N/A	Compositing or homogenizing	All analyte groups	^{10,11,12} must be nonmetallic if not SS
Solid - Soils	Shovel, bucket auger	SS	N/A	Sampling	All analyte groups ⁸	None
Solid – Soils	Shovel, bucket auger	Non-SS	N/A	Sampling	All analyte groups ⁸	^{10,11,12}
Solid - Soils	Split spoon	SS or carbon steel w/ FP insert	N/A	Sampling	All analyte groups ⁸	^{10,11,12}
Solid - Soils	Shelby tube	SS	N/A	Sampling	All analyte groups ⁸	⁹
Solid – Soils	Shelby tube	Carbon steel	N/A	Sampling	All analyte groups	^{9,10,12}
Solid - Sediment	Coring devices	SS, FP, glass, FP-coated, aluminum, PE, PP	N/A	Sampling	All analyte groups ⁸	^{9,10,11}
Solid – Sediment	Coring devices	Non-inert ⁶ nonmetallics	N/A	Sampling	All analyte groups	¹²
Solid – Sediment	Coring devices	Non-inert ⁶ metals	N/A	Sampling	All analyte groups	^{9,10,11}
Solid - Sediment	Grab – Young, Petersen, Shipek	FP, FP-lined, SS	N/A	Sampling	All analyte groups ⁸	None
Solid – Sediment	Grab – Young, Petersen, Shipek	Carbon steel	N/A	Sampling	All analyte groups	^{10,11}
Solid - Sediment	Dredges – Eckman, Ponar, Petit Ponar, Van Veen	SS	N/A	Sampling	All analyte groups ⁸	None
Solid – Sediment	Dredges – Eckman, Ponar, Petit Ponar, Van Veen	Carbon steel, brass	N/A	Sampling	All analyte groups	^{10,11}
Solid - Sediment	Trowel, scoop, spoon or spatula	SS, FP, FP-coated, PE, PP	N/A	Sampling	All analyte groups ⁸	-

DEP-SOP-001/01
FS 1000 General Sampling Procedures

**Table FS 1000-3
Equipment Use and Construction**

<u>¹SAMPLING MATRIX</u>	<u>EQUIPMENT</u>	<u>HOUSING¹</u>	<u>TUBING</u>	<u>USE</u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
Solid – Sediment	Trowel, scoop, spoon or spatula	SS, FP, FP-coated, PE, PP	N/A	Compositing	All analyte groups except volatile organics	Samples for volatile organics must be grab samples
Solid – Sediment	Trowel, scoop, spoon or spatula	Plastic	N/A	Sampling and compositing	All analyte groups <u>except</u> volatile and extractable organics	None must be nonmetallic if not SS
Solid - Sediment	Mixing tray (pan)	SS, FP, glass, FP-coated, aluminum, PE, PP	N/A	Sampling	All analyte groups ⁸	¹¹
Solid – Sediment	Mixing tray (pan)	SS, FP, glass, FP-coated, aluminum, PE, PP	N/A	Compositing or homogenizing	All analyte groups except volatile organics	¹¹
Solid – Sediment	Mixing tray (pan)	Non-inert ⁶	N/A	Compositing or homogenizing	All analyte groups <u>except</u> volatile and extractable organics	none ¹¹ must be nonmetallic if not SS
Waste ¹³	Scoop	SS	N/A	Liquids, solids & sludges	All analyte groups ⁸	Cannot collect deeper phases
Waste ¹³	Spoon	SS	N/A	Solids, sludges	All analyte groups ⁸	Cannot collect deeper phases
Waste ¹³	Push tube	SS	N/A	Solids, sludges	All analyte groups ⁸	Cannot collect deeper phases
Waste ¹³	Auger	SS	N/A	Solids	All analyte groups ⁸	None
Waste ¹³	Sediment sampler	SS	N/A	Impoundments, piles	All analyte groups ⁸	None
Waste ¹³	Ponar dredge	SS	N/A	Solids, sludges & sediments	All analyte groups ⁸	None
Waste ¹³	Coliwasa, Drum thief	Glass	N/A	Liquids, sludges	All analyte groups	None
Waste ¹³	Mucksucker, Dipstick	FP	-	Liquids, sludges	All analyte groups	Not recommended for tanks > 11 feet deep
Waste ¹³	Bacon bomb	SS	N/A	Liquids	All analyte groups ⁸	Not recommended for viscous wastes
Waste ¹³	Bailer	SS, FP	N/A	Liquids	All analyte groups ⁸	Do not use with heterogeneous wastes Not recommended for viscous wastes
Waste ¹³	Peristaltic pump	N/A	FP, Glass	Liquids	All analyte groups except volatile organics	Do not use in flammable atmosphere Not recommended for viscous wastes

DEP-SOP-001/01
FS 1000 General Sampling Procedures

**Table FS 1000-3
Equipment Use and Construction**

<u>¹SAMPLING MATRIX</u>	<u>EQUIPMENT</u>	<u>HOUSING¹</u>	<u>TUBING</u>	<u>USE</u>	<u>PERMISSIBLE ANALYTE GROUPS</u>	<u>RESTRICTIONS AND PRECAUTIONS</u>
Waste ¹³	Backhoe bucket	Steel	N/A	Solids, Sludges	-	Difficult to clean Volatiles and metals must be taken from the interior part of the sample
Waste ¹³	Split spoon	SS	N/A	Solids	All analyte groups ⁸	-
Waste ¹³	Roto-Hammer	Steel	N/A	Solids	All analyte groups ⁸	Physically breaks up sample Not for flammable atmospheres

Acronyms:

N/A	not applicable
SS	stainless steel
HDPE	high-density polyethylene
FP	fluoropolymer (polytetrafluoroethylene (PTFE; Teflon®), or other fluoropolymer
PE	polyethylene
PVC	polyvinyl chloride
PP	polypropylene
LDPE	low density polyethylene ¹⁴

¹ Refers to tubing and pump housings/internal parts that are in contact with purged or sampled water (interior and exterior of delivery tube, inner lining of the discharge tube, etc.).

² If used to collect volatile or extractable organics, all power cords and other tubing must be encased in Teflon, PE or PP.

³ If used as a non-dedicated system, pump must be completely disassembled, if practical, and cleaned between wells.

⁴ Delivery tubing must be precleaned and precut at the base of operations or laboratory. If the same tubing is used during the sampling event, it must be cleaned and decontaminated between uses.

⁵ In-line check valve required.

⁶ "Non-inert" pertains to materials that are reactive (adsorb, absorb, etc.) to the analytes being sampled. For organics, materials include rubber, plastics (except PE and PP), and PVC. For metals, materials include brass, galvanized, and carbon steel.

⁷ "Polishing": When purging for volatile or extractable organics, the entire length of tubing or the portion which comes in contact with the formation water must be constructed of Teflon, SS, PE or PP. If other materials (e.g., PVC, garden hoses, etc.) are used, the following protocols must be followed: 1) slowly withdraw the pump from the water column during the last phase of purging, to remove any water from the well that may have contacted the exterior of the pump and/or tubing; 2) remove a single well volume with the sampling device before sampling begins. **Do not use Tygon** for purging if purgeable or extractable organics are of interest. **Polishing is not recommended**; use of sampling equipment constructed of appropriate materials is preferred.

⁸ Do not use if collecting for hexavalent chromium (Chromium⁺⁶)

Table FS 1000-3
Equipment Use and Construction

- ⁹ If samples are sealed in the liner for transport to the laboratory, the sample for VOC analysis must be taken from the interior part of the core.
- ¹⁰ If a non-stainless steel (carbon steel, aluminum) liner, core barrel or implement is used, take the samples for metals, purgeable organics and organics from the interior part of the core sample.
- ¹¹ Aluminum foil, trays or liners may be used only if aluminum is not an analyte of interest.
- ¹² If non-inert-liner, core barrel or implement is used, take samples from the interior part of the collected sample.
- ¹³ If disposable equipment of alternative construction materials is used, the construction material must be compatible with the chemical composition of the waste, cannot alter the characteristics of the waste sample in any way, and cannot contribute analytes of interest or any interfering components.
- ¹⁴ LDPE may not be used for pump tubing when collecting VOCs.

DEP-SOP-001/01
FS 1000 General Sampling Procedures

Table FS 1000-4
40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*
Applicable to all Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

Test	Parameter No./Name (refers to parameter number on Tables IA, B, C, D, E, F, G & H as noted)	Container ¹	Preservation ^{2, 3}	Maximum holding time ⁴
Table IA Bacterial	1–5. Coliform, total, fecal, and <i>E. coli</i>	PA, G	Cool, <10 °C, 0.008% Na ₂ S ₂ O ₃ ⁵	8 hours ^{22, 23}
Table IA Bacterial	6. Fecal streptococci	PA, G	Cool, <10 °C, 0.008% Na ₂ S ₂ O ₃ ⁵	8 hours ²²
Table IA Bacterial	7. Enterococci	PA, G	Cool, <10 °C, 0.008% Na ₂ S ₂ O ₃ ⁵	8 hours ²²
Table IA Bacterial	8. Salmonella	PA, G	Cool, <10 °C, 0.008% Na ₂ S ₂ O ₃ ⁵	8 hours ²²
Table IA Aquatic Toxicity	9–12. Toxicity, acute and chronic	P, FP, G	Cool, ≤6 °C ¹⁶	36 hours
Table IB Inorganic	1. Acidity	P, FP, G	Cool, ≤6 °C ¹⁸	14 days
Table IB Inorganic	2. Alkalinity	P, FP, G	Cool, ≤6 °C ¹⁸	14 days
Table IB Inorganic	4. Ammonia	P, FP, G	Cool, ≤6 °C ¹⁸ , H ₂ SO ₄ to pH<2	28 days
Table IB Inorganic	9. Biochemical oxygen demand	P, FP, G	Cool, ≤6 °C ¹⁸	48 hours
Table IB Inorganic	10. Boron	P, FP, or Quartz	HNO ₃ to pH<2	6 months
Table IB Inorganic	11. Bromide	P, FP, G	None required	28 days
Table IB Inorganic	14. Biochemical oxygen demand, carbonaceous	P, FP, G	Cool, ≤6 °C ¹⁸	48 hours
Table IB Inorganic	15. Chemical oxygen demand	P, FP, G	Cool, ≤6 °C ¹⁸ , H ₂ SO ₄ to pH<2	28 days
Table IB Inorganic	16. Chloride	P, FP, G	None required	28 days
Table IB Inorganic	17. Chlorine, total residual	P, G	None required	Analyze within 15 minutes
Table IB Inorganic	21. Color	P, FP, G	Cool, ≤6 °C ¹⁸	48 hours
Table IB Inorganic	23–24. Cyanide, total or available (or CATC) and free	P, FP, G	Cool, ≤6 °C ¹⁸ , NaOH to pH>10 reducing agent if oxidizer is present. ^{5, 6}	14 days
Table IB Inorganic	25. Fluoride	P	None required	28 days
Table IB Inorganic	27. Hardness	P, FP, G	HNO ₃ or H ₂ SO ₄ to pH<2	6 months
Table IB Inorganic	28. Hydrogen ion (pH)	P, FP, G	None required	Analyze within 15 minutes
Table IB Inorganic	31, 43. Kjeldahl and organic N	P, FP, G	Cool, ≤6 °C ¹⁸ , H ₂ SO ₄ to pH<2	28 days
Table IB Metals ⁷	7 18. Chromium VI	P, FP, G	Cool, ≤6 °C ¹⁸ , pH = 9.3–9.7 ²⁰	28 days
Table IB Metals ⁷	35. Mercury (CVAA)	P, FP, G	HNO ₃ to pH<2	28 days
Table IB Metals ⁷	35. Mercury (CVAFS)	FP, G; and FP-lined cap	5 mL/L 12N HCl or 5 mL/L BrCl ¹⁷	90 days ¹⁷

DEP-SOP-001/01
FS 1000 General Sampling Procedures

Table FS 1000-4
40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*
Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

Test	Parameter No./Name (refers to parameter number on Tables IA,B, C, D,E, F, G & H as noted)	Container ¹	Preservation ^{2, 3}	Maximum holding time ⁴
Table IB Metals ⁷	3, 5–8, 12, 13, 19, 20, 22, 26, 29, 30, 32–34, 36, 37, 45, 47, 51, 52, 58–60, 62, 63, 70–72, 74, 75. Metals, except boron, chromium VI, and mercury.	P, FP, G	HNO ₃ to pH<2, or at least 24 hours prior to analysis ¹⁹	6 months
Table IB Inorganic	38. Nitrate	P, FP, G	Cool, ≤6 °C ¹⁸	48 hours
Table IB Inorganic	39. Nitrate-nitrite	P, FP, G	Cool, ≤6 °C ¹⁸ , H ₂ SO ₄ to pH<2	28 days
Table IB Inorganic	40. Nitrite	P, FP, G	Cool, ≤6 °C ¹⁸	48 hours
Table IB Inorganic	41. Oil and grease	G	Cool, ≤6 °C ¹⁸ , HCl or H ₂ SO ₄ to pH<2	28 days
Table IB Inorganic	42. Organic Carbon	P, FP, G	Cool, ≤6 °C ¹⁸ HCl, H ₂ SO ₄ , or H ₃ PO ₄ to pH<2.	28 days
Table IB Inorganic	44. Orthophosphate	P, FP, G	Cool, ≤6 °C ¹⁸ , ²⁴	Filter within 15 minutes; Analyze within 48 hours
Table IB Inorganic	46. Oxygen, Dissolved Probe	G, Bottle and top	None required	Analyze within 15 minutes
Table IB Inorganic	47. Winkler	G, Bottle and top	Fix on site and store in dark	8 hours
Table IB Inorganic	48. Phenols	G	Cool, ≤6 °C ¹⁸ , H ₂ SO ₄ to pH<2	28 days
Table IB Inorganic	49. Phosphorous (elemental)	G	Cool, ≤6 °C ¹⁸	48 hours
Table IB Inorganic	50. Phosphorous, total	P, FP, G	Cool, ≤6 °C ¹⁸ , H ₂ SO ₄ to pH<2	28 days
Table IB Inorganic	53. Residue, total	P, FP, G	Cool, ≤6 °C ¹⁸	7 days
Table IB Inorganic	54. Residue, Filterable	P, FP, G	Cool, ≤6 °C ¹⁸	7 days
Table IB Inorganic	55. Residue, Nonfilterable (TSS)	P, FP, G	Cool, ≤6 °C ¹⁸	7 days
Table IB Inorganic	56. Residue, Settleable	P, FP, G	Cool, ≤6 °C ¹⁸	48 hours
Table IB Inorganic	57. Residue, Volatile	P, FP, G	Cool, ≤6 °C ¹⁸	7 days
Table IB Inorganic	61. Silica	P or Quartz	Cool, ≤6 °C ¹⁸	28 days
Table IB Inorganic	64. Specific conductance	P, FP, G	Cool, ≤6 °C ¹⁸	28 days
Table IB Inorganic	65. Sulfate	P, FP, G	Cool, ≤6 °C ¹⁸	28 days
Table IB Inorganic	66. Sulfide	P, FP, G	Cool, ≤6 °C ¹⁸ , add zinc acetate plus sodium hydroxide to pH>9	7 days

DEP-SOP-001/01
FS 1000 General Sampling Procedures

Table FS 1000-4
40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*
Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

Test	Parameter No./Name (refers to parameter number on Tables IA,B, C, D,E, F, G & H as noted)	Container ¹	Preservation ^{2, 3}	Maximum holding time ⁴
Table IB Inorganic	67. Sulfite	P, FP, G	None required	Analyze within 15 minutes
Table IB Inorganic	68. Surfactants	P, FP, G	Cool, ≤6 °C ¹⁸	48 hours
Table IB Inorganic	69. Temperature	P, FP, G	None required	Analyze
Table IB Inorganic	73. Turbidity	P, FP, G	Cool, ≤6 °C ¹⁸	48 hours
Table IC Organic ⁸	13, 18–20, 22, 24–28, 34–37, 39–43, 45–47, 56, 76, 104, 105, 108–111, 113. Purgeable Halocarbons	G, FP-lined septum	Cool, ≤6 °C ¹⁸ , 0.008% Na ₂ S ₂ O ₃ ⁵	14 days
Table IC Organic ⁸	6, 57, 106. Purgeable aromatic hydrocarbons	G, FP-lined septum	Cool, ≤6 °C ¹⁸ , 0.008% Na ₂ S ₂ O ₃ ⁵ , HCl to pH 2	14 days ⁹
Table IC Organic ⁸	3, 4. Acrolein and acrylonitrile	G, FP-lined septum	Cool, ≤6 °C ¹⁸ , 0.008% Na ₂ S ₂ O ₃ , pH to 4–5	14 days ¹⁰
Table IC Organic ⁸	23, 30, 44, 49, 53, 77, 80, 81, 98, 100, 112. Phenols ¹¹	G, FP-lined cap	Cool, ≤6 °C ¹⁸ , 0.008% Na ₂ S ₂ O ₃	7 days until extraction, 40 days after extraction
Table IC Organic ⁸	7, 38. Benzidines ^{11, 12}	G, FP-lined cap	Cool, ≤6 °C ¹⁸ , 0.008% Na ₂ S ₂ O ₃ ⁵	7 days until extraction ¹³
Table IC Organic ⁸	14, 17, 48, 50–52. Phthalate esters ¹¹	G, FP-lined cap	Cool, ≤6 °C ¹⁸	7 days until extraction, 40 days after extraction
Table IC Organic ⁸	82–84. Nitrosamines ^{11, 14}	G, FP-lined cap	Cool, ≤6 °C ¹⁸ , store in dark, 0.008% Na ₂ S ₂ O ₃ ⁵	7 days until extraction, 40 days after extraction
Table IC Organic ⁸	88–94. PCBs ¹¹	G, FP-lined cap	Cool, ≤6 °C ¹⁸	1 year until extraction, 1 year after extraction
Table IC Organic ⁸	54, 55, 75, 79. Nitroaromatics and isophorone ¹¹	G, FP-lined cap	Cool, ≤6 °C ¹⁸ , store in dark, 0.008% Na ₂ S ₂ O ₃ ⁵	7 days until extraction, 40 days after extraction
Table IC Organic ⁸	1, 2, 5, 8–12, 32, 33, 58, 59, 74, 78, 99, 101. Polynuclear aromatic hydrocarbons ¹¹	G, FP-lined cap	Cool, ≤6 °C ¹⁸ , store in dark, 0.008% Na ₂ S ₂ O ₃ ⁵	7 days until extraction, 40 days after extraction
Table IC Organic ⁸	15, 16, 21, 31, 87. Haloethers ¹¹	G, FP-lined cap	Cool, ≤6 °C ¹⁸ , 0.008% Na ₂ S ₂ O ₃ ⁵	7 days until extraction, 40 days after extraction
Table IC Organic ⁸	29, 35–37, 63–65, 107. Chlorinated hydrocarbons ¹¹	G, FP-lined cap	Cool, ≤6 °C ¹⁸	7 days until extraction, 40 days after extraction
Table IC Organic ⁸	60–62, 66–72, 85, 86, 95–97, 102, 103. CDDs/CDFs ¹¹	-	-	-

DEP-SOP-001/01
FS 1000 General Sampling Procedures

Table FS 1000-4

40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*
Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

Test	Parameter No./Name (refers to parameter number on Tables IA,B, C, D,E, F, G & H as noted)	Container ¹	Preservation ^{2, 3}	Maximum holding time ⁴
Table IC Organic ⁸	Aqueous Samples: Field and Lab Preservation	G	Cool, ≤6 °C ¹⁸ , 0.008% Na ₂ S ₂ O ₃ ⁵ , pH<9	1 year
Table IC Organic ⁸	Solids and Mixed-Phase Samples: Field Preservation	G	Cool, ≤6 °C ¹⁸	7 days
Table IC Organic ⁸	Tissue Samples: Field Preservation	G	Cool, ≤6 °C ¹⁸	24 hours
Table IC Organic ⁸	Solids, Mixed-Phase, and Tissue Samples: Lab Preservation	G	Freeze, ≤-10 °C	1 year
Table IC Organic ⁸	114-118. Alkylated phenols	G	Cool, <6 °C, H ₂ SO ₄ to pH<2	28 days until extraction, 40 days after extraction
Table IC Organic ⁸	119. Adsorbable Organic Halides (AOX)	G	Cool, <6 °C ¹⁸ , 0.008% Na ₂ S ₂ O ₃ HNO ₃ to pH<2	Hold at least 3 days, but not more than 6 months
Table IC Organic ⁸	120. Chlorinated Phenolics	-	Cool, <6 °C ¹⁸ , 0.008% Na ₂ S ₂ O ₃ H ₂ SO ₄ to pH<2	30 days until acetylation, 30 days after acetylation.
Table ID Pesticides	Tests: 1–70. Pesticides ¹¹	G, FP-lined cap	Cool, ≤6 °C ¹⁸ , pH 5–9 ¹⁵	7 days until extraction, 40 days after extraction
Table IE Radiological	1–5. Alpha, beta, and radium	P, FP, G	HNO ₃ to pH<2	6 months
Table IH Bacterial	1. <i>E. coli</i>	PA, G, G	Cool, <10 °C, 0.008% Na ₂ S ₂ O ₃ Na ₂ S ₂ O ₃ ⁵ Cool, <10 °C, 0.008% Na ₂ S ₂ O ₃ ⁵	8 hours ²² hours ⁶
Table IH Bacterial	2. Enterococci	PA, G	Cool, <10 °C, 0.008% Na ₂ S ₂ O ₃ Na ₂ S ₂ O ₃ ⁵	8 hours ²²
Table IH Protozoan	8. Cryptosporidium	LDPE; field filtration	0–10 °C	96 hours. ²¹
Table IH Protozoan	9. Giardia	LDPE; field filtration	0–10 °C	96 hours ²¹

*Reference: This table is adapted from Table II, 40 CFR, Ch.I, Part 136.3, *Identification of Test Procedures*, including all footnotes listed below.

¹“P” is for polyethylene; “FP” is fluoropolymer (polytetrafluoroethylene (PTFE); Teflon®), or other fluoropolymer, unless stated otherwise in this Table II; “G” is glass; “PA” is any plastic that is made of a sterilizable material (polypropylene or other autoclavable plastic); “LDPE” is low density polyethylene.

DEP-SOP-001/01
FS 1000 General Sampling Procedures

Table FS 1000-4

40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*

Applicable to all Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

²Except where noted in this Table II and the method for the parameter, preserve each grab sample within 15 minutes of collection. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR part 403, appendix E), refrigerate the sample at ≤ 6 °C during collection unless specified otherwise in this Table II or in the method(s). For a composite sample to be split into separate aliquots for preservation and/or analysis, maintain the sample at ≤ 6 °C, unless specified otherwise in this Table II or in the method(s), until collection, splitting, and preservation is completed. Add the preservative to the sample container prior to sample collection when the preservative will not compromise the integrity of a grab sample, a composite sample, or aliquot split from a composite sample within 15 minutes of collection. If a composite measurement is required but a composite sample would compromise sample integrity, individual grab samples must be collected at prescribed time intervals (e.g., 4 samples over the course of a day, at 6-hour intervals). Grab samples must be analyzed separately and the concentrations averaged. Alternatively, grab samples may be collected in the field and composited in the laboratory if the compositing procedure produces results equivalent to results produced by arithmetic averaging of results of analysis of individual grab samples. For examples of laboratory compositing procedures, see EPA Method 1664 Rev. A (oil and grease) and the procedures at 40 CFR 141.24(f)(14)(iv) and (v) (volatile organics).

³When any sample is to be shipped by common carrier or sent via the U.S. Postal Service, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirement of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO₃) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H₂SO₄) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

⁴Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before the start of analysis and still be considered valid. Samples may be held for longer periods only if the permittee or monitoring laboratory have data on file to show that, for the specific types of samples under study, the analytes are stable for the longer time, and has received a variance from the Regional ATP Coordinator under §136.3(e). For a grab sample, the holding time begins at the time of collection. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR part 403, appendix E), the holding time begins at the time of the end of collection of the composite sample. For a set of grab samples composited in the field or laboratory, the holding time begins at the time of collection of the last grab sample in the set. Some samples may not be stable for the maximum time period given in the table. A permittee or monitoring laboratory is obligated to hold the sample for a shorter time if it knows that a shorter time is necessary to maintain sample stability. See §136.3(e) for details. The date and time of collection of an individual grab sample is the date and time at which the sample is collected. For a set of grab samples to be composited, and that are all collected on the same calendar date, the date of collection is the date on which the samples are collected. For a set of grab samples to be composited, and that are collected across two calendar dates, the date of collection is the dates of the two days; e.g., November 14-15. For a composite sample collected automatically on a given date, the date of collection is the date on which the sample is collected. For a composite sample collected automatically, and that is collected across two calendar dates, the date of collection is the dates of the two days; e.g., November 14-15. For static-renewal toxicity tests, each grab or composite sample may also be used to prepare test solutions for renewal at 24 h, 48 h, and/or 72 h after first use, if stored at 0-6 °C, with minimum head space.

DEP-SOP-001/01
FS 1000 General Sampling Procedures

Table FS 1000-4

40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*

Applicable to all Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

⁵ASTM D7365-09a specifies treatment options for samples containing oxidants (e.g., chlorine) for cyanide analyses. Also, Section 9060A of Standard Methods for the Examination of Water and Wastewater (20th and 21st editions) addresses dechlorination procedures for microbiological analyses.

⁶Sampling, preservation and mitigating interferences in water samples for analysis of cyanide are described in ASTM D7365-09a. There may be interferences that are not mitigated by the analytical test methods or D7365-09a. Any technique for removal or suppression of interference may be employed, provided the laboratory demonstrates that it more accurately measures cyanide through quality control measures described in the analytical test method. Any removal or suppression technique not described in D7365-09a or the analytical test method must be documented along with supporting data.

⁷For dissolved metals, filter grab samples within 15 minutes of collection and before adding preservatives. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR part 403, appendix E), filter the sample within 15 minutes after completion of collection and before adding preservatives. If it is known or suspected that dissolved sample integrity will be compromised during collection of a composite sample collected automatically over time (e.g., by interchange of a metal between dissolved and suspended forms), collect and filter grab samples to be composited (footnote 2) in place of a composite sample collected automatically.

⁸Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

⁹If the sample is not adjusted to pH 2, then the sample must be analyzed within seven days of sampling.

¹⁰The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

¹¹When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity (i.e., use all necessary preservatives and hold for the shortest time listed). When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to $\leq 6^{\circ}\text{C}$, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (regarding the requirement for thiosulfate reduction), and footnotes 12, 13 (regarding the analysis of benzidine).

¹²If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0 ± 0.2 to prevent rearrangement to benzidine.

¹³Extracts may be stored up to 30 days at $< 0^{\circ}\text{C}$.

¹⁴For the analysis of diphenylnitrosamine, add 0.008% $\text{Na}_2\text{S}_2\text{O}_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.

DEP-SOP-001/01
FS 1000 General Sampling Procedures

Table FS 1000-4

40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*

Applicable to all Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

¹⁵The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% Na₂S₂O₃.

¹⁶Place sufficient ice with the samples in the shipping container to ensure that ice is still present when the samples arrive at the laboratory. However, even if ice is present when the samples arrive, immediately measure the temperature of the samples and confirm that the preservation temperature maximum has not been exceeded. In the isolated cases where it can be documented that this holding temperature cannot be met, the permittee can be given the option of on-site testing or can request a variance. The request for a variance should include supportive data which show that the toxicity of the effluent samples is not reduced because of the increased holding temperature. Aqueous samples must not be frozen. Hand-delivered samples used on the day of collection do not need to be cooled to 0 to 6 °C prior to test initiation.

¹⁷Samples collected for the determination of trace level mercury (<100 ng/L) using EPA Method 1631 must be collected in tightly-capped fluoropolymer or glass bottles and preserved with BrCl or HCl solution within 48 hours of sample collection. The time to preservation may be extended to 28 days if a sample is oxidized in the sample bottle. A sample collected for dissolved trace level mercury should be filtered in the laboratory within 24 hours of the time of collection. However, if circumstances preclude overnight shipment, the sample should be filtered in a designated clean area in the field in accordance with procedures given in Method 1669. If sample integrity will not be maintained by shipment to and filtration in the laboratory, the sample must be filtered in a designated clean area in the field within the time period necessary to maintain sample integrity. A sample that has been collected for determination of total or dissolved trace level mercury must be analyzed within 90 days of sample collection.

¹⁸Aqueous samples must be preserved at ≤6 °C, and should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulatory authority. Also, for purposes of NPDES monitoring, the specification of “≤ °C” is used in place of the “4 °C” and “<4 °C” sample temperature requirements listed in some methods. It is not necessary to measure the sample temperature to three significant figures (1/100th of 1 degree); rather, three significant figures are specified so that rounding down to 6 °C may not be used to meet the ≤6 °C requirement. The preservation temperature does not apply to samples that are analyzed immediately (less than 15 minutes).

¹⁹An aqueous sample may be collected and shipped without acid preservation. However, acid must be added at least 24 hours before analysis to dissolve any metals that adsorb to the container walls. If the sample must be analyzed within 24 hours of collection, add the acid immediately (see footnote 2). Soil and sediment samples do not need to be preserved with acid. The allowances in this footnote supersede the preservation and holding time requirements in the approved metals methods.

²⁰To achieve the 28-day holding time, use the ammonium sulfate buffer solution specified in EPA Method 218.6. The allowance in this footnote supersedes preservation and holding time requirements in the approved hexavalent chromium methods, unless this supersession would compromise the measurement, in which case requirements in the method must be followed.

Table FS 1000-4

40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*

Applicable to all Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

²¹Holding time is calculated from time of sample collection to elution for samples shipped to the laboratory in bulk and calculated from the time of sample filtration to elution for samples filtered in the field.

²²Sample analysis should begin as soon as possible after receipt; sample incubation must be started no later than 8 hours from time of collection.

²³For fecal coliform samples for sewage sludge (biosolids) only, the holding time is extended to 24 hours for the following sample types using either EPA Method 1680 (LTB-EC) or 1681 (A-1): Class A composted, Class B aerobically digested, and Class B anaerobically digested.

²⁴The immediate filtration requirement in orthophosphate measurement is to assess the dissolved or bio-available form of orthophosphorus (*i.e.*, that which passes through a 0.45-micron filter), hence the requirement to filter the sample immediately upon collection (*i.e.*, within 15 minutes of collection).

Table FS 1000-5
Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times
• **For Analytes not Found in 40 CFR 136***

Analyte	Methods	Reference ¹	Container ²	Preservation ³	Maximum Holding Time ⁴
Bromine	DPD Colorimetric ⁵	SM 4500-Cl-G	P, G	None required	Analyze immediately
Bromates	Ion Chromatography	EPA 300.0 ⁶	P, G	Cool 4°C	30 days
Chlorophylls	Spectrophotometric	SM 10200 H	P, G ⁷	Dark 4°C Filtered, dark, -20°C	48 hours chilled until filtration ⁸ , and analyze immediately or 48 hours chilled until filtration ⁸ , and 28 days (frozen) after filtration
Corrosivity	Calculated (CaCO ₃ Stability, Langelier Index)	SM 2330 ASTM D513-92	P, G	Cool 4°C ⁹	7 days ⁹
Cyanotoxin ¹⁶	ELISA and LC/MSMS		G ⁷	Cool 6°C	7 days until extraction, 40 days after extraction
FL-PRO	Gas Chromatography	DEP (11/1/95) ¹⁸	G, PTFE lined cap only	Cool 4°C, H ₂ SO ₄ or HCl to pH<2	7 days until extraction, 40 days after extraction
Odor	Human Panel	SM 2150	G only	Cool 4°C	6 hours
Salinity	Electrometric ¹⁰ Hydrometric ¹⁰	SM 2520 B SM 2520 C	G, wax seal	Analyze immediately or use wax seal	30 days ¹⁰
Taste	Human Panel	SM 2160 B, C, D ASTM E679-91	G only	Cool 4°C	24 hours
Total Dissolved Gases	Direct-sensing Membrane-diffusion	SM 2810	-	-	Analyze in-situ
Total Petroleum Hydrocarbons	Gravimetry	EPA 1664 ¹⁷	G only	Cool 4°C, H ₂ SO ₄ or HCl to pH<2	28 days
Transparency	Irradiometric ¹¹	62-302.200(6), FAC	-	-	Analyze in-situ
Un-ionized Ammonia	Calculated ¹²	DEP-SOP ¹³	P, G	Cool 4°C Na ₂ S ₂ O ₃ ¹²	8 hours unpreserved 28 days preserved ¹²
Organic Pesticides ¹⁴	GC and HPLC	EPA (600-series) ¹⁴	¹⁵	¹⁵	¹⁵ ¹⁶

*40 CFR, Ch. I, Part 136.3, *Identification of Test Procedures*. Reference provided for informational purposes only.

Table FS 1000-5
Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times
• For Analytes not Found in 40 CFR 136*

¹ SM XXXX = procedures from "Standard Methods for the Examination of Water and Wastewater"; see Standard Methods Online (<http://www.standardmethods.org/store/>). Reference methods are listed for informational purposes only.

ASTM XXXX-YY = procedure from "Annual Book of ASTM Standards", Water and Environmental Technology, Volumes 11.01 and 11.02 (Water I and II). See American Society for Testing and Materials (ASTM International), <http://www.astm.org/Standard/index.shtml>. Reference methods are listed for informational purposes only.

² P = plastic, G = glass, FP= fluoropolymer.

³ When specified, sample preservation should be performed immediately upon sample collection.

⁴ The times listed are the maximum times that samples may be held before analysis and still be considered valid.

⁵ The approved procedure is for residual chlorine. However, in the absence of chlorine, the DPD colorimetric procedure can be adapted to measure bromine content of the sample. In such case, the validity of this assumption must be verified by using another procedure for chlorine which is not affected by the presence of bromine (i.e., negligible interference).

⁶ "The Determination of Inorganic Anions in Water by Ion Chromatography", EPA Method 300.0, Revision 2.1, Revised August 1993, by John D. Pfaff, U. S. EPA Cincinnati, Ohio 45268. Reference methods are listed for informational purposes only.

⁷ Collect samples in opaque bottles and process under reduced light. A secondary device, such as a Van Dorn/Niskin or bucket, may be used to collect the sample and then expeditiously transfer into an opaque bottle.

⁸ Samples must be filtered within 48 hours of collection. Add magnesium carbonate to the filter while the last of the sample passes through the filter.

⁹ Temperature and pH must be measured on site at the time of sample collection. 7 days is the maximum time for laboratory analysis of total alkalinity, calcium ion and total solids.

¹⁰ The electrometric and hydrometric analytical methods are suited for field use. The argentometric method is suited for laboratory use. Samples collected for laboratory analysis, when properly sealed with paraffin waxed stopper, may be held indefinitely. The maximum holding time of 30 days is recommended as a practical regulatory limit.

¹¹ Transparency in surface waters is defined as a compensation point for photosynthetic activity, i.e., the depth at which one percent of the light intensity entering at the water surface remains unabsorbed. The DEP Chapter 62-302, FAC requires that the light intensities at the surface and subsurface be measured simultaneously by irradiance meters such as the Kahlsico Underwater Irradiometer, Model No. 268 WA 310, or an equivalent device having a comparable spectral response.

¹² The results of the measurements of pH, temperature, salinity (if applicable) and the ammonium ion concentration in the sample are used to calculate the concentration of ammonia in the unionized state. Temperature, pH and salinity must be measured on-site at the time of sample collection. Laboratory analysis of the ammonium ion concentration should be conducted within eight hours of sample collection. If prompt analysis of ammonia is impossible, preserve samples with H₂SO₄ to pH between 1.5 and 2. Acid-preserved samples, stored at 4°C, may be held up to 28 days for ammonia determination. Sodium thiosulfate should only be used if fresh samples contain residual chlorine.

¹³ Calculation of Un-ionized Ammonia in Fresh Water, Chemistry Laboratory Methods Manual, Florida Department of Environmental Protection, Revision 2, 2/12/2001. The document is available from the DEP Standards & Assessment Section. Reference method listed for informational purposes only.

¹⁴ Other pesticides listed in approved EPA methods (608.1, 608.2, 614, 614.1, 615, 617, 618, 619, 622, 622.1, 627, 629, 631, 632, 632.1, 633, 642, 643, 644 and 645) that are not included in Table ID of 40 CFR Part 136.3 (7-1-13 Edition). Reference methods and CFR citation listed for informational purposes only.

Table FS 1000-5
Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times
• For Analytes not Found in 40 CFR 136*

¹⁵ Container, preservation and holding time as specified in each individual method must be followed.

¹⁶ Sample preservation procedures, container material and maximum allowable holding times for analytes not specified in DEP-SOP-001/01 (January 2017) shall follow the preservation, container and holding time requirements specified in the selected analytical method. If no method-specified requirements exist, the best available scientific knowledge shall be used as guidance for determining the appropriate procedures for use, per 62-160.400(2), F.A.C.

¹⁷ Method 1664, n-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated n-Hexane Extractable Material (SGT-HEM; Non-polar Material) by Extraction and Gravimetry. Revision A, February 1999. EPA-821-R-98-002, and, Revision B, February 2010. EPA-821-R-10-001. Reference methods listed for informational purposes only.

¹⁸ FL-PRO - Method for Determination of Petroleum Range Organics, Revision 1, November 1, 1995, Florida Department of Environmental Protection

Table FS 1000-6
Recommended Sample Containers, Sample Volumes, Preservation Techniques and Holding Times for Residuals, Soil and Sediment Samples

Analyte	Methods	References*	Container	Preservation	Maximum Holding Times
Volatile Organics	Purge-and-Trap GC and GC-MS	8015, 8260, 8021, 5035	See Table 1000-7	See Table 1000-7	See Table 1000-7
Semivolatile Organics	GC, HPLC, and GC-MS	8041, 8061, 8070, 8081, 8082, 8091, 8111, 8121, 8131, 8141, 8151, 8270, 8275, 8280, 8290, 8310, 8315, 8316, 8318, 8321, 8325, 8330, 8331, 8332, 8410, 8430, 8440, FL-PRO, MADEP, TPHWG	Glass, 8 oz widemouth with Teflon® -Lined lid	Cool $\leq 6^{\circ}\text{C}^1$	14 days until extraction, 40 days after extraction
Dioxins	-	8290	Amber Glass, 8 oz widemouth with Teflon® -Lined lid	Cool $\leq 6^{\circ}\text{C}^1$ in dark	30 days until extraction, 45 days after extraction
Total Metals-except mercury and chromium VI methods	Flame AA, Furnace AA, Hydride and ICP	All 7000-series (except 7195, 7196, 7197, 7198, 7470 and 7471), 6010 (ICP) and 6020 (ICP)	Glass or plastic 8 oz widemouth (200 grams sample)	None	6 months
Chromium VI	Colorimetric, Chelation with Flame AA - (200 gram sample)	7196 and 7197 (prep 3060)	Glass or plastic, 8 oz widemouth (200 gram sample)	Cool $\leq 6^{\circ}\text{C}^1$	1 month until extraction, 4 days after extraction ²
Mercury	Manual Cold Vapor AA	7471	Glass or plastic 8 oz widemouth (200 grams sample)	Cool $\leq 6^{\circ}\text{C}^1$	28 days
Microbiology (MPN)	-	MPN	Sterile glass or plastic	Cool $\leq 6^{\circ}\text{C}^1$	24 hours
Aggregate Properties	-	-	Glass or plastic	Cool $\leq 6^{\circ}\text{C}^1$	14 days
Inorganic nonmetallics all except:	-	-	Glass or plastic	Cool $\leq 6^{\circ}\text{C}^1$	28 days
Cyanide	-	-	Glass or plastic	Cool $\leq 6^{\circ}\text{C}^1$	14 days

Table FS 1000-6
Recommended Sample Containers, Sample Volumes, Preservation Techniques and Holding Times for Residuals, Soil and Sediment Samples

Analyte	Methods	References*	Container	Preservation	Maximum Holding Times
Sulfite, Nitrate, Nitrite, & o-phosphate	-	-	Glass or plastic	Cool $\leq 6^{\circ}\text{C}^1$	48 hours
Elemental Phosphorus	-	-	Glass or plastic	Cool $\leq 6^{\circ}\text{C}^1$	48 hours

The term "residuals" include: (1) sludges of domestic origin having no specific requirements in Tables FS-1000-4 or FS-1000-9; (2) sludges of industrial origin; and (3) concentrated waste samples.

¹ Keep soils, sediments and sludges cool at $\leq 6^{\circ}\text{C}$ from collection time until analysis. No preservation is required for concentrated waste samples.

² Storage Temperature is 4°C , $\pm 2^{\circ}\text{C}$

* Reference method numbers are listed for informational purposes only and are found in SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (<http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm>), except for the additional informational method sources listed below:

FL-PRO - Method for Determination of Petroleum Range Organics, Revision 1, November 1, 1995, Florida Department of Environmental Protection

MADEP – Method for the Determination of Extractable Petroleum Hydrocarbons (EPH), Revision 1.1, May 2004, Massachusetts Department of Environmental Protection

MPN – Microbiological test methods utilizing Most Probable Number procedures

TPHWG - TPH Working Group Series

Table FS 1000-7

Sample Handling, Preservation and Holding Time Table for SW 846 Method 5035A*

Conc. Level	Sampling Device*	Collection Procedure*	Sample Container Type*	Sample Container or Vial Preparation*	Preservation*	Sample Preparation*	Max HT ^{1,6*}	Determinative Procedure ^{2*}
≤200 ug/kg	VOC Sample Coring Device	5035A - Section 8.2.1	Glass Vial w/ PTFE-silicone Septum	5035A - Section 8.1.1	NaHSO ₄ / 4±2°C ⁴ (see 5035A - 8.4.3)	5035A - Section 11.2.3	14 D	Any recognized VOC Method (see 5035A – Section 11.2)
≤200 ug/kg	VOC Sample Coring Device	5035A - Section 8.2.1	Glass Vial w/ PTFE-silicone Septum	5035A - Section 8.1.1 ³ (See Appendix A, Section A.8.2.4)	4±2°C ⁴	5035A - Section 11.2.3	48 H	Any recognized VOC Method (see 5035A – Section 11.2)
≤200 ug/kg	VOC Sample Coring Device	5035A - Section 8.2.1	Glass Vial w/ PTFE-silicone Septum	5035A - Section 8.1.1 ³	4±2°C (Reagent Water) / < -7°C ^{4,5}	5035A - Section 11.2.3	48 H / 14 D ⁶	Any recognized VOC Method (see 5035A – Section 11.2)
≤200 ug/kg	EnCore or equivalent	5035A - Section 8.2.1	EnCore or equivalent	5035A – Section 8.1.1 ^{3, 7, 8}	4±2°C ⁴	5035A - Section 11.2.3	48 H	Any recognized VOC Method (see 5035A – Section 11.2)
≤200 ug/kg	EnCore or equivalent	5035A - Section 8.2.1	EnCore or equivalent	5035A – Section 8.1.1 ^{7, 8}	NaHSO ₄ / 4±2°C ⁴ (see 5035A, 8.4.3)	5035A - Section 11.2.3 ⁶	48 H / 14 D ^{4,6}	Any recognized VOC Method (see 5035A – Section 11.2)
≤200 ug/kg	EnCore or equivalent	5035A - Section 8.2.1	EnCore or equivalent	5035A – Section 8.1.1 ^{3,7,8}	4±2°C / < -7°C ⁴	5035A - Section 11.2.3 ⁶	48 H / 14 D ⁴	Any recognized VOC Method (see 5035A – Section 11.2)
>200 ug/kg	EnCore or equivalent	5035A - Section 8.2.2. ⁷ ;	EnCore or equivalent	5035A – Section 8.1.2 & 8.1.3 ^{7, 8} ;	4±2°C / Methanol ¹⁰ or < -7°C	5035A - Section 11.3 ⁶	48 H / 14 D ⁶	Any recognized VOC Method (see 5035A – Section 11.2)
>200 ug/kg ⁹	VOC Sample Coring Device	5035A - Section 8.2.2. ¹⁰	Glass Vial w/ PTFE-silicone Septum	5035A – Section 8.1.2 & 8.1.3 ¹⁰	4±2°C / Methanol ¹⁰ or < -7°C	5035A - Section 11.3	48 H / 14 D ⁶	Any recognized VOC Method (see 5035A – Section 11.2)
>200 ug/kg ⁹	Conventional Devices (e.g. bulk corer, spatula or spoon)	DEP SOP FS 3000 - Section 5.	Glass w/ PTFE-silicone Septum	5035A – Section 8.1.2	4±2°C	5035A - Section 11.3	14 D ⁶	Any recognized VOC Method (see 5035A – Section 11.2)
Oily Waste	Conventional Devices (e.g. bulk corer, spatula or spoon; waste samplers)	5035A - Section 8.2.4.	Glass w/ PTFE-silicone Septum	5035A - Section 8.1.4	4±2°C	5035A - Sections 11.4	14 D ⁶	Any recognized VOC Method (see 5035A – Section 11.4)

Table FS 1000-7

Sample Handling, Preservation and Holding Time Table for SW 846 Method 5035A*

Conc. Level	Sampling Device*	Collection Procedure*	Sample Container Type*	Sample Container or Vial Preparation*	Preservation*	Sample Preparation*	Max HT ^{1,6*}	Determinative Procedure ^{2*}
Oily Waste	Conventional Devices (e.g. bulk corer, spatula or spoon; waste samplers)	5035A - Section 8.2.4.	Glass w/ PTFE-silicone Septum	5035A - Section 8.1.4	Methanol/PEG + 4±2°C ¹⁰	5035A - Section 11.4	14 D ⁶	Any recognized VOC Method (see 5035A – Section 11.4)
Dry Weight	Conventional Devices (e.g. bulk corer, spatula or spoon)	5035A - Sections 8.2.1.6 & 8.2.2.7	Glass with Teflon liner	5035A – 6.4.1.1	4±2°C	5035A - Section 11.5	Not applicable	5035A - Section 11.5
Soil Screen	Conventional Devices (e.g. bulk corer, spatula or spoon)	5035A - Sections 8.2.1.6, 8.2.3	Glass w/ PTFE-silicone Septum	5035A – 6.4.1.1	4±2°C	5035A - Section 11.1	14 D ^{4,6}	5035A - Section 11.1

¹ Maximum holding time allowable from time/date of collection to sample analysis. H=Hours, D=Days

² See 62-160.320, F.A.C., Approved Laboratory Methods

³ Eliminate 8.1.1.2; use only organic-free water (when applicable).

⁴ Samples in glass vials must be frozen onsite or transported at 4±2°C, analyzed within 48 hours if not frozen, or frozen at the laboratory within 48 hours, stored at < -7°C. Organic-free reagent water may be added to the sample vial before sample collection or upon receipt at the laboratory before freezing within 48 hours. Samples in Encore or equivalent devices must be transported at 4±2°C, analyzed within 48 hours if not frozen, or extruded into glass vials at the laboratory and frozen within 48 hours at < -7°C. Do not freeze at less than -20°C. Frozen samples stored in Encore or equivalent devices may only be held for 48 hours. Frozen samples in glass vials may be held up to 14 days from the day of sample collection. Samples collected in or transferred to glass vials preserved with NaHSO₄/organic-free reagent water solution may be held up to 14 days from the day of sample collection without freezing, and is only recommended for aromatic VOCs, such as benzene, ethylbenzene, toluene and xylenes ("BTEX"). Additional bisulfate solution may be needed for alkaline soils. Do not preserve carbonate soils with the bisulfate/water solution, or when reactive compounds in the sample are suspected, such as 2-chloroethyl vinyl ether, which may be lost in acidic conditions. The sodium chloride matrix modifying reagent of Method 5021 was found to be as effective as NaHSO₄ for inhibiting biodegradation of aromatic hydrocarbons in soil and may be more advantageous to use with calcareous soils. NOTE: Biologically active soils may require immediate chemical preservation or freezing to reduce the loss of aromatic VOCs.

⁵ In order to ensure that vials do not break during freezing, store vials horizontally (on the side) or at a slanted angle to maximize surface area.

⁶ Maximum allowable time at 4±2°C is 48 hours; when applicable, maximum allowable time to sample analysis is 14 days (from time of sample collection) if sample in glass vial is preserved with methanol or frozen with 48 hours of sample collection. Methanolic extracts of samples may be stored up to 14 days at 4±2°C.

⁷ Conducted in the laboratory.

⁸ Entire contents of sampling device are extruded into the sample analysis vial containing the appropriate solvent (when applicable).

⁹ Procedures are limited only to those situations or programs in which the maximum contamination level does not exceed 200 ug/kg.

Table FS 1000-7

Sample Handling, Preservation and Holding Time Table for SW 846 Method 5035A*

¹⁰ Methanolic preservation in the field is not recommended, but may be used if approved by DEP for a project. Do not preserve oily waste samples of unknown solubility with methanol or PEG. The sample may be transported in ice at 4±2°C and preserved with methanol upon receipt at the laboratory within 48 hours to allow the 14-day holding time. Samples in Encore or equivalent coring devices must be extruded into glass vials to preserve with methanol upon laboratory receipt. Samples must be analyzed within 48 hours if not preserved with methanol. NOTE: Biologically active soils may require immediate chemical preservation or freezing to reduce the loss of aromatic VOCs, such as benzene, ethylbenzene, toluene and xylenes.

*See additional information in method 5035A, July 2002 (including information in Appendix A), in SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (<https://www.epa.gov/hw-sw846/validated-test-methods-recommended-waste-testing>) and DEP SOP FS 3000, Soil, in DEP-SOP-001/01, January 2017.

FS 1000-8
Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II

Analyte or EPA or Standard Method Number*	Preservation ¹	Holding Time ²	Holding Time for Extract ³	Container ⁴
MICROBIOLOGICAL-BACTERIA	Cool < 10°C, Na ₂ S ₂ O ₃ ⁵	-	-	P or G
Total Coliforms, fecal coliforms & <i>E. coli</i> in drinking water	Cool < 10°C ⁶ , Na ₂ S ₂ O ₃ ⁵	30 Hours ⁷	-	P or G
Total coliforms and fecal coliforms in source water Heterotrophic bacteria in drinking water	Cool < 10°C, Na ₂ S ₂ O ₃ ⁵	8 hours	-	P or G
Gross Alpha	Conc. HCl or HNO ₃ to pH <2 ^{8,9}	6 mo	-	P or G
Gross beta	Conc. HCl or HNO to pH <2 ^{8,9}	6 mo	-	P or G
Strontium-89	Conc. HCl or HNO to pH <2 ^{8,9}	6 mo	-	P or G
Strontium-90	Conc. HCl or HNO to pH <2 ^{8,9}	6 mo	-	P or G
Radium-226	Conc. HCl or HNO to pH <2 ^{8,9}	6 mo	-	P or G
Radium-228	Conc. HCl or HNO to pH <2 ^{8,9}	6 mo	-	P or G
Cesium-134	Concentrated HCl to pH <<2 ^{8,9}	6 mo	-	P or G
Iodine-131	None	8 days	-	P or G
Tritium	None	6 months	-	G
Uranium	Conc. HCl or HNO ₃ to pH <2 ^{8,9}	6 mo	-	P or G
Photon emitters	Conc. HCl or HNO ₃ to pH <2 ^{8,9}	6 mo	-	P or G
Asbestos	Cool 4°C	48 hours	-	P or G
Bromate	Ethylenediamine (50mg/L)	28 days	-	P or G
Cyanide	Ascorbic acid (if chlorinated) then, NaOH pH>12, Cool, 4°C,	14 days	-	P or G
Nitrate	Cool, 4°C	48 hours	-	P or G
Nitrate (chlorinated source)	Cool, 4°C	14 days	-	P or G
Odor	Cool 4°C	24 hours	-	G

FS 1000-8

Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II

Analyte or EPA or Standard Method Number*	Preservation ¹	Holding Time ²	Holding Time for Extract ³	Container ⁴
Method 502.2 Volatile Organic Compounds	Sodium Thiosulfate or Ascorbic Acid, then HCl pH<2, Cool 4°C	14 days	-	Glass with PFTE Lined Septum
EPA Method 504.1 1,2-Dibromoethane (EDB), 1,2-Dibromo-3-Chloro-Propane (DBCP), and 1,2,3-Trichloropropane (123TCP)	Sodium Thiosulfate Cool, 4°C,	14 days	4°C, 24 hours	Glass with PFTE-Lined Septum
EPA Method 505 Organohalide Pesticides and Commercial Polychlorinated Biphenyl (PCB)	Sodium Thiosulfate Cool, 4°C	14 days (7 days for Heptachlor)	4°C, 24 hours	Glass with PFTE-Lined Septum
EPA Method 506 Phthalate and Adipate Esters	Sodium Thiosulfate Cool, 4°C, Dark	14 days	4°C, dark, 14 days	Amber Glass with PFTE-lined Cap
EPA Method 507 Nitrogen- and Phosphorus-Containing Pesticides	Sodium Thiosulfate Cool, 4°C, Dark	14 days (see method for exceptions)	4°C, dark, 14 days	Amber Glass with PFTE-lined Cap
EPA Method 508 Chlorinated Pesticides	Sodium Thiosulfate Cool, 4°C, Dark	7 days (see method for exceptions)	4°C, dark, 14 days	Glass with PFTE-lined Cap
EPA Method 508A Polychlorinated Biphenyls	Cool, 4°C	14 days	30 days	Glass with PFTE-lined Cap
EPA Method 508.1 Chlorinated Pesticides, Herbicides, and Organohalides	Sodium Sulfite then HCl pH<2, Cool, 4°C	14 days (see method for exceptions)	30 days	Glass with PFTE-lined Cap
EPA Method 515.1 Chlorinated Acids	Sodium Thiosulfate Cool, 4°C, Dark	14 days	4°C, dark, 28 days	Amber Glass with PFTE-lined Cap
EPA Method 515.2 Chlorinated Acids	Sodium Thiosulfate HCl pH<2, Cool, 4°C, Dark	14 days	≤ 4°C, dark, 14 days	Amber Glass with PFTE-lined Cap
EPA Method 515.3 Chlorinated Acids	Sodium Thiosulfate HCl pH<2, Cool, 4°C, Dark	14 days	≤ 4°C, dark, 14 days	Amber Glass with PFTE-lined Cap
EPA Method 515.4 Chlorinated Acids	Sodium Sulfite, HCl pH<2, Cool, ≤10°C for first 48 hours ≤6°C thereafter, Dark	14 days	≤0°C, 21 days	-
EPA Method 524.2 Purgeable Organic Compounds	Ascorbic Acid, HCl pH<2, Cool 4°C	14 days	-	Glass with PFTE-lined Septum
EPA Method 525.2 Organic Compounds	Sodium Sulfite, then HCl pH<2 Dark, Cool, 4°C,	14 days (see method for exceptions)	≤ 4°C, 30 days from collection	Amber Glass with PFTE-lined Cap

FS 1000-8

Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II

Analyte or EPA or Standard Method Number*	Preservation ¹	Holding Time ²	Holding Time for Extract ³	Container ⁴
EPA Method 531.1 N-Methylcarbamoyloximes and N-Methylcarbamates, and Method Standard Method 6610 Carbamate Pesticides	Sodium Thiosulfate Monochloroacetic acid, pH<3, Cool, 4°C	Cool 4°C, 28 days	-	Glass with PFTE-lined Septum
EPA Method 531.2 N-Methylcarbamoyloximes and N-Methylcarbamates	Sodium Thiosulfate then Potassium Dihydrogen Citrate buffer to pH 4, dark, ≤10°C for first 48 hr, ≤6°C thereafter	28 days	-	-
EPA Method 547 Glyphosate	Sodium Thiosulfate Cool, 4°C	14 days (18 mo. frozen)	-	Glass with PFTE-lined Septum
EPA Method 548.1 Diquat and Paraquat	Sodium Thiosulfate (then HCl pH 1.5-2 if high biological activity), Cool, 4°C, Dark	7 days	≤4°C 14 days	Amber Glass with PFTE-lined Septum
EPA Method 549.2 Diquat and Paraquat	Sodium Thiosulfate (H ₂ SO ₄ pH<2 if biologically active), Cool, 4°C, Dark	7 days	21 days	High Density Amber Plastic or Silanized Amber Glass
EPA Methods 550 and 550.1 Polycyclic Aromatic Hydrocarbons	Sodium Thiosulfate Cool, 4°C, HCl pH<2	7 days	550, 30 days 550.1, 40 days Dark, 4°C	Amber Glass with PFTE-lined Cap
EPA Method 551.1 Chlorination Disinfection Byproducts, Chlorinated Solvents, and Halogenated Pesticides/Herbicides	Sodium Thiosulfate, Sodium Sulfite, Ammonium Chloride, pH 4.5-5.0 with phosphate buffer, Cool, 4°C	14 days	-	Glass with PFTE-lined Septum
EPA Method 552.1 Haloacetic Acids and Dalapon	Ammonium chloride, Cool, 4°C, Dark	14 days	≤4°C, dark 48 hours	Amber Glass with PFTE-lined cap
EPA Method 552.2 Haloacetic Acids and Dalapon	Ammonium chloride, Cool, 4°C, Dark	14 days	≤4°C, dark 7 days ≤-10°C 14 days	Amber Glass with PFTE-lined cap
EPA Method 555 Chlorinated Acids	Sodium Sulfite, HCl, pH ≤ 2, Dark, Cool 4°C	14 days	-	Glass with PFTE-lined cap
EPA Method 1613B Dioxins, tetra- thru octa- (CDDs) & Furans (CDFs)	Sodium Thiosulfate, Cool, 0-4°C, Dark	-	Recommend 40 days	Amber Glass with PFTE-lined Cap

FS 1000-8

Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II

¹ Preservation, when required, must be done immediately upon sample collection.

² Stated values are the maximum regulatory holding times. Sample processing must begin by the stated time.

³ Stated time is the maximum time a prepared sample extract may be held before analysis.

⁴ (P) polyethylene or (G) or glass. For microbiology, plastic sample containers must be made of sterilizable materials (poly-propylene or other autoclavable plastic).

⁵ Addition of sodium thiosulfate is only required if the sample has a detectable amount of residual chlorine, as indicated by a field test using EPA Method 330.4 or 330.2 or equivalent.

⁶ Temperature requirement applies only to source water samples, however once received by the laboratory, if sample processing does not begin on the same working day, samples must be refrigerated.

⁷ If samples are analyzed after 30 hours, but within 48 hours of collection, the laboratory is to indicate in the analytical report that the data may be invalid because of excessive delay in sample processing. No samples received after 48 hours are to be accepted or analyzed for compliance with the regulations of the Department of Environmental Protection or the Department of Health.

⁸ It is recommended that the preservative be added at the time of collection unless suspended solids activity is to be measured. It is also recommended that samples be filtered, if suspended or settleable solids are present, prior to adding preservative, at the time of collection. However, if the sample has to be shipped to a laboratory or storage area, acidification of the sample (in its original container) may be delayed for a period not to exceed 5 days. A minimum of 16 hours must elapse between acidification and analysis.

⁹ If HCl is used to acidify samples, which are to be analyzed for gross alpha or gross beta activities, the acid salts must be converted to nitrate salts before transfer of the samples to planchets.

*EPA or Standard Method numbers are provided as informational references only.

Table FS 1000-9
Containers, Preservation and Holding Times for Biosolids Samples and Protozoans

<i>ANALYTE NAME</i>	<i>CONTAINER</i>	<i>PRESERVATION</i>	<i>MAX HOLDING TIME</i>
Fecal Coliform	Plastic or Glass	Cool 4°C	24 hours
Salmonella	Plastic or Glass	< 10°C	24 hours
Enteric Viruses	Plastic or Glass	Up to 25°C	2 hours
Enteric Viruses	Plastic or Glass	2 to 10°C	48 hours
Specific Oxygen Uptake Rate	Plastic or Glass	None	As Soon As Possible
Helminth OVA	Plastic or Glass	< 4°C (Do not Freeze)	24 hours
Cryptosporidium/Giardia	Plastic or Glass	0 - 10°C (Do not Freeze)*	96 Hours
Total Solids	Plastic or Glass	≤6°C (Do not Freeze)	7 days
Metallics	Plastic or Glass	**	**
Other Inorganic Pollutants	Plastic or Glass	**	**

***Dechlorinate bulk samples when applicable**

****See Tables FS 1000-4, FS 1000-5, and FS 1000-6**

Table FS 1000-10
Container Materials, Preservation, and Holding Times for Fish and Shellfish

Analyte	Matrix	Sample Container	Field Preservation	Maximum Shipping Time (Transport to Lab)	Laboratory Storage	Laboratory Holding Time
--	Whole Organism (Fish, shellfish, etc.	Foil-wrap each organism (or composite for shellfish) and transport in waterproof plastic bag	Cool in wet ice or Freeze on dry ice	24 hours or 48 hours	-	-
Mercury	Tissue (fillets and edible portions, homogenates)	Plastic, borosilicate glass, quartz, PTFE	Cool in wet ice or Freeze on dry ice	24 hours or 48 hours	Freeze at <-20°C	1 year
Other metals	Tissue (fillets and edible portions, homogenates)	Plastic, borosilicate glass, quartz, PTFE	Cool in wet ice or Freeze on dry ice	24 hours or 48 hours	Freeze at <-20°C	6 months
Organics	Tissue (fillets and edible portions, homogenates)	Borosilicate glass, PTFE, quartz, aluminum foil	Cool in wet ice or Freeze on dry ice	24 hours or 48 hours	Freeze at <-20°C	1 year
Dioxin	Tissue (fillets and edible portions, homogenates)	Amber containers: Borosilicate glass, PTFE, quartz, aluminum foil	Cool in wet ice or Freeze on dry ice	24 hours or 48 hours	Freeze at <-20°C	30 days until extraction, 15 days after extraction
Lipids	Tissue (fillets and edible portions, homogenates)	Plastic, borosilicate glass, quartz, PTFE	Cool in wet ice or Freeze on dry ice	24 hours or 48 hours	Freeze at <-20°C	1 year

PTFE = Polytetrafluoroethylene (Teflon)

Table FS 1000-11
Holding Times for SPLP or TCLP Extraction, Sample Preparation and Determinative Analysis

Analyte	From: Field Collection To: SPLP or TCLP Extraction	From: SPLP or TCLP Extraction To: Preparative Extraction	From: Preparative Extraction To: Determinative Analysis	Total Elapsed Time
Volatiles	14	NA	7/14*	21/28*
Semi-Volatiles	14	7	40	61
Mercury	28	NA	28	56
Metals, except Mercury	180	NA	180	360

Holding Time in days.

NA – Not Applicable

*longer holding time if sample extract is adjusted to a pH of 2

Table FS 1000-12
Preventive Maintenance Tasks

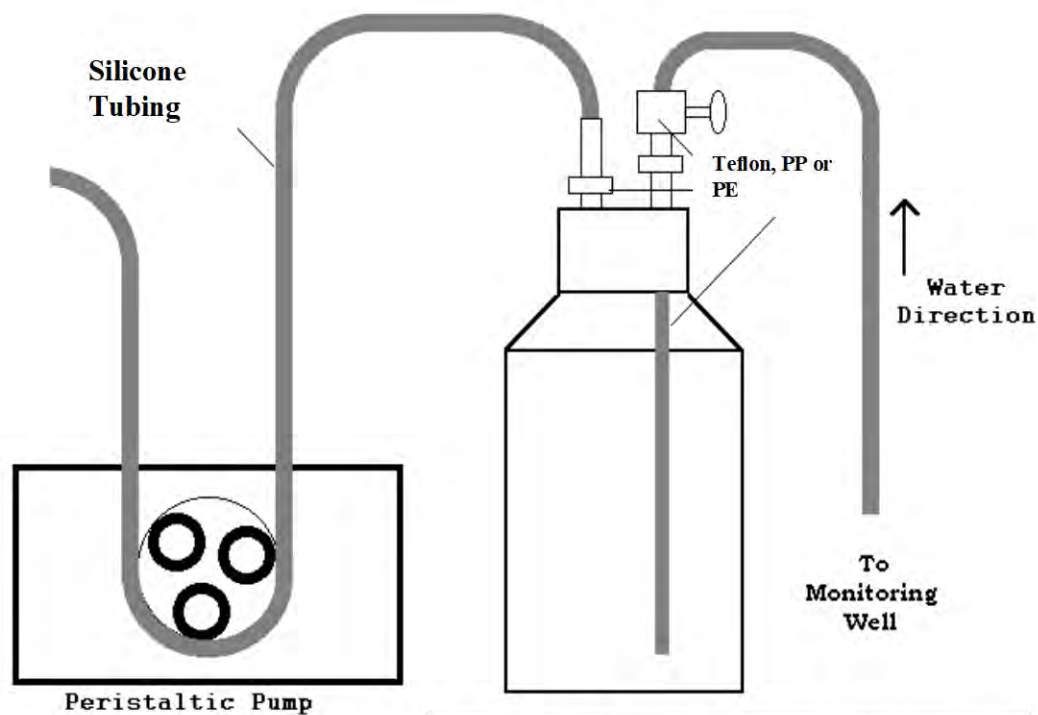
Instrument	Activity	Frequency
Refrigerators, Incubators, Ovens	Clean interior	Monthly
Refrigerators, Incubators, Ovens	Check thermometer temperature against certified thermometer or equivalent	Annually
Analytical Balances	Clean pan and compartment	Daily ¹
Analytical Balances	Check with Class S weights	Monthly
Analytical Balances	Manufacturer cleaning and calibration	Annually
pH and Ion Selective Electrodes – Probe	Check probe for cracks and proper levels of filling solution; check reference junction; clean electrode	Daily, Replace as necessary
pH and Ion Selective Electrodes – Probe	Check response time	Daily ¹
pH and Ion Selective Electrodes – Meter	Check batteries and electronics for loose connections and cracked leads	Daily ¹ , Replace as necessary
Turbidimeter	Clean instrument housing	Monthly
Turbidimeter	Clean cells	Daily ¹
Conductivity Meter	Check batteries and probe cables	Daily ¹
Conductivity Meter	Replatinize probe	Per manufacturer's recommendations
Dissolved Oxygen Meters – Probe	Check membrane for deterioration; check filling solution	Daily ¹ , Replace as necessary
Dissolved Oxygen Meters – Meter	Battery level and electronics checked	Daily ¹ , Replace as necessary
Thermometers	Check for cracks and gaps in the mercury	Daily ¹ , Replace as necessary
Temperature Probe	Check connections, cables	Daily ¹
Temperature Probe	Check against calibrated thermometer	Daily ¹
Automatic Sample Collection Systems (e.g., ISCO, Sigma)	Check sampler operation (forward, reverse, automatic through three cycles of the purge-pump-purge cycle)	Daily ¹ , Prior to Sampling Event

DEP-SOP-001/01
FS 1000 General Sampling Procedures

Instrument	Activity	Frequency
Automatic Sample Collection Systems (e.g., ISCO, Sigma)	Check purge-pump-purge cycle when sampler is installed	Daily ¹ , Prior to Sampling Event
Automatic Sample Collection Systems (e.g., ISCO, Sigma)	Check the flow pacer that activates the sampler to assure proper operation	Daily ¹ , Prior to Sampling Event
Automatic Sample Collection Systems (e.g., ISCO, Sigma)	Check desiccant	Daily ¹ , Replace as Necessary
Automatic Sample Collection Systems (e.g., ISCO, Sigma)	Check batteries	Daily ¹ , Replace as Necessary
Automatic Sample Collection Systems (e.g., ISCO, Sigma)	Check pumping rate against manufacturer's specifications	Daily ¹ , Replace as Necessary

¹Daily is defined as prior to use or a 12-hour period if equipment is run continuously.

Figure FS 1000-1
Organic Trap Configuration for Collecting Extractable Organics with a Peristaltic Pump



The glass sample bottle must be threaded to use a reusable sampling cap lined and installed with fittings made of Teflon, polypropylene or polyethylene, similar to the design shown.

FS 2000. GENERAL AQUEOUS SAMPLING

See also the following Standard Operating Procedures:

- FA 1000 Administrative Procedures
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000-9000 Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FQ 1000 Field Quality Control Requirements

1. COMMON PROCEDURES

The following procedures are applicable to the collection of all water samples.

1.1. Refer to FS 1000 for procedures that are common to all types of sample collection including general preservation and thermal preservation procedures.

1.2. Grab Samples

1.2.1. This is an individual sample collected over a period of time, usually all in one motion, generally not exceeding 15 minutes. The 15-minute time limit applies to aqueous samples only. No time limit applies to the collection of solid samples (e.g., residuals).

1.2.2. Grab samples represent the conditions that exist at the moment the sample is collected and do not necessarily represent conditions at any other time. Grab sampling is the preferred method of sampling under the following conditions:

- A snapshot of the water quality at a particular instant in time is desired.
- The water or wastewater stream is not continuous (e.g., batch discharges or intermittent flow).
- The characteristics of the water or waste stream are known to be constant or nearly so.
- When conditions are relatively constant over the period of discharge. In lieu of complex sampling activities, a grab sample provides a simple and accurate method of establishing waste characteristics.
- The sample is to be analyzed for analytes whose characteristics are likely to change significantly with time (e.g., dissolved gases, microbiological tests, pH).
- The sample is to be collected for analytes such as Oil and Grease, bacteriological tests or other parameters listed in number 3 of this section where the compositing process could significantly affect the actual concentration.
- Data on maximum/minimum concentrations are desired for a continuous water or wastewater stream.
- When identifying and tracking slug loads and spills.

1.2.3. If required, measure the following parameters on grab samples or in-situ.

NOTE: If the permit specifies a composite sample for any of the parameters mentioned below, **FOLLOW THE PERMIT CONDITIONS**

Parameters:

Cyanide

Residual Chlorine

Dissolved constituents in field-filtered samples (ortho-phosphorus, metals, etc.)

Dissolved Oxygen and other dissolved gases

Microbiological Parameters

TRPHs

FL-PRO

Total Phenols

Oil and Grease

pH

Specific Conductance

Un-ionized Ammonia

Volatile Organic Compounds

Temperature

1.3. Composite Samples

1.3.1. A composite sample is a sample collected over time, formed either by continuous sampling or by mixing discrete samples. Composite samples reflect the average characteristics during the compositing period.

1.3.2. Composite samples are used when stipulated in a permit or when:

- The water or wastewater stream is continuous;
- Analytical capabilities are limited;
- Determining average pollutant concentration during the compositing period;
- Calculating mass/unit time loadings; or
- Associating average flow data to parameter concentrations

1.3.3. Composite samples may be collected individually at equal time intervals if the flow rate of the sample stream does not vary more than plus or minus ten percent of the average flow rate or they may be collected proportional to the flow rate. The permit or work plan will specify which composite sample type to use, either time composites or flow proportional composites. The compositing methods, all of which depend on either continuous or periodic sampling, are described in the following discussions.

1.3.3.1. Time Composite Sample: Time composite samples are based on a constant time interval between samples. A time composite sample can be collected manually or with an automatic sampler. This type of composite is composed of discrete sample aliquots collected in one container at constant time intervals. This method provides representative samples when the flow of the sampled wastewater stream is constant. This type of sample is similar to a sequential composite sample described in number 3.3 of this section.

1.3.3.2. Flow Proportional Composite Sample: Flow proportional samples can be collected automatically with an automatic sampler and a compatible pacing flow measuring device, semi-automatically with a flow chart and an automatic sampler capable of collecting discrete samples, or manually. There are two methods used to collect this type of sample:

- Method 1: Collect a constant sample volume per stream flow (e.g., a 200 mL sample collected for every 5,000 gallons of stream flow) at time intervals proportional to stream flow. This method provides

representative samples of all waste streams when the flow is measured accurately.

- Method 2: Collect a sample by increasing the volume of each aliquot as the flow increases, while maintaining a constant time interval between the aliquots (e.g., hourly samples are taken with the sample volume being proportional to the flow at the time the sample is taken).

1.3.3.3. Sequential Composite Sample: Sequential composite samples are composed of discrete samples taken into individual containers at constant time intervals or constant discharge increments. For example, samples collected every 15 minutes are composited for each hour.

- The 24-hour composite is made up from the individual one-hour composites. Each of the 24 individual samples is manually flow-proportioned according to the flow recorded for the hour that the sample represents. Each flow-proportioned sample is then added to the composite samples. The actual compositing of the samples is done by hand and may be done in the field or the laboratory. In most cases, compositing in the field is preferable since only one sample container must be cooled, and then transported to, and handled, in the laboratory. A 24-hour composite is frequently used since an automatic sampler can easily collect the individual samples.
- A variation of the 24-hour composite is to collect a constant volume of sample taken at constant discharge increments, which are measured with a totalizer. For example, one aliquot is collected for every 10,000 gallons of flow
- Sequential sampling is useful to characterize the waste stream because you can determine the variability of the wastewater constituents over a daily period. For example, for pretreatment studies you can visually determine when high strength wastes are being discharged from a facility or when heavy solid loads are being discharged during a 24-hour cycle. You can measure the pH throughout the day. The value of this type of sampling must be weighed against the manpower constraints and sampling goals

1.3.3.4. Continuous Composite Sample: Collected continuously from the stream. The sample may be a constant volume that is similar to the time composite, or the volume may vary in proportion to the flow rate of the waste stream, in which case the sample is similar to the flow proportional composite.

1.3.3.5. Areal Composite: A sample composited from individual grab samples collected on an areal or cross-sectional basis. Areal composites must be made up of equal volumes of grab samples; each grab sample must be collected in an identical manner. Examples include residual samples from grid system points on a land application site, water samples collected at various depths at the same point or from quarter points in a stream, etc. Sample is similar to the flow proportional composite.

1.4. Collection Techniques

1.4.1. When filling a sample container that already contains premeasured preservative, slowly pour the sample down the side of the container so that the preservative does not splatter. If the preservative is concentrated acid, and the sample water is added too quickly, the reaction between the water and the acid can generate enough heat to burn unprotected skin or could splatter and cause acid burning.

1.4.2. Collect grab samples (single, discrete samples) unless directed by permit, program, or approved sampling plan or work plan to collect composite samples.

1.4.3. Except for volatile organic compounds and sulfide, leave ample headspace in the sample bottle to allow for expansion, effervescence and proper mixing at the laboratory.

1.5. Collecting Filtered/Dissolved Samples

1.5.1. Certain studies or projects require collection of dissolved (i.e., filtered) samples. Identify all analytes in samples that are filtered as “dissolved” or “filtered” in field notes or laboratory transmittal forms and on final reports.

1.5.2. If filtered samples are not required by the study or project sampling plan, do not filter samples to removed solids entrained during sample collection. If suspended solids are not representative of the water column, discard the sample and attempt to collect a representative sample.

1.5.3. Collect both filtered and unfiltered samples from the same water in a collection device (e.g., bailer, intermediate container) or consecutively if sampling from a pump.

1.5.4. Collect dissolved metals in groundwater according to the procedures discussed in FS 2225. **Do not** collect filtered samples for metals from groundwater sources unless:

1.5.4.1. The DEP has required or approved the protocol and the DEP program allows the use of the procedure; or

1.5.4.2. The organization is documenting that a filtered groundwater sample is as or more representative of the groundwater quality. In this case, collect **both** unfiltered and filtered samples for analysis. Submit the results of both samples the DEP for review.

1.5.5. Filtration, when performed, must be completed within 15 minutes of sample collection.

1.5.6. Collect dissolved groundwater samples for metals with a one-piece molded construction 1 µm filter unless otherwise specified by a DEP program. Use a 0.45 µm filter when filtering all other constituents **including** metals in surface water.

1.5.7. The filter must be compatible with the analyte to be filtered (e.g., zero carbon content for carbon analysis; non-protein binding filters for nitrogen).

1.5.8. Equipment blanks, when collected, must be processed through the filtration apparatus and analyzed for the analytes of interest.

1.5.9. Filters and filtration equipment are intermediate devices and therefore must be adequately rinsed per FS 2110 section 1.1.2.1.

THE FOLLOWING ARE SPECIAL CONSIDERATIONS FOR VARIOUS ANALYTE GROUPS:

FS 2001. *pH-Preserved Samples*

1. SAMPLE CONTAINERS

1.1. Use properly cleaned sample containers (see FC 1300).

1.2. Inspect all containers for visual defects or contamination. Discard if defects are present or containers do not appear clean.

2. SAMPLE COLLECTION PROCEDURES

2.1. Perform any filtration **before** the sample is poured into the container and **before** the sample is preserved.

2.2. Remove the cap from the sample container, and carefully pour the sample into the container without allowing sampling equipment or hands to touch the rim of the sample container.

2.3. If the preservative is added after the sample is collected, (the container is not prepreserved), do not fill the container to the rim.

3. PRESERVATION

3.1. Preserve the sample within 15 minutes of sample collection or filtration (if applicable) unless collected as a composite sample (see FS 1006, section 3.3) or for analysis of lead and copper for drinking water compliance (see FS 2310, section 2).

3.2. Dechlorination: Some treated water samples (drinking water and treated wastewater) may contain residual chlorine that must be removed with a dechlorination agent such as sodium thiosulfate or ascorbic acid. This process must occur **before** any additional preservatives (e.g., acid) are added.

3.3. Preserve the sample with the chemical specified by the method or preservation tables (Tables FS 1000-4 to FS 1000-10).

3.3.1. The chemical reagents must be pure enough so that the reagent does not contribute contamination or interferences to the analytes of interest.

3.4. Preserve the sample by adding an accurately measured amount of preservative to the container. Premeasured vials of the preservative, or a graduated container or pipet, may be used.

3.4.1. Tightly cap the sample container and gently tip the container two to three times to distribute the chemical.

3.5. The pH of the preserved sample must meet the pH criterion of the applicable preservation tables (see Tables FS 1000-4 to FS 1000-10). **Do not over preserve the sample.** Contact the receiving laboratory if the amount of preservative to add is in question.

3.5.1. Pour an aliquot of the preserved sample into a disposable container (e.g., sampling cup) or onto a piece of **narrow** range pH paper to determine if the pH meets the required level. **Do not put the pH paper directly into the sample container.**

3.5.2. If the pH does not meet the required level, add additional measured amounts of preservative and test with narrow range pH paper (see section 3.4.1 above) until the pH meets the pH requirement.

3.5.3. Record the total amount of preservative that was added to the sample. This documentation is necessary for the next site visit, since additional acid may be needed to adequately preserve the sample on subsequent visits.

3.6. Cooling to less than 6°C in wet ice (see FS 1006, section 5) may be required.

3.7. If required, protect from direct sunlight and store in dark (see tables FS 1000-4, FS 1000-5 and FS 1000-8)

3.8. Preserve all field blanks or equipment blanks with the **greatest** amount of preservative that was required in the associated sample set and note the amount in field documentation. However, do not preserve with excess acid where this may interfere with laboratory analysis of the sample.

3.9. After the sample has been preserved, screw the cap on tightly.

4. Verifying pH-Preserved Samples: Verify the pH of all pH-preserved samples (except volatile organics) in the field (see FS 2001, section 3.4) according to these frequencies:

4.1. During the first sampling event at a particular site, check **all** samples (e.g. each groundwater monitoring well, surface water location, or influent/effluent sampling location) that are pH-adjusted except volatile organics.

4.2. During subsequent visits to a particular site, check **at least one** sample per parameter group that must be pH-adjusted

4.2.1. If samples are routinely collected from the same sample location, a pH check is not required each time samples are collected. If the frequency of sample collection at a specified location is greater than once per month (e.g., weekly or daily), check the pH of **at least one** sample per parameter group according to the following schedule:

4.2.1.1. Weekly sampling: 1 pH check per month

4.2.1.2. Daily sampling: 1 pH check per week

4.2.2. If the frequency of sample collection at a specified location is once per month, check the pH of at least one sample per parameter group (except volatile organics) quarterly.

4.3. If repeat samplings at the same site are performed less frequently than monthly, or if site conditions vary from sampling event to sampling event, check all the samples per section 4.1 above.

5. DOCUMENTATION

5.1. Complete the sample container label and stick firmly on the container.

5.2. Complete the field notes.

5.3. Make notes on the transmittal form and in field records about any relevant observations or problems such as entrained sediment or preservation problems.

FS 2002. *Metals*

1. SAMPLE CONTAINERS

1.1. Use properly cleaned containers (see FC 1300).

1.2. Inspect the containers and caps for visual defects or contamination. Do not use containers if defects are present or if they do not appear clean.

2. SAMPLE COLLECTION PROCEDURES

2.1. Perform any filtration **before** the sample is poured into the container and **before** the sample is preserved.

2.2. Remove the cap from the sample container and carefully pour the sample into the container without allowing sampling equipment or hands to touch the rim of the sample container.

3. PRESERVATION - Follow preservation procedures outlined in FS 2001 above.

3.1. Requirements for specific metals:

3.1.1. For boron or cold-vapor atomic absorption Mercury with a grade of nitric acid (HNO₃) that is suitable for use for metals analysis. Use concentrated HNO₃ or 1:1 HNO₃ to lower the pH of less than 2 S.U., but greater than 1.62 S.U.

3.1.2. For Chromium VI add sufficient ammonium sulfate buffer solution specified per Table FS 1000-4 to the sample to raise the pH of the sample to a pH of 9.3 – 9.7 and place in ice (see FS 2002).

3.1.3. Trace Level Mercury

3.1.3.1. Collect samples for trace level mercury (<100 ug/L) in tightly-capped fluoropolymer or glass bottles.

3.1.3.2. If the samples cannot be received by the laboratory within 48 hours of sample collection, preserve the sample with BrCl or HCl solution.

3.1.3.3. For dissolved trace level mercury, samples must be filtered through a 0.45 µm filter within 24 hours of sample collection. If the samples cannot be

transported to the laboratory within 24 hours, follow the procedures in FS 8200 for field filtration.

3.1.4. Samples collected for lead and copper for drinking water compliance and metals other than those listed above do not require immediate acid preservation.

3.1.4.1. When samples are not acidified with acid, the transmittal form to the laboratory must:

- Clearly state that the samples are unpreserved; and
- Request that the laboratory preserve the samples.

3.1.4.2. If samples are acidified, use concentrated HNO_3 or 1:1 HNO_3 to lower the pH of less than 2 S.U., but greater than 1.62 S.U.

3.2. After the sample has been preserved, screw the cap on tightly.

4. DOCUMENTATION

4.1. Complete the sample container label and stick firmly on the container.

4.2. Complete the field notes.

4.3. Make notes on the transmittal form and in field records about any relevant observations or problems such as entrained sediment.

4.4. On the transmittal form, clearly identify samples that must be acidified by the laboratory (FS 2002, 3.1.3 or 3.1.4 above).

FS 2003. *Extractable Organics*

1. SAMPLE CONTAINERS

1.1. Most samples are collected in glass containers with Teflon-lined caps. Note: Teflon containers are also acceptable. There are some exceptions such as collecting samples in amber glass (e.g., nitroamines, nitroaromatics, etc.). If in doubt, verify the proper container type in Tables FS 1000-4 through FS 1000-10.

1.2. Inspect glass bottles to assure that there are no visual glass or liner defects. If defects are present and/or the sample containers do not appear clean, the bottles must be discarded.

2. SAMPLE COLLECTION PROCEDURES

2.1. Collect composite samples from automatic sample collection devices in refrigerated glass or Teflon containers through Teflon, polyethylene or polypropylene tubing.

2.2. Remove the cap from the sample container without touching the interior Teflon liner.

2.3. Carefully pour the sample into the container without allowing sampling equipment or hands to touch the rim of the sample container.

2.4. Fill bottle with sample to almost full capacity.

3. PRESERVATION

3.1. In general, these types of samples must be preserved by cooling to $\leq 6^\circ\text{C}$.

3.1.1. Some analyte groups require a chemical preservation. See Tables FS 1000-4 through FS 1000-10 for any additional preservation.

3.1.2. Add sodium thiosulfate if residual chlorine is present before preserving samples.

3.1.3. If the samples for pesticides cannot be extracted within 72 hours of collection, the sample pH must be in the range of 5 to 9. If needed, adjust sample to the specified pH range with sodium hydroxide or sulfuric acid.

3.2. Place samples in **wet** ice within 15 minutes of sample collection (see FS 1006, section 5).

4. DOCUMENTATION

- 4.1. Complete the sample container label and stick firmly on the container.
- 4.2. Document when samples were placed in wet ice immediately (see FS 1006, section 5).
- 4.3. Complete the field notes.
- 4.4. Make notes on the lab transmittal form and the field records about any sample that appears highly contaminated or exhibits other abnormal characteristics (i.e., foaming, odor, etc.).

FS 2004. *Volatile Organics*

1. SAMPLE CONTAINERS

- 1.1. Use a screw cap glass sample vial that is sealed with a Teflon-coated septum.
- 1.2. Collect **at least two** vials of each sample. Some laboratories may require three or more vials, therefore verify the laboratory's policy on the number of vials they require unless the laboratory provides the sampling kit.
- 1.3. Inspect the vials for glass or septum defects (e.g., rim must not have nicks or visible depressions and the septum must not be deformed). Do not use containers if defects are present or if they do not appear clean.

2. SAMPLE COLLECTION PROCEDURES

- 2.1. All samples must be grab samples, unless specified otherwise in a permit, order, sampling plan, or contract. If composite data are required, collect individual grab samples over the specified time period.
 - 2.1.1. Submit all samples for analysis.
 - 2.1.2. Average the concentrations of the results to determine the average concentration over time.
- 2.2. Special precautions for petroleum sources:
 - 2.2.1. If possible, transport and store fuels in a separate vehicle from sampling equipment, empty vials and collected samples. If these items must be transported in the same vehicle as fuel, store the fuels as far away from the vials as possible.
 - 2.2.2. Place all fuel or exhaust sources downwind of the sampling location.
 - 2.2.3. Position all petroleum-fueled engines (including the vehicle) downwind of the sampling operations.
- 2.3. Do not allow the sampling equipment or hands to touch the rim of the sample container.
- 2.4. Do not remove septum caps from VOC vials until just prior to filling. Cap vials immediately after filling with sample.
- 2.5. **DO NOT PRERINSE VOC VIALS.**
- 2.6. Do not aerate the sample during sample collection. If collecting from a spigot, reduce the flow rate to less than 100 mL/min. If collecting samples with a pump, maximize the flow rate within the range of 100 mL/min to 400 mL/min, depending on the sample source and pump and tubing configuration. See further discussion about sampling VOCs with pumps in FS 2200.
- 2.7. If preservation is required, proceed to section 3 below unless the laboratory supplied vials with premeasured quantities of acid, and the sample does not need to be dechlorinated (see 3.2 below).

2.7.1. If no preservation is required or if the vials are prepreserved (see 2.5 above), slowly and carefully allow the sample to flow down the **side** of the vial to minimize turbulence. Fill the vial until the surface tension holds the water in a “convex meniscus”.

2.7.2. If a vial overflows during the filling process, document the problem and notify the laboratory that the vial may not contain sufficient acid.

2.7.3. If using a bailer, the bailer must be equipped with a controlled flow bottom assembly.

3. PRESERVATION

3.1. Preserve the sample **during** the sample collection process.

3.2. Dechlorination: Some treated water samples (drinking water and treated wastewater) may contain residual chlorine that must be removed with a dechlorination agent such as sodium thiosulfate or ascorbic acid. This process must occur **before** any additional preservatives (e.g., acid) are added. The dechlorination agent must be **in the vial** before the sample is added.

3.2.1. Laboratories may supply vials with premeasured quantities of dechlorination agent. If acid preservation **is not required**, fill the vials (see section 2.5.1 above) and proceed to section 4 below.

3.2.2. For chlorinated drinking water samples, add 3 mg sodium thiosulfate per 40 mL vial.

3.2.3. If the chlorine level is unknown, the concentration must be measured (see FT 2000). For sources other than drinking water (e.g., chlorinated effluent), 10 mg sodium thiosulfate per 40 mL vial will remove up to 5 ppm Cl₂.

3.3. Acid Preservation

3.3.1. Chlorinated Samples

3.3.1.1. If acid preservation is required, carefully fill the vial with sample, but not to a convex meniscus as described in section 2.5.1 above.

3.3.1.2. Add four drops of concentrated HCl (more acid may be needed if the sample is known to contain high levels of bicarbonate or is otherwise buffered).

3.3.1.3. Add additional sample to create a convex meniscus.

NOTE: If the sample reacts with the acid by generating gas, do not submit preserved samples for analysis. Instead, collect unpreserved samples (seven-day holding time must be met).

3.3.2. Unchlorinated Samples

3.3.2.1. The laboratory may supply vials with premeasured quantities of acid. In this case, proceed to section 2.5.1 above. If a vial overflows during the filling process, document the problem and notify the laboratory that the vial may not contain sufficient acid.

3.3.2.2. If the samples are preserved in the field, follow the procedure in section 3.3 above.

4. CAPPING THE VIAL

4.1. Fill the vial so that the sample surface is above the container rim (convex meniscus).

4.1.1. **Do not pour** sample into cap.

4.1.2. Fill vial from the original source (tubing, spigot, etc.) **Do not fill vial from sample collected in the cap.**

4.2. **Immediately** cap the vial with the Teflon seal contacting the sample. Some sample may overflow while tightening the cap.

- 4.3. If acid has been added to the sample, tip the vial gently two or three times to distribute the preservative.
- 4.4. Turn the vial over and tap it to check for the presence of bubbles.
 - 4.4.1. If bubbles are present, and the total volume of the bubbles is less than 5 mm in diameter, the sample may be submitted.
 - 4.4.2. If the total volume of the bubbles is greater than 5 mm in diameter, discard the vial and fill a new one.
 - 4.4.3. **Do not reopen a vial to add additional sample.**
5. SAMPLE PACKING
 - 5.1. Label each vial with an appropriate field ID number and preservation (e.g., preserved with acid, sodium thiosulfate/acid, etc.).
 - 5.2. Wrap each vial in a protective material (e.g., bubble wrap).
 - 5.3. Place the set of vials in a small, sealable, untreated plastic bag unless the laboratory supplies an alternate method of packing.
 - 5.4. Place samples in **wet** ice within 15 minutes of sample collection (see FS 1006, section 5).
 - 5.5. Protect samples from environmental contamination during storage and transport to the laboratory.
 - 5.6. As an added measure, DEP recommends wrapping the set of replicate samples in bubble wrap and sealing them in a container. This procedure will add further protection from potential contamination.
6. DOCUMENTATION
 - 6.1. Label all the vials.
 - 6.2. Complete field records.
 - 6.3. Make note in the field records of any samples that appear highly contaminated or appear to effervesce when acid is added.

FS 2005. *Bacteriological Sampling*

1. SAMPLE CONTAINERS
 - 1.1. Collect the samples in properly sterilized containers.
 - 1.1.1. Presterilized Whirl-pak bags (or equivalent) are generally used.
 - 1.1.2. If Whirl-pak bags are not used, the sample container must have a volume of at least 125 mL.
 - 1.1.3. If using bottles, the caps must be sterilized. If the caps are lined, there must be documentation to show that the liner does not produce toxic compounds when sterilized.
 - 1.1.4. Bottles and caps must be sterilized according to procedures in FC 1320 or purchased presterilized from a commercial vendor.
2. SAMPLE COLLECTION PROCEDURES
 - 2.1. Unless a composite is specified by permit, all samples must be grab samples.
 - 2.2. Do not open the container once it has been sealed.
 - 2.3. Do not rinse sample container before collecting the sample.
 - 2.4. Use aseptic techniques to collect the sample:

2.4.1. If an intermediate device is used, thoroughly rinse with sample water. To ensure proper rinsing, DEP recommends that microbiological samples be the last sample collected with the sampling device.

2.4.2. Do not put fingers into the mouth of the container or on the interior of the cap.

2.4.3. Do not use any kind of disinfectant (alcohol, bleach, etc.) or heat to sterilize the sample equipment or sampling port.

2.4.3.1. If special sampling requirements suggest disinfection is required because of a questionable condition of the sampling port or spigot, e.g., for drinking water sampling, follow recommended procedures for potable water sampling in Section 9060, Samples, subsection 9060 A.3.a., Potable Water, 2006, in Standard Methods for the Examination of Water and Wastewater (see Standard Methods Online, <http://www.standardmethods.org/store/>), followed by thorough rinsing as described in SM 9060A, regardless of method of disinfection.

2.5. Rinse the sampling equipment with sample water before collecting the sample. Therefore, collect microbiological samples at the end of a sampling sequence.

2.6. Wells with In-Place Plumbing, Spigots and/or Faucets

2.6.1. Do not disinfect the spigot with bleach, alcohol or heat unless special sampling requirements suggest disinfection is required (see 2.4.3.1 above). Turn on spigot and flush at maximum velocity (see FS 2310).

2.6.2. After flushing, reduce the water flow to approximately 500 mL/min and allow the water to flow for a few minutes before collecting samples. If other samples (metals, nutrients, etc.) are to be collected, collect these samples first.

2.6.3. **Do not stop the flow before or during the filling process.**

2.7. Direct Grab Sample Collection

2.7.1. Hold a rigid container near the base and plunge neck downward, below the surface. Turn container until the neck points slightly upward with the mouth directed toward the current. Fill to within about 1/2 inch of the top and cap immediately.

2.7.2. Whirl-pak bags (or equivalent)

- Open the bag by zipping off the top and pulling the white tabs to open the bag. Hold the bag behind the wire ties, and plunge neck downward and up in one sweeping arc; or
- Zip off the top of the bag. Hold bag so that the mouth and wire ties are in front of the hands and fingers. Immerse the bag, and open the bag into the current.
- The above procedures may also be accomplished by attaching the bag to a pole.

2.7.2.1. Bring the bag to the surface, and press out excess water.

2.7.2.2. Seal the bag by folding the open ends at least three times and securely twisting the wire ties.

2.8. Intermediate Device Collection

2.8.1. When using an intermediate sampling device (bailer, DO dunker, niskin bottle, etc.), obtain sufficient sample in the sample collection device to completely fill the sample container. Begin pouring sample out of the device BEFORE collecting into the container. Continue to pour sample out of the device, place container under flowing stream, and fill. **Do not stop the flow before or during the filling process.**

3. PRESERVATION

- 3.1. Preserve samples according to Tables FS 1000-4 through FS 1000-10.
- 3.2. When the sample contains residual chlorine, add a dechlorinating agent such as sodium thiosulfate to the sample container.
 - 3.2.1. The final concentration of sodium thiosulfate must be approximately 100 milligrams per liter (mg/L) in the sample (add 0.1 mL of a 10% solution of thiosulfate to a 125 mL sample).
 - 3.2.2. Some vendors or laboratories provide sterile containers with premeasured amounts of dechlorinating agent. Determine if the source of the field containers already contain a dechlorinating agent.
 - 3.2.3. **Do not use containers with dechlorinating chemicals** when collecting samples from sources that are known to be free from residual chlorine.
- 3.3. Place all samples in wet ice immediately after sample collection (see FS 1006, section 5).
4. HOLDING TIME
 - 4.1. The holding time for microbiological samples is very short. Let the laboratory know the approximate time that samples will be collected and when they are expected to be delivered to the laboratory.
 - 4.2. The holding time begins at the time (hours and minutes) the sample is collected and ends at the time that the sample is placed in the incubator or water bath.
 - 4.3. Consult Tables FS 1000-4, -6, -8, and -9 for holding times.
5. DOCUMENTATION
 - 5.1. Label each sample container with an appropriate field ID number.
 - 5.2. Place samples in **wet** ice within 15 minutes of sample collection (see FS 1006, section 5).
 - 5.3. Complete field records.
 - 5.4. Make note in the field records of any unusual sample appearances or sampling conditions.

FS 2006. *Oil and Grease (O&G), FL-PRO, and Total Recoverable Petroleum Hydrocarbons (TRPHs)*

1. SAMPLE CONTAINERS
 - 1.1. Collect samples for O&G, FL-PRO and TRPHs in 1-liter wide mouth amber glass bottles.
 - 1.2. The cap must have a Teflon liner.
 - 1.3. Visually inspect glass bottles and caps for defects. Do not use container if defects are present or if they do not appear clean.
2. SELECTION OF SAMPLING POINTS
 - 2.1. Oil and grease may be present in wastewater as a surface film, an emulsion, a solution, or as a combination of these forms. Since it is very difficult to collect a representative ambient sample for oil and grease analysis, the sampler must carefully evaluate the location of the sampling point.
 - 2.1.1. Select a point of greatest mixing.
 - 2.1.2. For compliance samples at a facility, collect samples from a point that best represents oil and grease concentrations.
3. SAMPLE COLLECTION PROCEDURES

- 3.1. All samples must be grab samples, unless specified otherwise in a permit, order, sampling plan, or contract.
 - 3.1.1. If composite data are required, collect individual grab samples over the specified time period.
 - 3.1.2. Submit all samples for analysis.
 - 3.1.3. Average the concentrations of the results to determine the average concentration over time.
- 3.2. Do not collect the sample by skimming the surface.
- 3.3. Collect a discrete sample that will be used for analysis. Do not use this sample for any other test.
- 3.4. Remove the cap from the glass bottle without touching the interior of the container or lid.
- 3.5. Do not rinse the sampling device or the sample container with sample water.
- 3.6. Collect the sample directly into the container.
 - 3.6.1. If intermediate sampling equipment is needed, do not allow the sampling equipment to touch the rim of the sample container.
 - 3.6.2. Do not use automatic samplers to collect these types of samples.
 - 3.6.3. Fill the bottle with the sample water to almost full capacity.
 - 3.6.4. Add preservatives (see section 4 below).
 - 3.6.5. Quickly cap the container and tighten securely.
4. PRESERVATION
 - 4.1. Preserve the sample within 15 minutes of sample collection.
 - 4.2. The pH of the acidified sample must be less than 2. **Do not over acidify the sample.**
 - 4.3. Preserve the sample by adding an accurately measured amount of sulfuric or hydrochloric acid to the container. Premeasured vials of acid, or a graduated container or pipet, may be used.
 - 4.3.1. Tightly cap the sample container and shake to distribute the acid.
 - 4.3.2. Pour an aliquot of the acidified sample into a disposable container (e.g., sampling cup) or onto a piece of **narrow** range pH paper to determine if the pH is less than 2. **Do not put the pH paper directly into the sample container.**
 - 4.3.3. If the pH is greater than 2, add additional measured amounts of acid and test with narrow range pH paper (see section 4.3.2 above) until the pH has been reduced to below 2 pH units.
 - 4.3.4. Record the total amount of acid that was added to the sample.
 - 4.4. Acidify at least one of the equipment blanks with the **greatest** amount of acid that was required in the sample set and note the amount in field documentation.
 - 4.5. After the sample has been preserved, screw the cap on tightly.
 - 4.6. Immediately place the sample in **wet** ice after preserving with acid (see FS 1006, section 5).
5. DOCUMENTATION
 - 5.1. Label each vial with an appropriate field ID number.
 - 5.2. Protect glass container from breakage ("bubble wrap" is recommended).
 - 5.3. Complete field records.

5.4. Make notes on the transmittal form and in field records about any relevant observations or problems such as entrained sediment.

FS 2007. Radiological Sampling (Excludes Radon)

1. SAMPLE CONTAINERS

- 1.1. Use polyethylene, polyvinyl chloride (PVC), or Teflon containers.
- 1.2. Visually inspect the containers and caps for defects. If defects are present and/or sample containers do not appear to be clean, do not use the containers.

2. SAMPLE COLLECTION PROCEDURES

- 2.1. On unknown sites, survey the area with a beta-gamma survey instrument, such as a Geiger-Müller meter.
 - 2.1.1. If radiation levels are above instrument background, consult a radiation safety specialist to determine appropriate safety procedures.
- 2.2. Remove the cap from the sample container and carefully pour the sample into the container without allowing sampling equipment or hands to touch the rim of the sample container.

3. PRESERVATION

- 3.1. Preserve the sample with a suitable grade of nitric acid (HNO_3).
- 3.2. Preserve the sample within 15 minutes of sample collection.
- 3.3. The pH of the acidified sample must be less than 2. **Do not over acidify the sample.**
- 3.4. If the preservative is added after the sample is collected (the container is not prepreserved), do not fill the container to the rim.
- 3.5. Preserve the sample by adding an accurately measured volume of concentrated HNO_3 or 1:1 HNO_3 to the container. Premeasured vials of acid, or a graduated container or pipet, may be used.
 - 3.5.1. Tightly cap the sample container and shake to distribute the acid.
 - 3.5.2. Pour an aliquot of the acidified sample into a disposable container (e.g., sampling cup) or onto a piece of **narrow** range pH paper to determine if the pH is less than 2. **Do not put the pH paper directly into the sample container.**
 - 3.5.3. If the pH is greater than 2, add additional measured amounts of acid and test with narrow range pH paper (see section 3.5.2 above) until the pH has been reduced to just below 2 pH units.
 - 3.5.4. Record the total amount of acid that was added to the sample.
 - 3.5.5. Cooling to $\leq 6^\circ\text{C}$ is not required.
- 3.6. Acidify at least one of the equipment blanks with the **greatest** amount of acid that was required in the sample set and note the amount in field documentation.
- 3.7. After the sample has been preserved, screw the cap on tightly.

4. DOCUMENTATION

- 4.1. Complete the sample container label and stick firmly on the container.
- 4.2. Complete the field notes.
- 4.3. Make notes on the transmittal form and in field records about any relevant observations or problems such as entrained sediment.

FS 2008. *Radon Sampling*

Radon is a gas and is easily removed from water sources. Therefore, follow the same precautions and care used to collect volatile organic samples. Minimize contact with air during sample collection. Other sample collection techniques may be appropriate, depending on the analytical method or as specified in the project data quality objectives.

1. SAMPLE CONTAINERS

- 1.1. Use glass sample vials containing a premeasured portion of the scintillation "cocktail."
- 1.2. Visually inspect the containers and caps for defects. If defects are present and/or sample containers do not appear to be clean, do not use the containers.
- 1.3. Collect at least two samples.

2. PRESERVATION: The scintillation cocktail is the only required preservative.

3. SAMPLE COLLECTION PROCEDURES Obtain specific sample collection instructions from the laboratory that will analyze the samples. These instructions must include proper handling as well as sample size and packing instructions. The following are general instructions for collecting the samples:

- 3.1. Carefully fill a syringe (usually 10 mL) with sample water so that air bubbles are not pulled in with the sample before, during or after filling.
- 3.2. Place the tip of the syringe **BELOW** the scintillation cocktail and slowly dispense the sample **BENEATH** the cocktail surface.
- 3.3. Replace the lid and cap tightly.
- 3.4. Generally, the vial is used in the laboratory analytical instrument and labels or ID numbers on the sides of the containers may interfere with the analysis. Check with the laboratory for proper placement of labels or field ID numbers.
- 3.5. Ship in an upright position in the shipping containers that have been provided by the laboratory. If none are provided, protect vials from breakage ("bubble wrap" is recommended), segregate replicate samples in separate plastic bags, and ship to the laboratory in an upright position.

4. DOCUMENTATION

- 4.1. Complete the field notes.
- 4.2. Make notes on the transmittal form and in field records about any relevant observations or problems such as entrained sediment.

FS 2009. *Cyanide Sampling*

Cyanide is a very reactive and unstable species and is highly toxic. Samples suspected of containing cyanide must be handled very carefully.

1. SAMPLE CONTAINERS

- 1.1. Use polyethylene or glass sample containers.
- 1.2. Use properly cleaned containers (see FC 1300).
- 1.3. Visually inspect the containers and caps for defects. If defects are present and/or sample containers do not appear to be clean, do not use the containers.

2. SAMPLE COLLECTION PROCEDURES

- 2.1. Do not use automatic samplers, unless specified in the permit

2.2. Remove the cap from the sample container, and carefully pour the sample into the container without allowing sampling equipment or hands to touch the rim of the sample container.

3. PRESERVATION

3.1. Many different analytes interfere with the cyanide analysis (e.g., residual chlorine, sulfides). If any interferences are known to be present, pretreat the sample for interferences by following the applicable footnotes in Table FS 1000-4 before preserving the sample.

3.2. Preserve the sample within 15 minutes of sample collection.

3.3. Preserve samples with sodium hydroxide to a pH greater than 10.

3.4. Preserve the sample by adding an accurately measured amount of a sodium hydroxide solution or sodium hydroxide pellets to the container. Use a graduated container or pipet to add the solution.

3.4.1. Tightly cap the sample container and shake to distribute the preservative.

3.4.2. Pour an aliquot of the preserved sample into a disposable container (e.g., sampling cup) or onto a piece of **narrow** range pH paper to determine if the pH is greater than 10. **Do not put the pH paper directly into the sample container.**

3.4.3. If the pH is less than 10, add additional measured amounts of the preservative and test with narrow range pH paper (see section 3.4.2 above) until the pH has been raised to above 10 pH units.

3.4.4. Record the total amount of preservative that was added to the sample.

3.5. After the sample has been preserved, screw the cap on tightly.

3.6. Immediately put the sample in **wet** ice (see FS 1006, section 5).

3.7. Preserve at least one of the equipment blanks with all the reagents and the **greatest** amount of sodium hydroxide that was required in the sample set and note the amount in field documentation.

4. DOCUMENTATION

4.1. Complete the sample container label and stick firmly on the container.

4.2. Complete the field notes.

4.3. Make notes on the transmittal form and in field records about any relevant observations or problems such as entrained sediment.

4.4. Ensure that all preservation measures are part of the field notes.

FS 2010 Sulfide Sampling

1. Analyze samples within 15 minutes of collection, or the preserve the sample within 15 minutes for later analysis. If preservation is required add the zinc acetate and sodium hydroxide to the container **before** filling with sample.

2. Avoid aerating the sample during collection. Pour the sample slowly and carefully allow the sample to flow down the **side** of the container to minimize turbulence.

3. Check the pH (if necessary) before completing the filling process.

4. Complete the filling process. **Do not leave a head space.**

FS 2200. Groundwater Sampling

1. INTRODUCTION AND SCOPE

1.1 Use these Standard Operating Procedures to collect groundwater samples. They are designed to ensure that the collected samples will be representative of water in the aquifer or target formation and that the samples have not been altered or contaminated by the sampling and handling procedures. These procedures apply to permanently and temporarily installed monitoring wells, wells constructed using “direct-push” techniques, wells with installed plumbing, remedial groundwater treatment systems and excavations where groundwater is present. Use of alternative, DEP-approved and properly documented procedures (e.g., Corporate SOP, ASTM Standards, alternative equipment, etc.) is acceptable if they meet the intent (e.g., sample representativeness and integrity) of this standard (see FA 1000).

1.2 The topics in this SOP include equipment and supply selection, equipment construction materials, and purging and sampling techniques.

1.3 Use the following DEP SOPs in conjunction with FS 2200:

- FA 1000 Regulatory Scope and Administrative Procedures for Use of DEP SOPs
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000 Documentation Procedures
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FS 2000 General Aqueous Sampling
- FT 1000 Field Testing and Measurement
- FT 1100 Field pH
- FT 1200 Field Specific Conductance
- FT 1400 Field Temperature
- FT 1500 Field Dissolved Oxygen
- FT 1600 Field Turbidity

2. Groundwater samples may be collected from a number of different configurations. Each configuration is associated with a unique set of sampling equipment requirements and techniques:

3. Wells without Plumbing: These wells require that equipment be brought to the well to purge and sample unless dedicated equipment is placed in the well.

4. Wells with In-Place Plumbing: Wells with in-place plumbing do not require that equipment be brought to the well to purge and sample. In-place plumbing is generally considered permanent equipment routinely used for purposes other than purging and sampling, such as for water supply. They are generally found at wellfields, industrial facilities, and private residences. See FS 2300 for procedures to sample potable water wells. Air Strippers or Remedial Systems: These types of systems are installed as remediation devices. Sample these wells like drinking water wells (see FS 2300).

FS 2201 *Equipment and Supplies*

Use groundwater purging and sampling equipment constructed of only non-reactive, non-leachable materials that are compatible with the environment and the selected analytes. In selecting groundwater purging and sampling equipment, give consideration to the depth of the

well, the depth to groundwater, the volume of water to be evacuated, the sampling and purging technique, and the analytes of interest. Refer to Tables FS 1000-1, FS 1000-2, FS 1000-3 and FS 2200-1 for selection of appropriate equipment.

Additional supplies such as reagents, preservatives, and field measurement equipment are often necessary.

1. FLOW CONTAINER: DEP recommends using a flow-through cell or container when collecting measurements for purging stabilization. The design must ensure that fresh formation water continuously contacts the measuring devices and does not aerate the sample or otherwise affect the groundwater properties.
2. PUMPS: All pumps or pump tubing must be lowered and retrieved from the well slowly and carefully to minimize disturbance to the formation water. This is especially critical at the air/water interface. Avoid the resuspension of sediment particles (turbidity) at the bottom of the well or adhered to the well casing during positioning of the pump or tubing.

2.1 Above-Ground Pumps

2.1.1 Variable Speed Peristaltic Pump: Use a variable speed peristaltic pump to purge groundwater from wells when the static water level in the well is no greater than 20-25 feet below land surface (BLS). If the water levels are deeper than 18-20 feet BLS, the pumping velocity will decrease.

2.1.1.1 A variable speed peristaltic pump can be used for normal purging and sampling (see FS 2213 and FS 2221), sampling low permeability aquifers or formations (see FS 2222) and collecting filtered groundwater samples (see FS 2225, section 1).

2.1.1.2 Most analyte groups can be sampled with a peristaltic pump if the tubing and pump configurations are appropriate. See Table FS 1000-3 for proper tubing selection and pump configurations.

2.1.2 Variable Speed Centrifugal Pump: A variable speed centrifugal pump can be used to purge groundwater from 2-inch and larger internal diameter wells. Do not use this type of pump to collect groundwater samples.

2.1.2.1 When purging is complete, do not allow the water that remains in the tubing to fall back into the well. Install a check valve at the end of the purge tubing, and withdraw the tubing slowly from the well while the pump is still running.

2.1.2.2 See Table FS 1000-3 for proper tubing selection and allowable analyte groups.

2.2 Submersible Pumps

2.2.1 Variable Speed Electric Submersible Pump: A variable speed submersible pump can be used to purge and sample groundwater from 2-inch and larger internal diameter wells.

2.2.1.1 A variable speed submersible pump can be used for normal purging and sampling (see FS 2213 and FS 2221), sampling low permeability aquifers or formations (see FS 2222) and collecting filtered groundwater samples (see FS 2225, section 1).

2.2.1.2 Make sure that the pump housing, fittings, check valves and associated hardware are constructed of stainless steel, Teflon or other fluoropolymer, polyethylene or polypropylene. Make sure that any other materials are compatible with the analytes of interest. See Table FS 1000-3 for restrictions.

2.2.1.3 Install a check valve at the output side of the pump to prevent backflow.

2.2.1.4 If purging and sampling for organics:

- The entire length of the delivery tube must be Teflon or other fluoropolymer, polyethylene or polypropylene tubing. Do not use low-density polyethylene for the collection of samples for analysis of volatile organic compounds (VOCs).
- The electrical cord must be sealed in Teflon or other fluoropolymer, polyethylene or polypropylene and any cabling must be sealed in Teflon or other fluoropolymer, polyethylene or polypropylene, or be constructed of stainless steel.
- All interior components that contact the sample water (impeller, seals, gaskets, etc.) must be constructed of stainless steel or Teflon or other fluoropolymer, polyethylene or polypropylene.

2.2.2 Variable Speed Bladder Pump: A variable speed positive displacement bladder pump (no-gas contact) can be used to purge and sample groundwater from 3/4-inch and larger internal diameter wells.

2.2.2.1 A variable speed bladder pump can be used for normal purging and sampling (see FS 2213 and FS 2221), sampling low permeability aquifers or formations (see FS 2222) and collecting filtered groundwater samples (see FS 2225, section 1).

2.2.2.2 The bladder pump system is composed of the pump, the compressed air tubing, the water discharge tubing, the controller and a compressor or compressed gas supply.

2.2.2.3 The pump consists of a bladder and an exterior casing or pump body that surrounds the bladder and two (2) check valves. These parts can be composed of various materials, usually combinations of polyvinyl chloride (PVC), Teflon or other fluoropolymer, polyethylene, polypropylene and stainless steel. Other materials must be compatible with the analytes of interest. See Table FS 1000-3 for restrictions.

2.2.2.4 If purging and sampling for organics:

- The pump body must be constructed of stainless steel and the valves and bladder must be Teflon or other fluoropolymer, polyethylene or polypropylene.
- The entire length of the delivery tube must be Teflon or other fluoropolymer, polyethylene or polypropylene. Do not use low-density polyethylene for VOCs.
- Any cabling must be sealed in Teflon or other fluoropolymer, polyethylene or polypropylene, or be constructed of stainless steel.
- Permanently installed pumps may have a PVC pump body as long as the pump remains in contact with the water in the well.

3. BAILERS:

3.1 Purging: DEP does not recommend using bailers for purging unless no other equipment can be used or purging with a bailer has been specifically authorized by a DEP program, permit, contract or order (see Table FS 2200-3). Use a bailer if there is non-aqueous phase liquid (free product) in the well or non-aqueous phase liquid is suspected to be in the well. If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate DEP program or project manager. If a bailer is used, follow FS 2213, section 4, with no deviations.

3.2 Sampling: Bailers may be used to routinely collect some analyte groups or under specific circumstances for other analyte groups (see Table FS 2200-3).

3.3 Construction and Type:

3.3.1 Bailers must be constructed of materials compatible with the analytes of interest. See Table FS 1000-3 for restrictions.

3.3.2 Stainless steel, Teflon or other fluoropolymer, polyethylene and polypropylene bailers may be used to sample all analytes. Low-density polyethylene is not suitable for the collection of VOCs.

3.3.3 Use disposable bailers when sampling grossly contaminated sample sources.

3.3.4 DEP recommends using dual check valve bailers when collecting samples.

3.3.5 Use bailers with a controlled flow bottom when collecting volatile organic samples.

3.3.6 Use bailers that can be pressurized when collecting filtered samples for metals.

3.4 Contamination Prevention:

3.4.1 Keep the bailer wrapped (foil, butcher paper, etc.) until just before use.

3.4.2 Use protective gloves to handle the bailer once it is removed from its wrapping.

3.4.3 Handle the bailer by the lanyard to minimize contact with the bailer surface.

4. LANYARDS

4.1 Lanyards must be made of non-reactive, non-leachable material such as cotton twine, nylon, or stainless steel; or, coated with Teflon or other fluoropolymer, polyethylene or polypropylene.

4.1.1 Evaluate the appropriateness of the lanyard material with analyses of equipment blanks for the analytes of interest, as necessary.

4.2 Discard cotton twine, nylon, and non-stainless steel braided lanyards after sampling each monitoring well.

4.3 Decontaminate stainless steel, coated Teflon or other fluoropolymer, polyethylene and polypropylene lanyards between monitoring wells (see FC 1003). They do not need to be decontaminated between purging and sampling operations.

4.4 Securely fasten lanyards to downhole equipment (bailers, pumps, etc.).

4.5 Do not allow lanyards used for downhole equipment to touch the ground surface.

FS 2210. GROUNDWATER PURGING

Perform procedures in the following sections to calculate purging parameters and to purge groundwater from monitoring wells, wells with installed plumbing, high-volume wells, air stripper systems and other remedial treatment systems.

FS 2211 *Water Level and Purge Volume Determination*

Collect representative groundwater samples from the aquifer. The amount of water that must be purged from a well is determined by the volume of water and/or field parameter stabilization.

1. GENERAL EQUIPMENT CONSIDERATIONS

1.1 Selection of appropriate purging equipment depends on the analytes of interest, the well diameter, transmissivity of the aquifer, the depth to groundwater and other site conditions.

1.2 Use a pump to purge the well.

1.3 Use a bailer if there is non-aqueous phase liquid in the well or non-aqueous phase liquid is suspected to be in the well.

1.4 Bailers may be used if approved by a DEP program, or if bailer use is specified in a permit, contract or DEP order (see Table FS 2200-3). If used, bailers must be of appropriate type and construction, and the user must follow the procedure outlined in FS 2213, section 4, with no deviations. If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate DEP program or project manager. DEP does not recommend using bailers because improper bailing:

- 1.4.1 Introduces atmospheric oxygen which precipitates metals (i.e., iron) or causes other changes in the chemistry of the water in the sample (i.e., pH)
- 1.4.2 Agitates groundwater which biases volatile and semi-volatile organic analyses due to volatilization
- 1.4.3 Agitates the water in the aquifer and resuspends fine particulate matter
- 1.4.4 Surges the well, loosening particulate matter in the annular space around the well screen
- 1.4.5 Introduces dirt into the water column if the sides of the casing wall are scraped

2. INITIAL INSPECTION

- 2.1 Verify the identification of the monitoring well by examining markings, sign plates, placards or other designations.
- 2.2 Remove the well cover and remove all standing water around the top of the well casing (manhole) before opening the well cap.
- 2.3 Inspect the exterior protective casing of the monitoring well for damage and document the results of the inspection if there is a problem.
- 2.4 It is recommended that you place a protective covering around the well head. Replace the covering if it becomes soiled or ripped.
- 2.5 Inspect the well lock and determine whether the cap fits tightly. Replace the cap if necessary.

3. WATER LEVEL MEASUREMENTS: Use an electronic probe or chalked tape to determine the water level.

3.1 General Procedures

Perform these steps using either the electronic probe or chalked tape method.

- 3.1.1 Decontaminate all equipment that will contact the groundwater in the well before use.
- 3.1.2 Measure the depth to groundwater from the top of well casing to the nearest 0.01 foot and always measure from the same reference point or survey mark on the well casing. If there is no reference mark, measure from the north side of the casing.
- 3.1.3 Record the measurement and the reference point.

3.2 Electronic Probe

- 3.2.1 Follow the manufacturer's instructions for use.
- 3.2.2 Record the measurement.

3.3 Chalked Line Method: This method is not recommended if collecting samples for organic or inorganic parameters.

- 3.3.1 Lower chalked tape into the well until the lower end is in the water (usually determined by the sound of the weight hitting the water).
- 3.3.2 Record the length of the tape relative to the reference point (see section 3.2 above).
- 3.3.3 Quickly remove the tape from the well.

3.3.4 Record the length of the wetted portion to the nearest 0.01 foot.

3.3.5 Determine the depth to water by subtracting the length of the wetted portion (see section 3.5.3 above) from the total length (see section 3.5.2 above). Record the result.

4. WATER COLUMN DETERMINATION

4.1 Do not determine the total depth of the well by lowering the probe to the bottom of the well immediately before purging and sampling. If the well must be sounded, delay purging and sampling activities for at least 24 hours after the well was sounded or for a time sufficient to meet the purge stabilization criterion for turbidity. Alternatively, collect samples before sounding the well. Total well depth can also be determined from construction logs or previous measurements.

4.2 Subtract the depth to the top of the water column from the total well depth to determine the length of the water column.

4.3 The total well depth depends on the well construction. Some wells may be drilled in areas of sinkhole or karst formations or rock leaving an open borehole. Attempt to find the total borehole depth in cases where there is an open borehole below the cased portion.

5. WELL WATER VOLUME

5.1 Calculate the total volume of water in gallons in the well using the following equation:

$$V = (0.041)d \times d \times h$$

Where: V = volume in gallons

d = well diameter in inches

h = height of the water column in feet

5.2 The total volume of water in the well may also be determined with the following equation by using a casing volume per foot factor (Table FS 2211-1, Gallons per Foot of Water) for the appropriate diameter well (results calculated using factors from the table will yields slightly different results than the formula above due to the rounding differences):

$$V = [\text{Gallons per Foot of Water}] \times h$$

Where: V = volume in gallons

h = height of the water column in feet

Table FS 2211-1. Approximate gallons per foot of water for common casing internal diameters.

Casing Internal Diameter	Approximate Gallons per Foot of Water
0.75"	0.02
1"	0.04
1.25"	0.06
2"	0.16
3"	0.37
4"	0.65
5"	1.02
6"	1.47
12"	5.88

5.3 Record all measurements and calculations in the field records.

6. Purging Equipment Volume

Calculate the total volume of the pump, associated tubing and container that is used for in situ measurements (flow container), if used, using the following equation:

$$V = p + ((0.041)d \times d \times l) + fc$$

Where: V = volume in gallons
p = volume of pump in gallons
d = tubing diameter in inches
l = length of tubing in feet
fc = volume of flow cell in gallons

7. When collecting samples from multiple wells on a site, if the groundwater elevation data are to be used to construct groundwater elevation contour maps, all water level measurements must be taken within the same 24-hour time interval unless a shorter time period is required by a DEP program. If the site is tidally influenced, complete the water level measurements within the time frame of an incoming or outgoing tide.

FS 2212 Well Purging Techniques

The selection of the purging technique and equipment is dependent on the hydrogeologic properties of the aquifer, especially depth to groundwater and hydraulic conductivity. The intent of proper purging is to stabilize the water level in the well and minimize the hydraulic stress to the hydrogeologic formation.

Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging completion criteria.

A flowchart which summarizes purging procedure options is presented in Figure FS 2200-2.

Select equipment using the construction and configuration requirements specified in Table FS 2200-1. See the discussions in FS 2201.

1. MEASURING THE PURGE VOLUME: The volume of water that is removed during purging must be recorded. Measure the volume during the purging operation.

1.1 Collect the water in a graduated container and multiply the number of times the container was emptied by the volume of the container, or

1.2 Estimate the volume based on pumping rate. Use this technique only if the pumping rate is constant. Determine the pumping rate by measuring the amount of water that is pumped for a fixed period of time or use a flow meter.

1.2.1 Calculate the amount of water that is discharged per minute:

$$D = \frac{\text{Measured amount}}{\text{Total time in minutes}}$$

1.2.2 Calculate the time needed to purge one (1) well volume or one (1) purging equipment volume:

$$\text{Time} = \frac{V}{D}$$

Where: V = well volume determined from FS 2211, section 5, or purging equipment volume

D = discharge rate calculated in section 1.2.1. above

1.2.3 Make new measurements (see section 1.2.1 above) each time the pumping rate is changed, or

1.3 Use a totalizing flow meter.

1.3.1 Record the reading on the totalizer prior to purging.

1.3.2 Record the reading on the totalizer at the end of purging.

1.3.3 Subtract the reading on the totalizer prior to purging from the reading on the totalizer at the end of purging to obtain the volume purged.

1.4 Record in the field records the times that purging begins and ends.

2. Stabilization Measurement Frequency

2.1 Begin to record stabilization measurements after pumping the minimum volume as prescribed in options 2.3 – 2.5 below. Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging criteria.

2.2 If the well screened interval is not known, use option 2.3, below.

2.3 Wells with Fully Submerged Screen and Pump or Intake Tubing Placed at the Top of the Water Column (conventional purge): Purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one (1) well volume prior to collecting measurements of the stabilization parameters. Allow at least one quarter (1/4) well volume to purge between subsequent measurements.

2.4 Wells with Fully Submerged Screen and Pump or Intake Tubing Placed Within the Screened Interval (minimizing purge volume): Purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one (1) volume of the pump, associated tubing and flow container (if used) prior to collecting measurements of the stabilization parameters. Take measurements of the stabilization parameters no sooner than two (2) minutes apart. Purge at least three (3) volumes of the pump, associated tubing and flow container, if used, prior to collecting a sample.

If the water level drops into the screened interval during purging, lower the pump or tubing intake as in FS 2213, section 1.3 below and follow purging procedures for partially submerged well screens (2.5 below).

2.5 Wells with a Partially Submerged Well Screen: Purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one (1) well volume prior to collecting measurements of the stabilization parameters. Take measurements of the stabilization parameters no sooner than two (2) minutes apart.

3. PURGING COMPLETION: DEP recommends the use of a flow-through container to measure the stabilization parameters discussed below. Alternatively, measure all parameters *in situ* by inserting measurement probes into the well at the depth appropriate for the purging option. Purging is considered complete if the criteria in section 3.1, 3.2 or 3.3 below are satisfied. Make every attempt to satisfy the criteria in section 3.1. Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging criteria.

3.1 Three (3) consecutive measurements of the five (5) parameters listed below must be within the stated limits. The measurements evaluated must be the last three consecutive measurements taken before purging is stopped. The range between the highest and the lowest values for the last three measurements of temperature, pH and specific conductance cannot exceed the stated limits. The last three consecutive measurements of dissolved oxygen and turbidity must all be at or below the listed thresholds.

- Temperature: $\pm 0.2^{\circ} \text{C}$
- pH: ± 0.2 Standard Units

- Specific Conductance: $\pm 5.0\%$ of reading
- Dissolved Oxygen: $\leq 20\%$ Saturation
- Turbidity: ≤ 20 NTU

3.2 Naturally occurring conditions may prevent attaining the $\leq 20\%$ saturation criterion for dissolved oxygen, typically in surficial aquifers. See section 3.5, below.

3.3 Naturally occurring conditions may prevent attaining the ≤ 20 NTU criterion for turbidity. However, when collecting groundwater samples for metals or certain inorganic (e.g., phosphorus forms) or extractable organic (e.g. polynuclear aromatic hydrocarbons) chemicals, make every attempt to reduce turbidity to ≤ 20 NTU to avoid a potential turbidity-associated bias for these analytes. See section 3.5, below.

3.4 Document and report the following, as applicable, except that the last four (4) items only need to be submitted once:

- Purging rate.
- Drawdown in the well, if any.
- Pump or tubing intake placement.
- Length and location of the screened interval.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

3.5 If the criteria in section 3.1 above for dissolved oxygen and/or turbidity cannot be met, then three (3) consecutive measurements of the five (5) parameters listed below must be within the stated limits.

3.5.1 The measurements of the five continuously monitored parameters evaluated must be the last three consecutive measurements taken before purging is stopped. The range between the highest and the lowest values for the last three measurements cannot exceed the stated limits.

- Temperature: $\pm 0.2^\circ \text{C}$
- pH: ± 0.2 Standard Units
- Specific Conductance: $\pm 5.0\%$ of reading
- Dissolved Oxygen: ± 0.2 mg/L or 10%, whichever is greater
- Turbidity: ± 5 NTUs or 10%, whichever is greater

3.5.2 Additionally, document and report the following, as applicable, except that the last four (4) items only need to be submitted once:

- Purging rate.
- Drawdown in the well, if any.
- Pump or tubing intake placement.
- Length and location of the screened interval.
- A description of conditions at the site that cause the dissolved oxygen to be high and/or dissolved oxygen measurements made within the screened or open borehole portion of the well with a downhole dissolved oxygen probe.
- A description of conditions at the site that cause the turbidity to be high and any procedures that will be used to minimize turbidity in the future.

- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

3.5.3 If from review of the submitted data the Department determines that both the elevated Dissolved Oxygen and Turbidity measurements are due to naturally occurring conditions, then only the first four (4) items are required to be submitted in future reports. However, if the Department cannot determine if the Dissolved Oxygen or Turbidity is elevated due to naturally occurring conditions, then in addition to the first four (4) items, a description of the conditions at the site that caused the affected parameter(s) to be high is required to be submitted in future reports.

3.6 If the stabilization parameters in either section 3.1 or 3.2 cannot be met, and all attempts have been made to minimize the drawdown, check the instrument condition and calibration, purging flow rate and all tubing connections to determine if they might be affecting the ability to achieve stable measurements. All measurements that were made during the attempt must be documented. The sampling team leader may decide whether or not to collect a sample or to continue purging after five (5) well volumes (conventional purge section 2.1 or 2.3 above) or five (5) volumes of the screened interval (minimizing purge volumes in section 2.2 above). If the decision is made to continue purging past five well or screened interval volumes, the measurements of the five continuously monitored parameters evaluated must be the last three consecutive measurements taken before purging is stopped.

Further, the report in which the data are submitted must include the following, as applicable, except that the last four (4) items only need to be submitted once:

- Purging rate.
- Pump or tubing intake placement.
- Length and location of the screened interval.
- Drawdown in the well, if any.
- A description of conditions at the site that caused the dissolved oxygen to be high and/or dissolved oxygen measurements made within the screened or open borehole portion of the well with a downhole dissolved oxygen probe.
- A description of conditions at the site that caused the turbidity to be high and any procedures that will be used to minimize turbidity in the future.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

If from review of the submitted data the DEP determines that both the elevated Dissolved Oxygen and Turbidity measurements are due to naturally occurring conditions, then only the first four (4) items are required to be submitted in future reports. However, if the DEP cannot determine if the Dissolved Oxygen or Turbidity is elevated due to naturally occurring conditions, then in addition to the first four (4) items, a description of the conditions at the site that caused the affected parameter(s) to be high is required to be submitted in future reports.

3.7 One fully dry purge (not recommended). This criterion applies only if purging was attempted per FS 2212, FS 2213, and section 3.4.1 below, and if it is impossible to balance the pumping rate with the rate of recharge at very low pumping rates (< 100 mL/minute).

3.7.1 If wells have previously and consistently purged dry, when purged according to FS 2212 and FS 2213, and the current depth to groundwater indicates that the well will purge dry during the current sampling event, minimize the amount of water removed from the well by using the same pump to purge and collect the sample:

3.7.1.1 Place the pump or tubing intake within the well screened interval.

3.7.1.2 Use very small diameter Teflon or other fluoropolymer, polyethylene or polypropylene tubing and the smallest possible pump chamber volume to minimize the total volume of water pumped from the well and to reduce drawdown. If samples will be collected for VOCs, do not use low-density polyethylene tubing.

3.7.1.3 Select tubing that is thick enough to minimize oxygen transfer through the tubing walls while pumping.

3.7.1.4 Pump at the lowest possible rate (100 mL/minute or less) to reduce drawdown to a minimum.

3.7.1.5 Purge at least two (2) volumes of the pumping system (pump, tubing and flow cell, if used).

3.7.1.6 Measure pH, Specific Conductance, Temperature, Dissolved Oxygen and Turbidity and begin to collect the samples (see FS 2222).

4. Collect samples immediately after purging is complete.

4.1 The time period between completing the purge and sampling cannot exceed six (6) hours.

4.2 If sample collection does not occur within one (1) hour of purging completion, re-measure the five (5) field parameters Temperature, pH, Specific Conductance, Dissolved Oxygen and Turbidity just prior to collecting the sample.

4.2.1 If the measured values are not within 10 percent of the previous measurements, re-purge the well.

4.2.2 See section 3.4 above when collecting samples from wells that have purged dry.

FS 2213 *Purging Wells Without Plumbing (Monitoring Wells)*

1. TUBING/PUMP PLACEMENT

1.1 Do not lower the pump or intake hose (tubing) to the bottom of the well. Pump or tubing placement procedures will be determined by the purging option selected in FS 2212, section 2 above or FS 2214 below.

1.1.1 Minimizing Purge Volume: If the following conditions can be met, position the intake hose (tubing) or pump in the screened or open borehole interval.

- The same pump must be used for both purging and sampling,
- The well screen or borehole interval must be less than or equal to 10 feet, and
- The well screen or borehole must be fully submerged.

1.1.2 If the position or length of the screened interval or open borehole is unknown or estimated, place the intake hose (tubing) or pump to perform conventional purging in 1.2 below.

1.1.3 Position the pump or intake hose when purging large-diameter deep wells with open boreholes using the procedure in FS 2214 below.

1.2 Conventional Purging: Position the pump or intake tubing in the top one foot of the water column or no deeper than necessary for the type of pump.

1.2.1 If purging with a bailer, see section 4 below.

1.3 Partially Submerged Screened Interval: If the well screen or open borehole is partially submerged, and the pump will be used for both purging and sampling, position the pump or intake hose (tubing) in the portion of the water column within the submerged screened or open borehole interval.

1.3.1 If the position or length of the screened interval or open borehole is unknown or estimated, place the intake hose (tubing) or pump to perform conventional purging in 1.2 above.

1.3.2 Purge large-volume, high-recharge wells as in FS 2214 below.

1.3.3 If purging with a bailer, see section 4 below.

2. NON-DEDICATED (PORTABLE) PUMPS

2.1 Variable Speed Peristaltic Pump

2.1.1 Install a new, 1-foot maximum length of silicone tubing in the peristaltic pump head.

2.1.2 Attach a short section of tubing to the discharge side of the pump-head silicone tubing and into a graduated container.

2.1.3 Attach one end of a length of new or precleaned transport tubing to the intake side of the pump head silicone tubing.

2.1.4 Place the transport tubing in the monitoring well per one of the options in FS 2213, section 1 above.

2.1.5 Measure the depth to groundwater at frequent intervals.

2.1.6 Record these measurements.

2.1.7 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.1.8 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.1.9 If the water table continues to drop during pumping, lower the tubing at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.1.10 Record the purging rate each time the rate changes.

2.1.11 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.1.12 Record this measurement.

2.1.13 Decontaminate the drop (down-hole) and delivery tubing between wells (see FC 1000) unless new, precleaned tubing is used for each well.

2.2 Variable Speed Centrifugal Pump

2.2.1 Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

2.2.2 Place the decontaminated suction hose so that water is always pumped from the top of the water column.

2.2.3 Equip the suction hose with a foot valve to prevent purge water from re-entering the well.

2.2.4 Measure the depth to groundwater at frequent intervals.

2.2.5 Record these measurements.

2.2.6 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.2.7 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.2.8 If the water table continues to drop during pumping, lower the tubing at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.2.9 Record the purging rate each time the rate changes.

2.2.10 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.2.11 Record this measurement.

2.2.12 Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

2.3 Variable Speed Electric Submersible Pump

2.3.1 Position fuel powered equipment downwind and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

2.3.2 Carefully position the decontaminated pump per one of the options in FS 2213, section 1 above.

2.3.3 Measure the depth to groundwater at frequent intervals.

2.3.4 Record these measurements.

2.3.5 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.3.6 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.3.7 If the water table continues to drop during pumping, lower the tubing or pump at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.3.8 Record the purging rate each time the rate changes.

2.3.9 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.3.10 Record this measurement.

2.3.11 Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

2.4 Variable Speed Bladder Pump

2.4.1 Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

2.4.2 Attach the tubing and carefully position the pump per one of the options in FS 2213, section 1 above.

2.4.3 Measure the depth to groundwater at frequent intervals.

2.4.4 Record these measurements.

2.4.5 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.4.6 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.4.7 If the water table continues to drop during pumping, lower the tubing or pump at the approximate rate of drawdown so that the water is removed from the top of the water column.

- 2.4.8 Record the purging rate each time the rate changes.
- 2.4.9 Measure the purge volume by one of the methods outlined in FS 2212, section 1.
- 2.4.10 Record this measurement.
- 2.4.11 Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.
- 3. DEDICATED PORTABLE PUMPS: Place dedicated pumps per one of the options in FS 2213, section 1 above.
 - 3.1 Variable Speed Electric Submersible Pump
 - 3.1.1 Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.
 - 3.1.2 Measure the depth to groundwater at frequent intervals.
 - 3.1.3 Record these measurements.
 - 3.1.4 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.
 - 3.1.5 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal with the recharge rate.
 - 3.1.6 Record the purging rate each time the rate changes.
 - 3.1.7 Measure the purge volume by one of the methods outlined in FS 2212, section 1.
 - 3.1.8 Record this measurement.
 - 3.2 Variable Speed Bladder Pump
 - 3.2.1 Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.
 - 3.2.2 Measure the depth to groundwater at frequent intervals.
 - 3.2.3 Record these measurements.
 - 3.2.4 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.
 - 3.2.5 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal with the recharge rate.
 - 3.2.6 Record the purging rate each time the rate changes.
 - 3.2.7 Measure the purge volume by one of the methods outlined in FS 2212, section 1.
 - 3.2.8 Record this measurement.
- 4. BAILERS: DEP recommends against using bailers for purging except as a last contingency, or if free product is present in the well or suspected to be in the well. However, they may be used if approved by a DEP program, or specified in a permit, contract or DEP order (see Table FS 2200-3 and FS 2211, section 1.3). If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate DEP program or project manager.
 - 4.1 Minimize handling the bailer as much as possible.
 - 4.1.1 Remove the bailer from its protective wrapping just before use.
 - 4.1.2 Attach a lanyard of appropriate material (see FS 2201, section 4).
 - 4.1.3 Use the lanyard to move and position the bailer.
 - 4.2 Lower and retrieve the bailer slowly and smoothly.
 - 4.3 Lower the bailer carefully into the well to a depth approximately a foot above the water column.

4.3.1 Do not lower the top of the bailer more than one (1) foot below the top of the water table so that water is removed from the top of the water column. Ensure that the length of the bailer does not exceed the length of the water column.

4.3.2 Allow time for the bailer to fill with aquifer water as it descends into the water column.

4.4 Carefully raise the bailer.

4.4.1 Retrieve the bailer at the same rate of 2 cm/sec until the bottom of the bailer has cleared to top of the water column.

4.5 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

4.5.1 Record the volume of the bailer.

4.6 Continue to carefully lower and retrieve the bailer as described above until the purging completion conditions specified in FS 2212, section 3, have been satisfied.

4.6.1 Remove at least one (1) well volume before collecting measurements of the field parameters. Take each subsequent set of measurements after removing at least one quarter (1/4) well volume between measurements.

FS 2214 *Purging Large-Volume, High-Recharge Wells With Portable Pumps*

If a well originally constructed for high-flow-rate pumping will be sampled as a monitoring well, use these guidelines to develop a purging procedure applicable to the specific details of the well construction. Typical wells constructed for this purpose may be deep, large-diameter wells with a section of open borehole. Evaluate each well on a case-by-case basis and consider any available information on the construction and hydraulic performance of the well.

1. PURGING PROCEDURE

1.1 Place the pump at the top of the open borehole segment of the well.

1.2 Start purging while monitoring stabilization parameters as in FS 2212, section 3 above.

1.3 Purge at least one equipment volume before measuring stabilization parameters.

1.4 If the well is being purged for the first time using these guidelines, monitor stabilization parameters for an extended period until confident that sufficient volume has been pumped from the open borehole to draw fresh formation water into the pump tubing and flow-through container. Use the information obtained from the first-time purging of the well to determine the pumping rate and duration of purging required for future sampling events at the well.

1.5 Purge at least three equipment volumes before evaluating purging completion.

2. PURGING COMPLETION

2.1 Complete the purging of the well when the last three consecutive measurements of the purge stabilization parameters have met the applicable criteria specified in FS 2212, section 3 above.

3. Collect samples from the well using the procedures in FS 2221, section 1 below.

FS 2215. *Purging Wells With Plumbing (production wells or permanently installed pumps equipped with sampling ports or sampling spigots)*

Wells with in-place plumbing are commonly found at municipal water treatment plants, industrial water supplies, private residences, etc. Depending on the sampling objective for collecting samples using installed plumbing, purge the system and collect samples closest to the point of consumption, or, as close to the source well as possible. When purging is required and the

purge volume of the plumbing system is not known, purge the system until the purging completion criteria in FS 2212, section 3, have been met.

1. CONTINUOUSLY RUNNING PUMPS

- 1.1 Select the spigot that is closest to the pump and before any storage tanks (if possible).
- 1.2 Remove all hoses, aerators and filters (if possible).
- 1.3 Open the spigot and purge at maximum flow.
- 1.4 If a storage tank is located between the pump and the spigot, purge the volume of the tank, lines and spigot.
- 1.5 If the spigot is before any storage tank, purge until sufficient volume is removed to flush the stagnant water from the spigot and the tap line to the spigot.
- 1.6 Reduce the flow rate to ≤ 500 mL/minute (a 1/8" stream) or approximately 0.1 gal/minute before collecting samples. When sampling for volatile organic compounds, reduce the flow to between 100 mL/minute and 400 mL/minute before collecting the samples.

2. INTERMITTENTLY RUNNING PUMPS

- 2.1 Select the spigot that is closest to the pump and before any storage tanks (if possible).
- 2.2 Remove all hoses, aerators and filters (if possible).
- 2.3 Open the spigot and purge sufficient volume at a maximum, practical flow rate to flush the spigot and lines and until the purging completion criteria in FS 2212, section 3, have been met. Wait a minimum of 2 minutes between stabilization measurements.
- 2.4 If a storage tank is located between the pump and the spigot, purge the volume of the tank, lines and spigot.
- 2.5 Ensure that the purge stabilization measurement of dissolved oxygen is not biased with aeration of the sample by a high flow rate in the flow-through container.
- 2.6 Reduce the flow rate to ≤ 500 mL/minute (a 1/8" stream) or approximately 0.1 gal/minute before collecting samples. When sampling for volatile organic compounds, reduce the flow to between 100 mL/minute and 400 mL/minute before collecting the samples.

FS 2216. *Purging Airstrippers and Remedial Treatment Systems*

If collecting samples for groundwater contamination monitoring, follow FS 2215 above.

FS 2217 *Purging Artesian (Free-Flowing) Wells*

Purge artesian wells according to the following recommendations.

1. For capped artesian wells or artesian wells with installed plumbing, once flow has been initiated (e.g., via installed valve), determine the discharge rate (e.g., per FS 2212, section 1.2, above) and begin measuring purging stabilization parameters as in FS 2212, section 3, above, using an appropriate flow-through container (FS 2201, section 1, above) downhole sensors, or other measurement configuration, as applicable.
 - 1.1 Complete the purging of the well by ensuring that the last three consecutive measurements of the purge stabilization parameters have met the applicable criteria specified in FS 2212, section 3 above.
 - 1.2 If the well is being purged for the first time using these guidelines, monitor stabilization parameters for an extended period until confident that sufficient volume has

discharged from the artesian well to draw fresh formation water into the flow-through container or to the level of the downhole or other sensor location(s). Use the information obtained from the first-time purging of the well to help determine the discharge rate and duration of purging required for future sampling events at the artesian well.

2. For continuously flowing artesian wells, collect samples without purging.
3. Collect samples from artesian wells using the procedures in FS 2223, below. Other sampling techniques may also be appropriate, depending on the specific configuration of the artesian well.

FS 2220. GROUNDWATER SAMPLING TECHNIQUES

1. Purge wells using the techniques outlined in FS 2210.
2. Replace the protective covering around the well if it is soiled or torn after completing the purging operations.
3. GENERAL CONSIDERATIONS FOR SAMPLING EQUIPMENT AND PROCEDURES

Follow all notes and restrictions as indicated in Table FS 2200-1 and as discussed in FS 2201.

NOTE: The only pumps that are currently approved for use in collecting samples for the analysis of volatile organic compounds (VOCs) through the pump without additional restrictions are stainless steel and Teflon or other fluoropolymer, polyethylene and polypropylene variable speed submersible pumps; stainless steel and Teflon or other fluoropolymer, polyethylene or polypropylene variable speed bladder pumps; and, permanently installed variable speed bladder or submersible pumps with PVC bodies, as long as the PVC pump remains in contact with the water in the well at all times. Peristaltic pumps may be used for VOC sample collection only according to the requirements in this SOP.

- 3.1 Collect the sample into the sample container to be sent to the laboratory directly from the sampling tap or spigot, the pump delivery tubing or other sampling device. **Do not** use intermediate containers.
- 3.2 In order to avoid contaminating the sample or loss of analytes from the sample:
 - 3.2.1 Handle the sampling equipment as little as possible.
 - 3.2.2 Minimize the amount of equipment that is exposed to the sample, where possible.
 - 3.2.3 Employ precautions and procedures specific to the collection of samples for VOC analysis.
 - 3.2.3.1 Minimize aeration of samples collected for VOC analysis.
 - 3.2.3.2 Reduce flow rates to 100 - 400 mL/minute when using a pump to collect VOC samples. Attempt to maximize the flow rate within this range. Do not sample at flow rates lower than 100 mL/minute or higher than 400 mL/minute.
 - 3.2.3.3 See subpart FS 2221, section 1, including subsections 1.1 – 1.1.3.9, 1.2 – 1.2.3.3, 1.3.2 – 1.3.3.1, 1.3.4 – 1.3.4.2 and 1.4 for additional VOC sampling instructions, restrictions, precautions and criteria when sampling a well without installed plumbing.
- 3.3 Dedicated Sampling Equipment
 - 3.3.1 Whenever possible, use dedicated equipment because it significantly reduces the chance of cross-contamination.
 - 3.3.2 Dedicated is defined as equipment that is to be used solely for one location for the life of that equipment (e.g., permanently mounted pump).

3.3.3 All material construction and restrictions from Table FS 2200-1 also apply to dedicated equipment. Purchase equipment with the most sensitive analyte of interest in mind.

3.4 Cleaning/Decontamination

3.4.1 Clean or ensure dedicated pumps are clean before installation. They do not need to be cleaned prior to each use but must be cleaned if they are withdrawn for repair or servicing.

3.4.2 Clean or make sure any permanently mounted tubing is clean before installation.

3.4.3 Change or clean tubing when the pump is withdrawn for servicing.

3.4.4 Clean any replaceable or temporary parts as specified in FC 1000.

3.4.5 Collect equipment blanks on dedicated pumping systems when the tubing is cleaned or replaced.

3.4.6 Clean or ensure dedicated bailers are clean before placing them into the well.

3.4.7 Collect an equipment blank on dedicated bailers before introducing them into the water column.

3.4.8 Suspend dedicated bailers above the water column if they are stored in the well.

FS 2221. *Sampling Wells Without Plumbing*

1. SAMPLING WITH PUMPS: Variable speed stainless steel and Teflon or other fluoropolymer, polyethylene and polypropylene submersible pumps; stainless steel, Teflon or other fluoropolymer, polyethylene or polypropylene bladder pumps; and, permanently installed variable speed submersible or bladder pumps with PVC bodies (as long as the pump remains in contact with the water in the well at all times), may be used to sample for all organics. The pump tubing must be Teflon or other fluoropolymer, polyethylene or polypropylene. Do not use low-density polyethylene (LDPE) bladders or tubing to collect samples for volatile organic compounds (VOCs). **Extractable organics** may be collected through a peristaltic pump if ≤ 1 foot of silicone tubing is used in the pump head or a vacuum trap is used (see Figure FS 2200-1 for specific configuration). Samples for **volatile organic compounds** (VOCs) may be collected through the peristaltic pump roller tubing if ≤ 1 foot of silicone tubing is used in the pump roller head, according to the instructions and restrictions listed in section 1.1.1, below. Follow all notes and restrictions as defined in Table FS 2200-1 and discussed in Equipment and Supplies (FS 2201) when using pumps to collect samples. Do not lower the pump or tubing to the bottom of the well.

1.1 Peristaltic Pump

1.1.1 Volatile Organics Collected Through the Pump Roller Tubing: Ensure that no more than a maximum length of one foot of new silicone tubing is installed in the peristaltic pump roller head assembly before the well is purged, if the same pump and tubing assembly is used to purge and sample the well. Otherwise, install a new length of silicone roller tubing as described above before beginning to sample (see NOTE below). If the pump will be used to sample more than one well, replace the silicone roller tubing before purging and sampling each new well. Use Teflon or other fluoropolymer, Kynar, high-density polyethylene (HDPE) or similarly inert material for the drop (down-hole) and delivery tubing. Do not use low-density polyethylene (LDPE) tubing. Minimize aeration of the sample during collection. If samples for additional analytes other than VOCs will be collected, fill the VOC sample containers last, if possible. For low-recharge wells, collect VOCs first after purging is completed, where excessive drawdown or dry purging occurs. NOTE: Depending on the recharge characteristics of the well and sampler skill, attempt to maximize the flow rate for VOC sample collection within the range stipulated below in

sections 1.1.1.1 and 1.1.1.2. Collect the VOC sample directly into the sample container from the discharge flow exiting from the pump delivery tubing. Disconnect flow-through containers, manifolds, valves or other devices from the delivery tubing before collecting the VOC samples, if applicable. If the tubing assembly intended for VOC sample collection was not used to purge the well, begin pumping using the new sampling tubing assembly, adjust the pumping rate for the maximum possible flow rate for VOC sampling and pump a minimum of 3 equipment volumes (pump and tubing volume) through the entire tubing assembly before collecting the VOC samples. If the pump tubing is placed within the screened interval, new tubing cannot be reinserted into the well and the same tubing must be used for purging and sampling.

1.1.1.1 For wells with sufficient recharge where the pumping rate can be matched with the recharge rate, use tubing with the smallest practical inside diameter and collect VOC samples with a pumping rate in the range of 100 mL/minute – 400 mL/minute. Attempt to maximize the flow rate within this range. Do not reduce the flow rate below 100 mL/minute or exceed 400 mL/minute while sampling. Minimize aeration of the sample during collection, and observe all other precautions as indicated in FS 2000, subpart FS 2004. If samples for additional analytes other than VOCs will be collected, fill the VOC sample containers last, if possible.

1.1.1.2 For low-recharge wells, use tubing with the smallest practical inside diameter and collect VOC samples with a pumping rate in the range of 100 mL/minute – 400 mL/minute. Attempt to maximize the flow rate within this range. Do not reduce the flow rate below 100 mL/minute (if possible) or exceed 400 mL/minute while sampling. Minimize aeration of the sample during collection, and observe all other precautions as indicated in FS 2000, subpart FS 2004. If samples for additional analytes other than VOCs will be collected, fill the VOC sample containers last, if possible. Collect VOCs first after purging is completed, where excessive drawdown or dry purging occurs. See subpart FS 2212, section 3.7 for wells that purge dry.

1.1.2 Volatile Organics Using Manual Fill and Drain Method: This method is also denoted as the “straw” method (with gravity drain). Collect volatile organics last. If the pump tubing is placed within the screened interval, do not reinsert the tubing into the well after withdrawing, and do not repeat steps 1.1.2.3 through 1.1.2.6.

1.1.2.1 Insert sufficient length of drop tubing to provide enough sample volume to fill all necessary VOC sample containers, if possible. Use Teflon or other fluoropolymer, Kynar, high-density polyethylene (HDPE) or similarly inert material for the drop (down-hole) and delivery tubing. Do not use low-density polyethylene (LDPE) tubing

1.1.2.2 Remove the drop tubing from the inlet side of the pump.

1.1.2.3 Submerge the drop tubing into the water column and allow it fill.

1.1.2.4 Remove the drop tubing from the well.

1.1.2.5 Prevent the water in the tubing from flowing back into the well.

1.1.2.6 Carefully allow the groundwater to drain by gravity into the VOC sample containers. Avoid turbulence. Do not aerate the sample.

1.1.2.7 Repeat steps 1.1.2.3 - 1.1.2.6 until enough sample containers are filled.

1.1.3 Volatile Organics Using the Pump to Fill and Drain the Tubing: This method is also denoted as the “straw” method with reverse-flow. Collect volatile organics last. If the pump tubing is placed within the screened interval, do not reinsert the tubing into the well after withdrawing, and do not repeat steps 1.1.3.2 through 1.1.3.8, below. Do not

reduce the flow rate below 100 mL/minute or exceed 400 mL/minute while pumping. Do not collect sample that has passed through the pump roller head silicone tubing.

1.1.3.1 Insert sufficient length of drop tubing to provide enough sample volume to fill all necessary VOC sample containers, if possible. Use Teflon or other fluoropolymer, Kynar, high-density polyethylene (HDPE) or similarly inert material for the drop (down-hole) and delivery tubing. Do not use low-density polyethylene (LDPE) tubing

1.1.3.2 Submerge the drop tubing into the water column.

1.1.3.3 Use the pump to fill the drop tubing.

1.1.3.4 Quickly remove the tubing from inlet side of the pump.

1.1.3.5 Prevent the water in the tubing from flowing back into the well.

1.1.3.6 Remove the drop tubing from the well and fill the VOC sample containers using the reverse-flow or gravity-drain methods in steps 1.1.3.7 or 1.1.3.8 below.

1.1.3.7 Reverse the flow on the peristaltic pump to deliver the sample into the VOC sample containers at a slow, steady rate. Avoid turbulence. Do not aerate the sample.

1.1.3.8 Or, remove the drop tubing from the inlet side of the pump and carefully allow the groundwater to drain into the VOC sample containers. Avoid turbulence. Do not aerate the sample.

1.1.3.9 Repeat steps 1.1.3.2 - 1.1.3.8 until enough VOC sample containers are filled.

1.1.4 Extractable Organics Collected Through Silicone Pump-Head Tubing:

1.1.4.1 Ensure that a 1-foot maximum length of new silicone tubing was installed in the peristaltic pump head assembly before the well was purged if the same pump is being used to purge and sample the well. Otherwise, install a new length of tubing as described above.

1.1.4.2 Collect extractable organic samples directly from the effluent delivery tubing (attached to discharge side of the silicone pump head tubing) into the sample container.

1.1.4.3 If there is a concern that sample analytes are absorbed, adsorbed, leached or otherwise affected or lost by pumping through the silicone pump-head tubing, sample the well using the organic trap assembly in 1.1.4 below.

1.1.5 Extractable Organics Using an Optional Organic Trap Assembly

1.1.5.1 Assemble the components of the pump and trap according to Figure FS 2200-1.

1.1.5.2 The sample container should be the trap bottle.

1.1.5.3 All equipment that contacts the groundwater **before** the sample container must be constructed of Teflon or other fluoropolymer, polyethylene, polypropylene, stainless steel or glass, including the transport tubing to and from the sample container, the interior liner of the container cap and all fittings. **Do not use a rubber stopper as a cap.**

1.1.5.4 Connect the outflow tubing from the container to the influent side of the peristaltic pump.

1.1.5.5 Prevent the water in the down-hole delivery tubing from flowing back into the well while performing this connection.

1.1.5.6 Turn the pump on and reduce the flow rate to a smooth and even flow.

1.1.5.7 Discard a small portion of the sample to allow an air space.

1.1.5.8 Preserve (if required), label and complete the field notes.

1.1.6 Inorganics

1.1.6.1 Inorganic samples may be collected from the effluent tubing.

1.1.6.2 If samples are collected from the pump, decontaminate all tubing (including the tubing in the head) or change it between wells.

1.1.6.3 Preserve (if required), label and complete field notes.

1.2 Variable Speed Bladder Pump

1.2.1 If sampling for organics the pump body must be constructed of stainless steel and the valves and bladder must be Teflon or other fluoropolymer, polyethylene or polypropylene. All tubing must be Teflon or other fluoropolymer, polyethylene, or polypropylene and any cabling must be sealed in Teflon or other fluoropolymer, polyethylene or polypropylene, or made of stainless steel. Do not use low-density polyethylene (LDPE) tubing or bladders for the collection of VOC samples.

1.2.2 After purging to a smooth even flow, reduce the flow rate.

1.2.2.1 When sampling for volatile organic compounds, reduce the flow rate to 100 – 400 mL/minute, if possible. Attempt to maximize the flow rate within this range.

1.2.3 Sampling for Volatile Organic Compounds (VOCs)

1.2.3.1 Use Teflon or other fluoropolymer, Kynar, HDPE or similarly inert material for the bladder or tubing. Do not use LDPE bladders or tubing. Minimize aeration of the sample during collection. If samples for additional analytes other than VOCs will be collected, fill the VOC sample containers last, if possible. For low-recharge wells, collect VOCs first after purging is completed, where excessive drawdown or dry purging occurs. Depending on the recharge characteristics of the well and sampler skill, attempt to maximize the flow rate for VOC sample collection within the range stipulated above in section 1.2.3. Collect the VOC sample directly into the sample container from the discharge flow exiting from the pump delivery tubing. Disconnect flow-through containers, manifolds, valves or other devices from the delivery tubing before collecting the VOC samples, if applicable.

1.2.3.2 If the pump and/or tubing assembly intended for VOC sample collection was not used to purge the well, begin pumping using the sampling pump and/or tubing assembly, adjust the pumping rate for the maximum possible flow rate for VOC sampling and pump a minimum of 3 equipment volumes (pump and tubing volume) through the entire tubing assembly before collecting the VOC samples.

1.2.3.3 If the pump is placed within the screened interval, use the same pump and tubing assembly for both purging and sampling.

1.3 Variable Speed Submersible Pump

1.3.1 The housing must be stainless steel.

1.3.2 If sampling for organics, the internal impellers, seals and gaskets must be constructed of stainless steel, Teflon or other fluoropolymer, polyethylene or polypropylene. The delivery tubing must be Teflon or other fluoropolymer, polyethylene or polypropylene. Do not use low-density polyethylene (LDPE) for the collection of VOC samples. The electrical cord must be sealed in Teflon or other fluoropolymer, polyethylene or polypropylene, and any cabling must be sealed in Teflon or other fluoropolymer, polyethylene or polypropylene, or constructed of stainless steel.

1.3.3 After purging to a smooth even flow, reduce the flow rate.

1.3.3.1 When sampling for volatile organic compounds, reduce the flow rate to 100 – 400 mL/minute, if possible. Attempt to maximize the flow rate within this range.

1.3.4 Sampling for Volatile Organic Compounds (VOCs)

1.3.4.1 Use Teflon or other fluoropolymer, Kynar, HDPE or similarly inert material for the pump tubing. Do not use LDPE tubing. Minimize aeration of the sample during collection. If samples for additional analytes other than VOCs will be collected, fill the VOC sample containers last, if possible. For low-recharge wells, collect VOCs first after purging is completed, where excessive drawdown or dry purging occurs. Depending on the recharge characteristics of the well and sampler skill, attempt to maximize the flow rate for VOC sample collection within the range stipulated above in section 1.3.4. Collect the VOC sample directly into the sample container from the discharge flow exiting from the pump delivery tubing. Disconnect flow-through containers, manifolds, valves or other devices from the delivery tubing before collecting the VOC samples, if applicable.

1.3.4.2 If the pump and/or tubing assembly intended for VOC sample collection was not used to purge the well, begin pumping using the sampling pump and/or tubing assembly, adjust the pumping rate for the maximum possible flow rate for VOC sampling and pump a minimum of 3 equipment volumes (pump and tubing volume) through the entire tubing assembly before collecting the VOC samples.

1.4 For all analytes, if the pump is placed within the screened interval, use the same pump and tubing assembly for both purging and sampling.

2. SAMPLING WITH BAILERS: A high degree of skill and coordination are necessary to collect representative samples with a bailer. When properly used, bailers may be used to collect samples for certain analyte groups and under specific conditions (see Table FS 2200-3). They must be of an appropriate type and construction (see FS 2201, section 3), and must be used as outlined below. If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate DEP program or project manager.

2.1 General Considerations

2.1.1 Minimize handling the bailer as much as possible.

2.1.1.1 Wear sampling gloves.

2.1.1.2 Remove the bailer from its protective wrapping just before use.

2.1.1.3 Attach a lanyard of appropriate material (see FS 2201, section 4).

2.1.1.4 Use the lanyard to move and position the bailers.

2.1.2 Do not allow the bailer or lanyard to touch the ground.

2.1.3 Rinsing

2.1.3.1 If the bailer is certified precleaned, no rinsing is necessary.

2.1.3.2 If both a pump and a bailer are to be used to collect samples, rinse the exterior and interior of the bailer with sample water from the pump before removing the pump.

2.1.3.3 If the purge pump is not appropriate for collecting samples (e.g., non-inert components), rinse the bailer with by collecting a single bailer of the groundwater to be sampled. Use the technique described in section 2.2, Bailing Technique, below.

2.1.3.4 Discard the water appropriately.

2.1.3.5 **Do not** rinse the bailer if Oil & Grease, TRPHs, etc., (see FS 2006) are to be collected.

2.2 Bailing Technique

2.2.1 Collect all samples that are required to be collected with a pump before collecting samples with the bailer.

2.2.2 Raise and lower the bailer gently to minimize stirring up particulate matter in the well and the water column which can increase sample turbidity.

2.2.3 Lower the bailer carefully into the well to a depth approximately a foot above the water column. Ensure that the length of the bailer does not exceed the length of the water column.

2.2.3.1 When the bailer is in position, lower the bailer into the water column at a rate of 2 cm/sec until the desired depth is reached (see section 2.2.3 above).

2.2.4 Do not lower the top of the bailer more than one (1) foot below the top of the water table so that water is removed from the top of the water column.

2.2.5 Allow time for the bailer to fill with aquifer water as it descends into the water column.

2.2.6 Do not allow the bailer to touch the bottom of the well or particulate matter will be incorporated into the sample.

2.2.6.1 Carefully raise the bailer (see section 2.2.2 above). Retrieve the bailer at the same rate of 2 cm/sec until the bottom of the bailer has cleared to top of the water column.

2.2.7 Lower the bailer to approximately the same depth each time.

2.2.8 Collect the sample.

2.2.8.1 Install a device to control the flow from the bottom of the bailer and discard the first few inches of water. Reduce the flow to ≤ 100 mL/minute when collecting VOC samples.

2.2.8.2 Fill the appropriate sample containers by allowing the sample to slowly flow down the side of the container. Minimize aeration of VOC samples.

2.2.8.3 Discard the last few inches of water in the bailer.

2.2.9 Repeat steps 2.2.1 through 2.2.8.3 for additional samples.

2.2.10 Measure the DO, pH, temperature, turbidity and specific conductance after the final sample has been collected.

2.2.10.1 Record all measurements and note the time that sampling was completed.

3. SAMPLING WELLS WITH FLOATING NON-AQUEOUS PHASE LIQUID: DEP does not recommend the sampling of wells with floating non-aqueous phase liquid for trace contaminants. This concerns primarily petroleum related sites, but includes any chemical product (e.g., solvent) that floats on the water table. Sampling is acceptable if the information is to be used for the purpose of remedial design.

Sample data from such wells cannot provide useful information regarding the level of contamination. Furthermore, these wells typically do not provide legitimate data because of permanent chemical contamination from product contact with the well casing for an extended period of time.

DEP does reserve the right to require sampling of these wells, not for levels of trace contaminants, but for confirmation of an appropriate remediation technique. This type of sampling is performed **below** the non-aqueous phase layer (see section 3.2 below).

3.1 Non-Aqueous Phase Liquid Sampling: Non-aqueous phase liquid may be evident in a cased monitoring well or in an open excavation.

3.1.1 Non-aqueous phase liquid is normally sampled for two reasons:

- Documentation for its existence and thickness; and
- Determination of the type of product so that the proper analyses can be performed to determine extent. This is only feasible for relatively recent releases as it may not be possible to identify weathered product.

3.1.2 Disposable plastic (acrylic, clear PVC) bailers are recommended for sampling. Disposable polyethylene and polypropylene bailers are also acceptable. Other wide mouth vessels may be used for sampling non-aqueous phase liquid in an excavation.

3.1.3 Monitoring Well

3.1.3.1 If a non-aqueous phase liquid is identified in a monitoring well during the water level measurement, measure its thickness in the well. If the thickness of the non-aqueous phase liquid is greater than 0.01 foot or product globules are present, collect a sample using a precleaned disposable bailer.

3.1.3.2 Measure the product thickness to the nearest 0.01 foot after withdrawing the bailer.

3.1.3.3 Pour a portion of the product into a glass sample container.

3.1.3.4 This sample is considered a concentrated waste. Therefore, package the container in protective wrapping to prevent breakage, isolate from other samples, and ice to 4°C.

3.1.4 Excavation

3.1.4.1 If non-aqueous phase liquid is observed in an open excavation, a glass sample container or a precleaned intermediate vessel may be used to collect the sample.

3.1.4.2 Securely tie a lanyard to the container and lower it into the excavation.

3.1.4.3 Gently lower and retrieve the container so that no solid material is released or collected.

3.1.4.4 If sufficient water is available, a bailer can be used.

3.1.4.5 Although not recommended, screened casing can be placed (or augered and placed) in the bottom of the excavation and the product sampled with a bailer.

3.1.4.6 Avoid dangerous situations, such as standing too close to the edge of an excavation, riding in the backhoe bucket, or entering a trench or excavation that may collapse.

3.1.4.7 DEP recommends following all applicable OSHA regulations.

3.2 Sampling Below Product

3.2.1 This type of depth-specific sampling to attempt to sample the dissolved constituents in the water column below the product layer is performed only at the request of DEP or its designee.

3.2.2 These data provide information that helps define adequate groundwater treatment. Without these data, incorrect (and sometimes unnecessarily expensive) remediation techniques may be designed for a situation where they are not required.

3.2.3 There are some substantial logistical problems involved with sending a sampler through non-aqueous phase liquid to sample the groundwater below. Although there are some products designed specifically for this type of sampling, they are expensive and the results may not be commensurate with their cost. The use of "self-engineered" equipment or coverings may be the best option.

3.2.4 These data are only to be used for qualitative use and will aid in deciding on an appropriate remediation technique.

3.2.5 Wrapping bailers and tubing in plastic seems to be the most popular technique in getting past the product layer.

3.2.6 Although not recommended, some have wrapped submersible pumps in several layers of plastic and retrieved each layer by a separate lanyard. One suggestion would be to use a rigid piece of stainless steel tubing wrapped in plastic.

3.2.6.1 Once the covered tubing is past the layer, pull up on the plastic, piercing the plastic and exposing the (somewhat) clean tubing inlet.

3.2.6.2 Introduce the wrapped hose slowly to not entrain any more product into the dissolved layer located below.

3.2.6.3 Also, perform this procedure with a peristaltic pump or a vacuum pump linked to a trap bottle. To use this setup, the water table must be no deeper than 15-20 feet, realizing that actual sampling may be occurring several feet below the product layer.

FS 2222. *Sampling Low Permeability Aquifers or Wells That Have Purged Dry*

1. Collect the sample(s) after the well has been purged according to FS 2212, section 3.4. Minimize the amount of water removed from the well by using the same pump to purge and collect the sample. If the well has purged dry, collect samples as soon as sufficient sample water is available. If samples for additional analytes other than VOCs will be collected, fill the VOC sample containers last, if possible. However, collect VOCs first after purging is completed, where excessive drawdown or dry purging occurs.
2. Measure the five (5) field parameters Temperature, pH, Specific Conductance, Dissolved Oxygen and Turbidity at the time of sample collection.
3. Advise the analytical laboratory and the client that the usual amount of sample for analysis may not be available.

FS 2223. *Sampling Wells With In-Place Plumbing*

1. If a storage tank is present, locate a cold water spigot, valve or other sampling point close to the well head between the pump and the storage tank. If there is no sampling location between the pump and the storage tank, locate the spigot, valve or other sampling point closest to the tank.
 - 1.1 Depending on the sampling objective for collecting samples using installed plumbing, purge the system and collect samples closest to the point of consumption, or, as close to the source well as possible.
2. Remove all screens or aerators and reduce the flow rate to no more than 500 mL/minute. If collecting samples for volatile organic compounds, reduce the flow rate to 100 mL/minute or less. Collect the samples directly into the appropriate containers.

FS 2224. *Sampling Airstripper and Remedial Treatment System Sampling*

1. Reduce the flow rate to less than 500 mL/minute and begin sample collection.
2. If collecting samples for volatile organic compounds, reduce the flow rate to 100 mL/minute or less.
3. Collect the samples directly into the appropriate containers.

FS 2225. *Filtering Groundwater Samples*

Filtered groundwater samples can only be collected after approval from the DEP program or project manager. If filtering is approved, the DEP program or permit condition may require both filtered and unfiltered samples to be collected, analyzed and reported.

1. FILTERING GROUNDWATER FOR METALS:

1.1 Unless specified otherwise by the DEP program, use a new, disposable, high capacity, 1- μ m in-line filter.

1.2 Use a variable speed peristaltic, bladder or submersible pump with the in-line filter fitted on the outlet end.

1.2.1 Peristaltic pumps, bladder pumps or submersible pumps can be used when water levels are no greater than 20 to 25 feet deep.

1.2.2 Bladder pumps or submersible pumps must be used when water levels are greater than 20 to 25 feet deep.

1.3 Ensure that a 1-foot maximum length of new, silicone tubing was installed in the peristaltic pump head assembly before the well was purged if the same pump is being used to purge and sample the well. Otherwise, install a new length of tubing as described above.

1.4 Ensure that new or precleaned delivery tubing was assembled with the peristaltic pump before the well was purged if the same pump is being used to purge and sample the well. Otherwise, assemble the pump with new or precleaned delivery tubing and the new filter.

1.5 Insert the filter on the high pressure side (i.e., on the delivery side) of the pump.

1.5.1 Flush the filter before attaching to the pump tubing assembly with 30-50 mL of analyte free water or an inert gas (nitrogen) to remove atmospheric oxygen;

1.5.2 Or, with the filter attached to the pump tubing assembly, hold the filter upright with the inlet and outlet in the vertical position and pump water from the aquifer through the filter until all atmospheric oxygen has been removed.

1.6 Collect the filtered samples directly into the sample container from the high-pressure (delivery) side of the pump tubing assembly.

1.6.1 Collect filtered samples by either of the methods in 1.6.1.3 or 1.6.1.4 below if the static water level in the well is too deep for a variable speed peristaltic pump and a variable speed electric submersible pump or variable speed bladder pump is not available.

1.6.1.1 Do not agitate the sample or expose it to atmospheric oxygen.

1.6.1.2 **Do not** pour the sample into any intermediate vessel for subsequent filtration.

1.6.1.3 Collect the sample in a polyethylene, Teflon or other fluoropolymer or polypropylene bailer that can be pressurized. When the bailer has been retrieved, immediately connect the filter and begin to pressurize the bailer;

1.6.1.4 Or, collect the sample with a bailer and immediately place the intake tube of the peristaltic pump into the full bailer and begin pumping the water through the filter as described in section 1.2 above.

1.7 **Do not** use the following equipment for filtering groundwater samples for metals:

1.7.1 Any pump and apparatus combination in which the filter is on the vacuum (suction) side of the pump.

1.7.2 Any type of syringe or barrel filtration apparatus.

1.7.3 Any filter that is not encased in a one-piece, molded unit.

2. Filtering groundwater for non-metallic analytes

2.1 The following analytes cannot be filtered:

- Oil and Grease
- Total Recoverable Petroleum Hydrocarbons (TRPH)
- FL-PRO
- Volatile Organic Compounds (VOC)
- Microbiological Analytes
- Volatile Inorganic Compounds (e.g., Hydrogen Sulfide)

2.2 Unless specified otherwise by the regulatory program, use a new, disposable, high capacity, 0.45 µm in-line filter.

2.3 Assemble the pump, tubing and filter as in 1.2 – 1.5 above.

2.4 Flush the filter as in 1.5.1 or 1.5.2 above.

2.5 Collect the samples as in 1.6 – 1.6.1.4 above.

Appendix FS 2200
Tables, Figures and Forms

Table FS 2200-1 Equipment for Collecting Groundwater Samples

Table FS 2200-2 Dissolved Oxygen Saturation

Table FS 2200-3 Allowable Uses for Bailers

Figure FS 2200-1 Pump and Trap for Extractable Organics

Figure FS 2200-2 Groundwater Purging Procedures

Table FS 2200-1
Equipment for Collecting Groundwater Samples

Activity	Equipment Type
Well Purging	Variable speed centrifugal pump Variable speed submersible pump Variable speed bladder pump Variable speed peristaltic pump Bailer with lanyard: Not Recommended
Well Stabilization	pH meter DO meter Conductivity meter Thermometer/Thermistor Turbidimeter Flow-through cell Multi-function meters
Sample Collection	Variable speed peristaltic pump Variable speed submersible pump Variable speed bladder pump Bailer with lanyard (See Table FS 2200-3)
Filtration	Variable speed peristaltic pump Variable speed submersible pump Variable speed bladder pump Pressurized bailer 1.0 µm high capacity molded filter 0.45 µm high capacity molded filter
Groundwater Level	Electronic sensor Chalked tape

Table FS 2200-2
Dissolved Oxygen Saturation

Temp (°C)	100% sat. (mg/L)	20% sat. (mg/L)	Temp (°C)	100% sat. (mg/L)	20% sat. (mg/L)	Temp (°C)	100% sat. (mg/L)	20% sat. (mg/L)	Temp (°C)	100% sat. (mg/L)	20% sat. (mg/L)
15.0	10.084	2.017	19.0	9.276	1.855	23.0	8.578	1.716	27.0	7.968	1.594
15.1	10.062	2.012	19.1	9.258	1.852	23.1	8.562	1.712	27.1	7.954	1.591
15.2	10.040	2.008	19.2	9.239	1.848	23.2	8.546	1.709	27.2	7.940	1.588
15.3	10.019	2.004	19.3	9.220	1.844	23.3	8.530	1.706	27.3	7.926	1.585
15.4	9.997	1.999	19.4	9.202	1.840	23.4	8.514	1.703	27.4	7.912	1.582
15.5	9.976	1.995	19.5	9.184	1.837	23.5	8.498	1.700	27.5	7.898	1.580
15.6	9.955	1.991	19.6	9.165	1.833	23.6	8.482	1.696	27.6	7.884	1.577
15.7	9.934	1.987	19.7	9.147	1.829	23.7	8.466	1.693	27.7	7.870	1.574
15.8	9.912	1.982	19.8	9.129	1.826	23.8	8.450	1.690	27.8	7.856	1.571
15.9	9.891	1.978	19.9	9.111	1.822	23.9	8.434	1.687	27.9	7.842	1.568
16.0	9.870	1.974	20.0	9.092	1.818	24.0	8.418	1.684	28.0	7.828	1.566
16.1	9.849	1.970	20.1	9.074	1.815	24.1	8.403	1.681	28.1	7.814	1.563
16.2	9.829	1.966	20.2	9.056	1.811	24.2	8.387	1.677	28.2	7.800	1.560
16.3	9.808	1.962	20.3	9.039	1.808	24.3	8.371	1.674	28.3	7.786	1.557
16.4	9.787	1.957	20.4	9.021	1.804	24.4	8.356	1.671	28.4	7.773	1.555
16.5	9.767	1.953	20.5	9.003	1.801	24.5	8.340	1.668	28.5	7.759	1.552
16.6	9.746	1.949	20.6	8.985	1.797	24.6	8.325	1.665	28.6	7.745	1.549
16.7	9.726	1.945	20.7	8.968	1.794	24.7	8.309	1.662	28.7	7.732	1.546
16.8	9.705	1.941	20.8	8.950	1.790	24.8	8.294	1.659	28.8	7.718	1.544
16.9	9.685	1.937	20.9	8.932	1.786	24.9	8.279	1.656	28.9	7.705	1.541
17.0	9.665	1.933	21.0	8.915	1.783	25.0	8.263	1.653	29.0	7.691	1.538
17.1	9.645	1.929	21.1	8.898	1.780	25.1	8.248	1.650	29.1	7.678	1.536
17.2	9.625	1.925	21.2	8.880	1.776	25.2	8.233	1.647	29.2	7.664	1.533
17.3	9.605	1.921	21.3	8.863	1.773	25.3	8.218	1.644	29.3	7.651	1.530
17.4	9.585	1.917	21.4	8.846	1.769	25.4	8.203	1.641	29.4	7.638	1.528
17.5	9.565	1.913	21.5	8.829	1.766	25.5	8.188	1.638	29.5	7.625	1.525
17.6	9.545	1.909	21.6	8.812	1.762	25.6	8.173	1.635	29.6	7.611	1.522
17.7	9.526	1.905	21.7	8.794	1.759	25.7	8.158	1.632	29.7	7.598	1.520
17.8	9.506	1.901	21.8	8.777	1.755	25.8	8.143	1.629	29.8	7.585	1.517
17.9	9.486	1.897	21.9	8.761	1.752	25.9	8.128	1.626	29.9	7.572	1.514
18.0	9.467	1.893	22.0	8.744	1.749	26.0	8.114	1.623	30.0	7.559	1.512
18.1	9.448	1.890	22.1	8.727	1.745	26.1	8.099	1.620	30.1	7.546	1.509
18.2	9.428	1.886	22.2	8.710	1.742	26.2	8.084	1.617	30.2	7.533	1.507
18.3	9.409	1.882	22.3	8.693	1.739	26.3	8.070	1.614	30.3	7.520	1.504
18.4	9.390	1.878	22.4	8.677	1.735	26.4	8.055	1.611	30.4	7.507	1.501
18.5	9.371	1.874	22.5	8.660	1.732	26.5	8.040	1.608	30.5	7.494	1.499
18.6	9.352	1.870	22.6	8.644	1.729	26.6	8.026	1.605	30.6	7.481	1.496
18.7	9.333	1.867	22.7	8.627	1.725	26.7	8.012	1.602	30.7	7.468	1.494
18.8	9.314	1.863	22.8	8.611	1.722	26.8	7.997	1.599	30.8	7.456	1.491
18.9	9.295	1.859	22.9	8.595	1.719	26.9	7.983	1.597	30.9	7.443	1.489

Derived using the formula in Standard Methods for the Examination of Water and Wastewater,
Page 4, 101, 18th Edition, 1992.

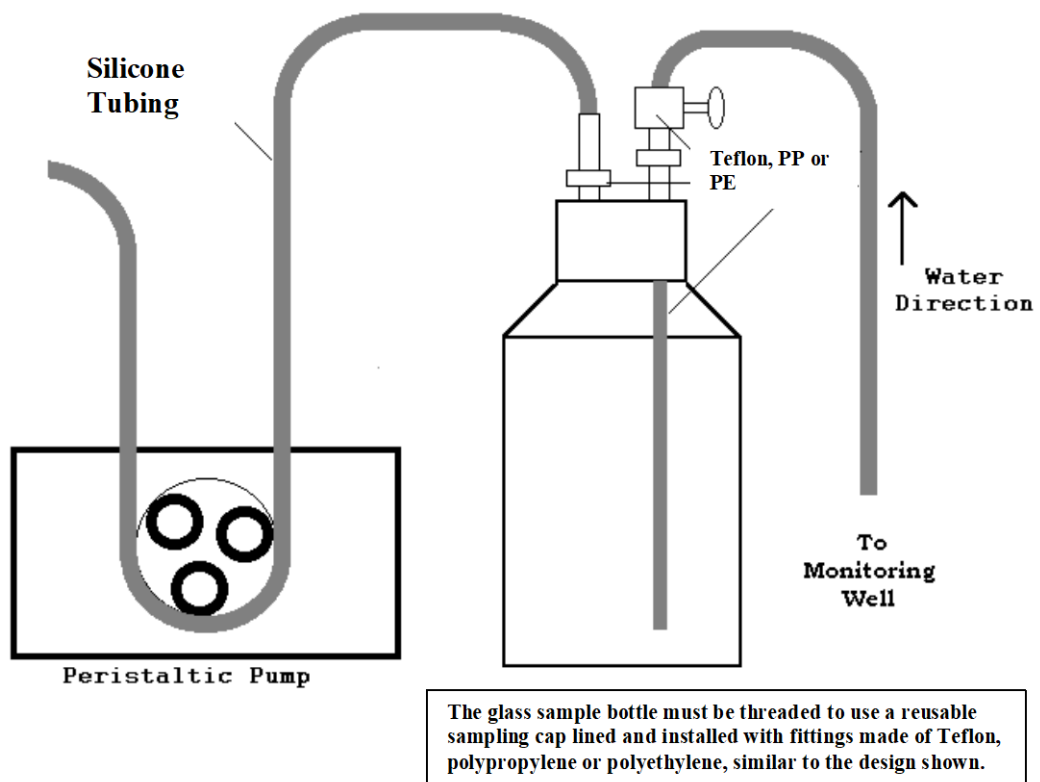
Table FS 2200-3
Allowable Uses for Bailers

Analyte Group(s)	Purging (Not Recommended)	Sampling Use	Sampling Not Recommended
Volatile Organics Extractable Organics Radionuclides, including Radon Metals Volatile Sulfides	If allowed by permit, program, contract or order or If operated by a skilled individual with documented training in proper techniques. Field documentation must demonstrate that the procedure in FS 2213, section 4 was followed without deviation.	If concentrations exceed action levels, the purpose is to monitor effective treatment, and the DEP program allows the use of bailers; or If specified by DEP permit, program, contract or order. or If operated by a skilled individual with documented training in proper techniques and using appropriate equipment. Field documentation must demonstrate that the procedure in FS 2221, section 2 was followed without deviation.	If concentrations are near or below the stated action levels; or If a critical decision (e.g., clean closure) will be made based on the data; or If data are to demonstrate compliance with a permit or order.
Petroleum Hydrocarbons (TRPH) & Oil & Grease	If allowed by permit, program, contract or order or If operated by a skilled individual with documented training in proper techniques. Field documentation must demonstrate that the procedure in FS 2213, section 4 was followed without deviation.	Only if allowed by permit, program, contract or order as samples should be collected into the container without intermediate devices.	Unless allowed by permit, program, contract or order.

DEP-SOP-001/01
FS 2200 Groundwater Sampling

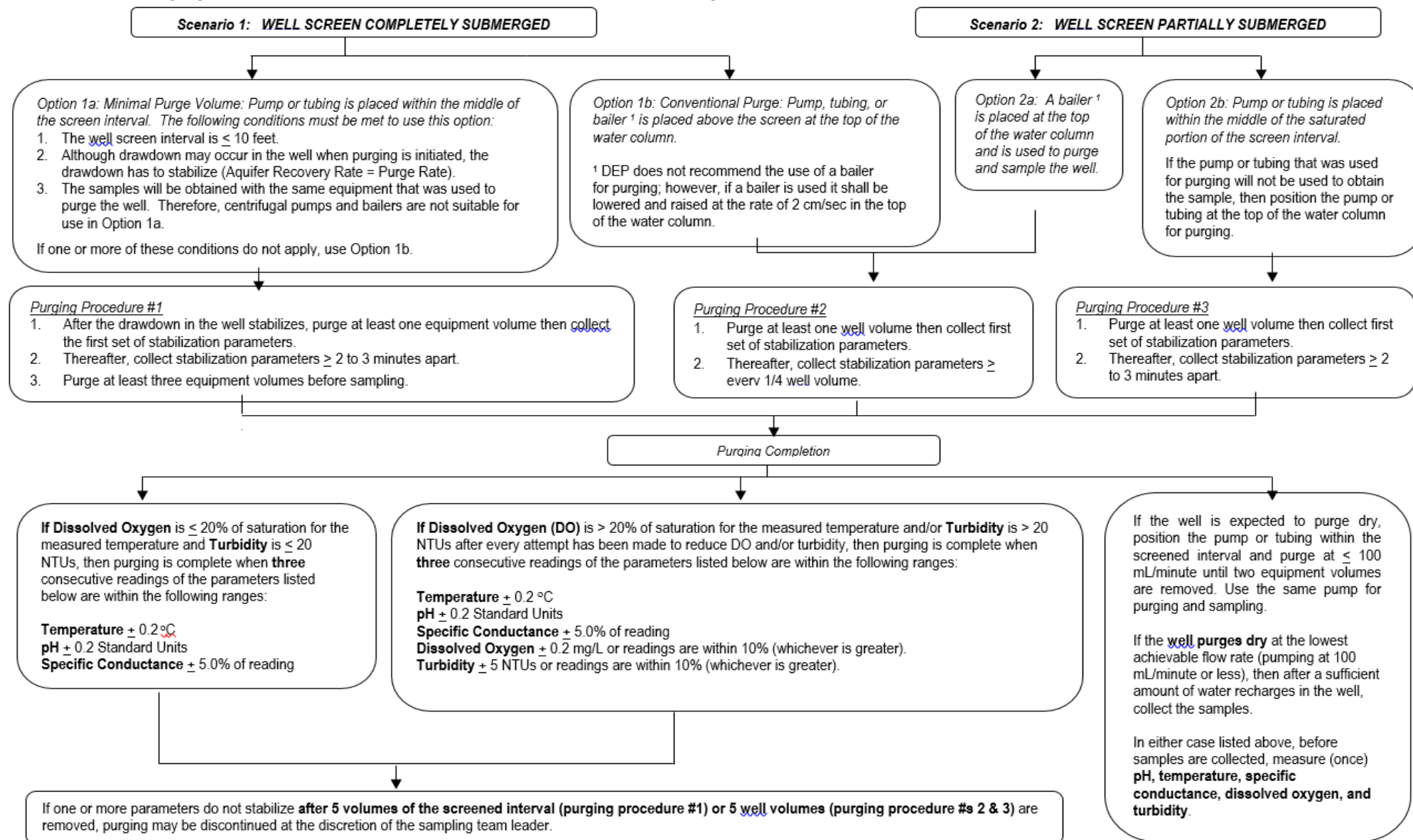
Analyte Group(s)	Purging (Not Recommended)	Sampling Use	Sampling Not Recommended
Biologicals Inorganic Non-Metallics Aggregate Organics Microbiological Physical and Aggregate Properties	If allowed by permit, program, contract or order or If operated by a skilled individual with documented training in proper techniques. Field documentation must demonstrate that the procedure in FS 2213, section 4 was followed without deviation.	If all analytes collected from the well can be collected with a bailer; or If collected <u>after</u> collecting all analytes that require the use of a pump.	Before collecting any analytes that must be collected with a pump.
Ultra-Trace Metals	Never	Never	N/A

Figure FS 2200-1
Pump and Trap for Extractable Organics



Groundwater Purging Procedures

Figure FS 2200-2



FT 1000. GENERAL FIELD TESTING AND MEASUREMENT

Use the following SOPs in conjunction with FT 1000:

- FD 1000 Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FS 1000 General Sampling Procedures
- FT 1100 through FT 3000 Specific Field Testing Procedures

1. INTRODUCTION

1.1. Scope and Applicability: SOPs FT 1100 to FT 3000 outline procedures to conduct field testing measurements and observations. They include the parameters that are measured *in-situ* or in a field-collected sample. Additionally, some samples with allowable extended holding times may be collected for laboratory measurement, as described in the specific FT-series SOPs. FT 1000 contains the general requirements applicable to the following:

- FT 1100 Field Measurement of Hydrogen Ion Activity (pH)
- FT 1200 Field Measurement of Specific Conductance (Conductivity)
- FT 1300 Field Measurement of Salinity
- FT 1400 Field Measurement of Temperature
- FT 1500 Field Measurement of Dissolved Oxygen (DO)
- FT 1600 Field Measurement of Turbidity
- FT 1900 Continuous Monitoring with Installed Meters
- FT 2000 Field Measurement of Residual Chlorine

1.2. Exclusions: **If proposed for experimental purposes, field-screening procedures employing techniques not addressed in these SOPs** must be submitted to the DEP site or project manager. Such procedures must be addressed for each program or project dealing specifically with the planning and design of sampling events. Data quality objectives for quantitative assessment preclude the use of field-screening procedures for regulatory purposes.

1.3. Expectations and Requirements:

1.3.1. In some cases, specific instruments are identified in the SOP, with detailed instruction provided on their use. If you are using a different instrument from that identified in the SOP, follow the manufacturer's instructions for assembly, operation, and maintenance.

1.3.2. When required, the FT-series SOPs outline the instrument specifications. A field instrument must meet the stated requirements.

1.3.3. The FT-Series SOPs specify the calibration and verification requirements for each method. Although instruments may vary in configuration or operation, the specified calibration and verification requirements must be met, including for those instruments that can only be calibrated by the manufacturer or vendor (i.e., "factory-calibrated" instruments).

1.3.3.1. Where applicable to the FT-series SOP, use the minimum number of calibration standards specified.

1.3.3.2. Do not establish the lower limit of the quantitative calibration bracket with “zero” solutions, quality control blanks or reagent dilution water. However, the user may set the zero point of the instrument according to the manufacturer’s instructions, if applicable.

1.3.4. Ensure that all equipment is in proper working condition, calibrated, and that batteries are properly charged before using the equipment for field testing measurements.

1.3.5. If reagents or standards are prepared from stock chemicals, they must be analytical reagent grade or better. Some procedures may specify a higher grade or assay of reagent or standard.

1.4. Recommendations and Requirements for Use of Grab Samples or *in situ* Field Testing Measurements:

1.4.1. Use *in situ* readings where practical for field measurements in surface water and wastewater.

1.4.2. Use *in situ* readings or flow-through containers for field measurements for groundwater stabilization during purging and for other applications where groundwater monitoring measurements are required.

1.4.3. If grab samples are collected for measurement where allowed in the individual FT-series SOP, measure samples within fifteen (15) minutes of collection when immediate analysis is specified per Table FS 1000-4 and FS 1000-5. Otherwise, analyze grab samples within the applicable holding times specified in Table FS 1000-4 and FS 1000-5.

2. MINIMUM CALIBRATION REQUIREMENTS:

2.1. Calibration Definitions: This section outlines the essential calibration concepts that must be applied to each field test. Specific requirements for calibration are addressed in the individual SOPs.

2.1.1. Initial Calibration (IC): The instrument or meter electronics are adjusted (manually or automatically) to a theoretical value (e.g., dissolved oxygen saturation) or a known value of a calibration standard.

2.1.2. Initial Calibration Verification (ICV): The instrument or meter calibration is checked or verified directly following initial calibration by measuring a calibration standard of known value in “read” or “run” mode as if it were a sample and comparing the measured result to the calibration acceptance criteria listed in the SOP.

2.1.3. Continuing Calibration Verification (CCV): The instrument or meter calibration is checked or verified by measuring a calibration standard of known value in “read” or “run” mode as if it were a sample and comparing the measured result to the calibration acceptance criteria listed in the SOP.

2.1.4. Chronological Calibration Bracket: The interval of time between verifications within which environmental sample measurements must occur. The instrument or meter is verified before and verified after the time of environmental sample measurement(s).

2.1.5. Quantitative Calibration Bracket: The instrument or meter is calibrated or verified at two known values that encompass the range of observed environmental sample measurement(s).

2.1.6. Acceptance Criteria: The numerical limits within which calibration verifications are acceptable.

2.2. Calibration Activities: Specific calibration procedures are given in the individual SOPs.

2.2.1. Chronological Calibration Bracket:

2.2.1.1. Ensure that the field test result is preceded by an acceptable ICV or CCV and followed by an acceptable CCV.

2.2.1.2. Specific requirements for chronological bracketing are addressed in the individual FT-series SOPs.

2.2.2. Quantitative Calibration Bracket:

2.2.2.1. Choose two standards that bracket the range of sample measurements. These standards may be used for initial calibrations or for verifications.

2.2.2.2. Specific requirements for quantitative bracketing are addressed in the individual FT-series SOPs.

2.2.3. Initial Calibration: Calibrate if no initial calibration has been performed or if a calibration verification does not meet acceptance criteria. Do not reuse standards for initial calibrations.

2.2.4. Initial Calibration Verification:

2.2.4.1. Perform an ICV immediately after calibration. All ICVs must meet the calibration acceptance criteria specified in the applicable FT-series SOP. See Table FT 1000-1 for a list of acceptance criteria for the most common field testing procedures.

2.2.4.2. If an ICV fails to meet acceptance criteria, immediately recalibrate the instrument using the applicable initial calibration procedure or remove it from service.

2.2.5. Continuing Calibration Verification: Perform a CCV at no more than 24-hour intervals from previous verification, except where noted for individual FT-series SOPs or demonstrated as in Sections 2.2.5.1 and 2.2.5.2.

2.2.5.1. If historically generated data demonstrate that a specific instrument remains stable for longer periods of time, the time interval between calibration verifications may be increased.

2.2.5.2. Base the selected time interval on the shortest interval that the instrument maintains stability. If CCVs consistently fail, shorten the time period between verifications or replace/repair the instrument. If the instrument is subjected to conditions that might affect the calibration (such as mechanical shock or vibration, or extreme temperature changes), or used frequently at locations with differing matrix characteristics, consider performing CCVs more frequently to avoid qualifying data.

2.2.5.3. All CCVs must meet the calibration acceptance criteria specified in the applicable FT-series SOP. See Table FT 1000-1 for a list of acceptance criteria for the most common field testing procedures.

2.2.5.4. If a CCV fails to meet acceptance criteria perform one or more of the following procedures as necessary:

- Reattempt the CCV again within the chronological bracket time interval without changing the instrument calibration. Do not perform maintenance, repair, or cleaning of the instrument or probe. Probes may be rinsed with analyte-free water or fresh verification standard. The CCV may be reattempted with a fresh aliquot of verification standard.
- Perform the initial calibration, perform an ICV, re-analyze the sample(s), and perform a CCV.
- Report all results between the last acceptable calibration verification and the failed calibration verification as estimated (report the value

with a "J"). Include a narrative description of the problem in the field notes.

2.2.5.5. For installed instruments that are used for continuous monitoring, see FT 1900.

2.2.5.6. For unattended instrument deployment, refer to FT 1000 sections 2.2.5.1-2.2.5.4.

2.2.6. Determining the Values of Secondary Standards: Use only those standards recommended by the manufacturer for a specific instrument. Only use secondary standards for continuing calibration verifications. See the individual FT-series SOPs for specific procedures for use of secondary standards. At documented intervals, determine or verify the values of secondary standards immediately after performing an initial calibration or after verifying the calibration with primary standards. Read each secondary standard as a sample. Compare the assigned or stated standard value with the reading. This reading must be within the manufacturer's stated tolerance range and the acceptance criterion required in the individual FT-series SOP. If the SOP criterion is not met, assign this reading as the new value of the secondary standard. If the reading is outside the manufacturer's stated tolerance range, discard the secondary standard.

2.2.7. **More frequent calibration verifications may be required for discharge permit compliance measurements or other regulatory requirements.**

3. PREVENTIVE MAINTENANCE: Record all maintenance and repair notes in the maintenance logbook for each meter (see FS 1007). If rental equipment is used, a log is not required. However, the origin (i.e., rental company), rental date, equipment type, model number, and identification number (if applicable) must be entered into the field notes or a rental equipment notebook.

4. DOCUMENTATION

4.1. Standard and Reagent Documentation: Document information about standards and reagents used for calibrations, verifications, and sample measurements.

4.1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents. Document acceptable verification of any standard used after its expiration date.

4.1.2. Record the concentration or other value for the standard in the appropriate measurement units.

4.1.2.1. Note vendor catalog number and description for pre-formulated solutions as well as for neat liquids and powdered standards.

4.1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

4.1.3. Record the grade of standard or reagent used.

4.1.4. When formulated in-house, document all calculations used to formulate calibration standards. Record the date of preparation for all in-house formulations.

4.1.5. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

4.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

4.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

4.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used. Record the manufacturer

name, model number, and identifying number such as a serial number for each instrument unit.

4.2.3. Record the time and date of all initial calibrations and all calibration verifications.

4.2.4. Record the instrument reading (value in appropriate measurement units) of all calibrations and verifications to the resolution stated by the instrument manufacturer.

4.2.5. Record the name of the analyst(s) performing the calibration.

4.2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., pH buffer)
- Value of standard, including correct units (e.g., pH = 7.0 SU)
- Manufacturer's tolerance range for secondary standards
- Link to information recorded according to section 4.1 above

4.2.7. Retain manufacturers' instrument specifications.

4.2.8. Document whether successful initial calibration occurred.

4.2.9. Document whether each calibration verification passed or failed.

4.2.10. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

4.2.10.1. Document the date and time of any corrective actions.

4.2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

4.2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

4.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value, recorded to the resolution stated by the instrument manufacturer for the measurement range (value in appropriate measurement units)
- Reporting units
- "J" qualifier code and explanatory comment if the sample measurement is not chronologically and quantitatively bracketed by acceptable calibrations and verifications per section 2.2 above
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

Appendix FT 1000
Tables, Figures and Forms

Table FT 1000-1 Field Testing Acceptance Criteria

Parameter	Acceptance Criteria
pH (FT 1100)	± 0.2 Standard pH Units of buffer or more stringent program criteria
Specific Conductance (FT 1200)	$\pm 5\%$ of standard value
Temperature (FT 1400)	$\pm 0.5^{\circ}\text{C}$ of NIST-traceable value (with correction factors) Verification over range of applicable values
Dissolved Oxygen (FT 1500)	± 0.3 mg/L of theoretical value (see Table FT 1500-1)
Turbidity (FT 1600)	0.1-10 NTU: $\pm 10\%$ of standard value 11-40 NTU: $\pm 8\%$ of standard value 41-100 NTU: $\pm 6.5\%$ of standard value >100 NTU: $\pm 5\%$ of standard value
Total Residual Chlorine (FT 2000)	0.995 calibration curve correlation coefficient $\pm 10\%$ of primary standard value $\pm 10\%$ of secondary standard value Color comparator acceptance criterion: $\pm 10\%$ of primary standard value

FT 1600. Field Measurement of Turbidity

Use in conjunction with:

- FT 1000 General Field Testing and Measurement
- FS 1000 General Sampling Procedures
- FD 1000 Documentation Procedures

1. INTRODUCTION: Turbidity measures the scattering effect that suspended solids have on the propagation of light through a body of water (surface or ground waters). The higher the effect (i.e., intensity of scattered light), the higher the turbidity value. Suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, and plankton and other microscopic organisms cause turbidity in water.

This SOP describes the use of true nephelometric measurement using instruments meeting the specifications outlined in 2.1.

Exceptions to the requirements specified in 2.1 below include:

- 1.1. In situ probes with turbidity sensors used for screening purposes (e.g., groundwater purge stabilization measurements).
- 1.2. Non standard light sources, detectors or other turbidity measuring devices may be proposed for use in studies that entail comparison measurements (dredge and fill) or unattended deployment for monitoring purposes.
- 1.3. **Do not report results from “non standard” sensors or configurations for regulatory purposes such as permit compliance unless the Department has approved the use for the specific project.**
- 1.4. All “non-standard” instruments must be calibrated and verified according to the requirements in this SOP.

2. EQUIPMENT AND SUPPLIES

2.1. Field Instrument: Use a turbidimeter (nephelometer) or a spectrophotometer consisting of a light source and one or more photoelectric detectors with a readout device to indicate the intensity of light. The instrument must meet these specifications:

- 2.1.1. The light source must have a tungsten-filament lamp operated at a color temperature between 2000 and 3000 K.
- 2.1.2. The distance traversed by the incident light and scattered light within the sample tube must not exceed 10 cm.
- 2.1.3. The light detector, positioned at 90° to the incident light, must have an acceptance angle that does not exceed $\pm 30^\circ$ from 90°.
- 2.1.4. The detector and any filter system must have a spectral peak response between 400 and 600 nanometers.
- 2.1.5. The instrument sensitivity must permit detection of a turbidity difference of 0.02 NTU at the 0 – 1.0 NTU scale.
- 2.1.6. Note: using the appropriate equipment and following the procedures in this SOP, the field accuracy of this measurement is close to $\%R = 100 \pm 10\%$ for turbidities in the range of 1 to 100 NTU.

2.2. Sample Cells (cuvettes): Use sample cells or tubes of clear, colorless glass or plastic.

- 2.2.1. Keep cells clean, both inside and out, and discard if scratched or etched.

- 2.2.1.1. Never handle them where the light beam strikes the sample.
- 2.2.1.2. Clean sample cells by thorough washing with laboratory soap (inside and out) followed by multiple rinses with distilled or de-ionized water, and let air-dry.
- 2.2.2. Use a very thin layer of silicone oil on the outside surfaces to mask minor imperfections or scratches in the cells.
 - 2.2.2.1. Use silicone oil with the same refractive index of the glass; making sure the cell appear to be nearly dry with little or no visible signs of oil.
- 2.2.3. Because small differences between cells significantly impact measurement, use either matched pairs or the same cell for standardization and sample measurement.

2.3. Standards:

2.3.1. Primary standards: Use these standards for initial calibration.

2.3.1.1. Formazin standards can be either obtained commercially or prepared according to method 2130B (2011), section 3. in Standard Methods for the Examination of Water and Wastewater (see Standard Methods Online, <http://www.standardmethods.org/store/>).

2.3.1.2. Some instruments may require the use of styrene divinylbenzene (SDVB) standards for calibration.

2.3.2. Secondary Standards: Use only those certified by the manufacturer for a specific instrument. Secondary standards must only be used for continuing calibration verifications according to the procedures in section 3.4 below. Determine or verify the values of secondary standards according to the procedure in section 3.3 below.

2.3.3. Turbidity-free water: Use filtered, laboratory reagent water demonstrated to be free of measurable turbidity (<0.01 NTU) or purchase commercially prepared turbidity-free water.

3. CALIBRATION AND USE

3.1. General Concerns

3.1.1. Light absorption by dissolved and suspended matter may cause a negative bias on the turbidity measurement. When present in significant concentrations, particles of light-absorbing materials such as activated carbon will cause a negative interference. Likewise, the presence of dissolved, color-causing substances that absorb light may also cause a negative interference. Some commercial instruments may have the capability of either correcting for slight color interference or optically blanking out the color effect.

3.1.2. Handle samples with natural effervescence as described in 3.5.7.1 below.

3.2. Calibration and Initial Calibration Verification

3.2.1. Follow the calibration activities in FT 1000, section 2.2, including requirements for chronological and quantitative bracketing.

3.2.2. Perform an initial calibration using at least two primary standards.

3.2.2.1. If the instrument cannot be calibrated with two standards, calibrate the instrument with one standard and verify with a second standard per 3.2.3 below.

3.2.2.2. For measurement of samples of very low turbidity, select the lowest standard commercially available for bracketing the lower end of the anticipated sample turbidity range or dilute higher turbidity standards with turbidity-free water.

3.2.2.3. Do not use turbidity-free water as a calibration verification standard.

3.2.3. Perform an initial calibration verification by reading at least one primary standard as a sample in "read" or "run" mode. The acceptance criterion for the initial calibration verification depends on the range of turbidity of the standard value:

- Standard Value = 0.1-10 NTU: the response must be within 10% of the standard except specified in 3.2.3.1 below;
- Standard Value = 11-40 NTU: the response must be within 8% of the standard;
- Standard Value = 41-100 NTU: the response must be within 6.5% of the standard; and
- Standard Value > 100 NTU: the response must be within 5% of the standard.

3.2.3.1. Turbidity-free water sold as a standard by a vendor (i.e., a blank) does not have to meet the acceptance requirement of $\pm 10\%$, but must meet the vendor's stated value (typically < 0.1 NTU) or be less than the reporting limit. The user may still use this blank to set the zero point according to the instrument manufacturer's manual.

3.3. Determining the Values of Secondary Standards

3.3.1. Use only those standards certified by the manufacturer for a specific instrument.

3.3.2. Use verified secondary standards only for continuing calibration verifications.

3.3.3. Determining the initial value(s) of secondary standard(s):

3.3.3.1. Calibrate or verify the instrument with primary standards. Select primary standards that bracket the range of the secondary standards.

3.3.3.2. Immediately after an initial calibration with primary standards or verification with a primary standard, read each secondary standard as a sample in "read" or "run" mode, using the reading from the instrument as the first assigned value.

3.3.4. Verifying Secondary Standards

3.3.4.1. At least once per quarter or at other documented intervals (see 3.3.5 below), determine or verify the values of secondary standards immediately after the instrument has been calibrated or verified with primary standards.

3.3.4.2. Read each secondary standard as a sample in "read" or "run" mode. This reading must be within the manufacturer's stated tolerance range and within the acceptance ranges of the assigned standard value as listed in 3.2.3., above. If the criteria in section 3.2.3., above are not met, assign this reading as the value of the standard. If the reading is outside the manufacturer's stated tolerance range, discard the secondary standard.

3.3.5. More frequent calibration verifications may be required for discharge permit compliance measurements or other regulatory requirements.

3.4. Continuing Calibration Verification

Determine the maximum time between continuing calibration verifications for the specific turbidity measurement device based on instrument stability at demonstrated intervals as in FT 1000, sections 2.2.5.1 and 2.2.5.2. Sample readings must be chronologically and quantitatively bracketed per requirements in FT 1000, section 2.2.

3.4.1. Perform a continuing calibration verification using at least one primary or secondary standard by reading the standard as a sample in "read" or "run" mode.

3.4.2. The calibration acceptance criteria are the same as those listed in section 3.2.3 above.

3.5. Measuring Turbidity in Samples

3.5.1. Double-rinse the sample cell or cuvette with a small amount of the sample.

3.5.2. Discard, and pour an aliquot into the sample cell or cuvette.

- 3.5.3. Gently agitate the sample and wait until air bubbles disappear.
- 3.5.4. Gently dry out its external surface with lint-free paper.
- 3.5.5. Insert the cell in the instrument and read the turbidity directly from the meter display.
- 3.5.6. Process and measure the sample as above and record the instrument reading within 15 minutes of sample collection.
- 3.5.7. Do not use vacuum degassing, ultrasonic bath or other devices to remove bubbles from the sample. If the sample contains visible bubbles or if it effervesces (as in groundwater, with changes in pressure and temperature), make a note of this in the field records and collect a sample for laboratory measurement.
 - 3.5.7.1. If effervescing samples are collected for laboratory analysis collect the sample without leaving headspace in the container and ship it as soon as possible to the laboratory (the holding time for this measurement is only 48 hrs).
 - 3.5.7.2. Ship this sample in wet ice at $\leq 6^{\circ}\text{C}$.
- 3.5.8. Pour out the sample, double-rinse the cuvette with de-ionized water in preparation for the next sample.
- 3.5.9. For measurement of turbidity *in situ* with a turbidity probe (for purposes included in Section 1 above), immerse or place the probe at a measuring location representative of the sampling source.
 - 3.5.9.1. If the turbidity instrument has selectable settings to measure the full range of potential sample turbidities, select the correct range in order to take a reading.
 - 3.5.9.2. Allow the turbidity instrument reading to stabilize.
 - 3.5.9.3. Record the sample turbidity measurement after all applicable meter adjustments have been made and the instrument reading has stabilized.
 - 3.5.9.4. For *in situ* measurements of turbidity at depth in surface water or wastewater, immerse the probe at the desired depth and wait for stabilization of the reading and record its value, as above.
 - 3.5.9.5. Measure groundwater sample turbidity *in situ* with a downhole probe or in a flow-through container or other applicable measurement configuration.
- 4. PREVENTIVE MAINTENANCE: Refer to FT 1000, section 3.
- 5. DOCUMENTATION
 - 5.1. Standard and Reagent Documentation: Document information about standards and reagents used for calibrations, verifications, and sample measurements.
 - 5.1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents. Document acceptable verification of any standard used after its expiration date.
 - 5.1.2. Record the concentration or other value for the standard in the appropriate measurement units.
 - 5.1.2.1. Note vendor catalog number and description for preformulated solutions as well as for neat liquids and powdered standards.
 - 5.1.2.2. Retain vendor assay specifications for standards as part of the calibration record.
 - 5.1.3. Record the grade of standard or reagent used.
 - 5.1.4. When formulated in-house, document all calculations used to formulate calibration standards. Record the date of preparation for all in-house formulations.

5.1.5. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

5.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

5.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

5.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used. Record manufacturer name, model number, and identifying number (such as a serial number) for each instrument unit.

5.2.3. Record the time and date of all initial calibrations and all calibration verifications.

5.2.4. For all calibration verifications, record the instrument reading (value) in appropriate measurement units to the resolution stated by the instrument manufacturer for the measurement range.

5.2.5. Record the name of the analyst(s) performing the calibration.

5.2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., formazin)
- Value of standard, including correct units (e.g., 20 NTU)
- Link to information recorded according to section 5.1 above

5.2.7. Retain manufacturers' instrument specifications.

5.2.8. Document whether successful initial calibration occurred.

5.2.9. Document whether each calibration verification passed or failed.

5.2.10. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

5.2.10.1. Document date and time of any corrective action.

5.2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

5.2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

5.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value, recorded to the resolution stated by the instrument manufacturer for the measurement range
- Reporting units
- "J" data qualifier code and explanatory comment if the sample measurement is not chronologically and quantitatively bracketed by acceptable calibrations and verifications per requirements in FT 1000, section 2.2
- Initials or name of analyst performing the measurement

DEP-SOP-001/01
FT 1600 Field Measurement of Turbidity

- Unique identification of the specific instrument unit(s) used for the test(s)

FIELD PROCEDURE

FIELD FORMS

PROCEDURE NO. MAFB-CP-01

This page was intentionally left blank.



Field Forms

Procedure No. MAFB-CP-01

1.0 PURPOSE

This Field Procedure provides all field forms required for support of environmental restoration field activities at Avon Park Air Force Range, FL under contract to the United States Army Corps of Engineers (USACE) Mobile District.

2.0 ATTACHMENTS

- Site Safety Briefing Form
- Equipment Maintenance and Calibration Record
- Cooler/Sample Receipt Form
- Field Sampling Report
- Surface Water Sampling Data
- Daily Quality Control Report

This page was intentionally left blank.

ATTACHMENT 1

Field Forms

This page was intentionally left blank.



SITE SAFETY BRIEFING FORM

Project _____ Location _____
Date _____ Time _____
Type of Work _____

SAFETY TOPICS PRESENTED

Protective Clothing/Equipment _____

Chemical Hazards _____

Physical Hazards _____

Biological Hazards _____

Emergency Procedures Refer to Site Safety and Health Plan

Hospital/Clinic _____ Phone _____
Hospital Address _____
Special Equipment _____
Other _____

ATTENDEES

Name (Printed)

Signature

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Meeting Conducted by: _____

Site Safety Officer: _____

This page was intentionally left blank.



EQUIPMENT MAINTENANCE AND CALIBRATION RECORD

Contract/Project: _____				Equipment Description: _____		
Activity: _____				Equipment ID: _____		
				Equipment Serial No.: _____		

Calibration Date/Time	Parameter	Standard Used (Concentration)	Lot Control No./ Expiration Date	Post Calibration Reading	Comments Pass/Fail	Signature

Maintenance Performed: _____

This page was intentionally left blank.

FIELD SAMPLING REPORT

LOCATION: _____		PROJECT : _____	
SITE: _____			
SAMPLE INFORMATION			
MATRIX _____		SAMPLE ID: _____	
SAMPLING METHOD _____		DUP./REP. OF : _____	
BEGINNING DEPTH _____		MATRIX SPIKE/MATRIX SPIKE DUPLICATE YES () NO ()	
END DEPTH _____			
GRAB () COMPOSITE ()		DATE: _____ TIME: _____	
CONTAINER	PRESERVATIVE/ PREPARATION	EXTRACTION METHOD	ANALYTICAL METHOD
SIZE/TYPE	#	ANALYSIS	

NOTABLE OBSERVATIONS		
PID READINGS	SAMPLE CHARACTERISTICS	MISCELLANEOUS
1st	COLOR:	
2nd	ODOR:	
	OTHER:	

pH _____ Temperature _____ Dissolved oxygen _____ Specific Conductivity _____

GENERAL INFORMATION	
WEATHER: SUN/CLEAR _____ OVERCAST/RAIN _____ WIND DIRECTION _____ AMBIENT TEMP _____	
SHIPMENT VIA: FED-X _____ HAND DELIVER _____ COURIER _____ OTHER _____	
SHIPPED TO: _____	
COMMENTS: _____	
SAMPLER: _____ OBSERVER: _____	

MATRIX TYPE CODES DC=DRILL CUTTINGS SL=SLUDGE WG=GROUND WATER SO=SOIL LH=HAZARDOUS LIQUID WASTE GS=SOIL GAS SH=HAZARDOUS SOLID WASTE WS=SURFACE WATER SE=SEDIMENT SW=SWAB/WIPE	SAMPLING METHOD CODES B=BAILER G=GRAB BR=BRASS RING HA=HAND AUGER CS=COMPOSITE SAMPLE H=HOLLOW STEM AUGER C=CONTINUOUS FLIGHT AUGER HP=HYDRO PUNCH DT=DRIVEN TUBE SS=SPLIT SPOON W=SWAB/WIPE SP=SUBMERSIBLE PUMP
---	---

This page was intentionally left blank.



Location Sketch	
-----------------	--

This page was intentionally left blank.



Tanaq

ENVIRONMENTAL

DAILY QUALITY CONTROL REPORT

Date_____

	S	M	T	W	Th	F	S
Weather							
Temp							
Wind							
Humidity							

USACE PROJECT MANAGER:

PROJECT:

CONTRACT NUMBER:

[illegible]



Date _____

PROJECT:

CONTRACT
NUMBER:

Quality Control Activities (including field calibrations):

Health and Safety Level Activities:

Problems Encountered/Corrective Action Taken:

Special Notes

Signature:

Title:

FIELD PROCEDURE

CHAIN OF CUSTODY

PROCEDURE No. MAFB-CP-02

This page was intentionally left blank.

	STANDARD OPERATING PROCEDURE	
Field Logbook Use and Maintenance	SOP No.: 4.07	
	SOP Category: Environmental Services	
	Revision No.: 2	
	Revision Date: July 2017	
	Review Date: July 2019	

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the methods for use and maintenance of field logbooks. This procedure outlines methods, lists examples for proper data entry into a field logbook, and provides the standardized Tanaq format.

2.0 SCOPE AND APPLICATIONS

This procedure provides guidance for routine field operations on environmental projects. Site-specific deviations from the methods presented herein must be approved by the assigned Tanaq project manager and the Tanaq project quality assurance/quality control officer. Consult the project-specific planning documents for other documentation requirements that apply to the project.

3.0 GENERAL REQUIREMENTS

All work will be performed in accordance with the project-specific planning documents. Refer to the project-specific health and safety plan for relevant health and safety requirements.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and documented in the planning documents. Deviations from requirements will be sufficiently documented to re-create the modified process.

All field personnel who travel to a site to conduct work related to environmental projects are responsible for documenting field investigation activities in project field logbooks in a legible manner and maintaining field logbooks over the course of the project in accordance with this SOP. Daily logs will be kept during field activities by the Tanaq field team leader, or approved designee, to provide daily records of significant events, observations, and measurements taken in the field.

The project manager or an approved designee is responsible for checking the field logbooks and verifying that they have been completed in accordance with this SOP.

4.0 PROCEDURE

4.1 INTRODUCTION

Field logbooks provide a means for recording observations and activities at a site. Field logbooks are intended to provide sufficient data and observation notes to enable participants to reconstruct events that occurred while performing field activities and to refresh the memory of field personnel when

Field Logbook Use and Maintenance	SOP No.: 4.07
	SOP Category: Environmental Services
	Revision No.: 2
	Revision Date: July 2017
	Review Date: July 2019

writing reports or giving testimony during legal proceedings. As such, all entries will be as factual, detailed, and as descriptive as possible so that a particular situation can be reconstructed without reliance on the collector's memory. Field logbooks are not intended to be used as the sole source of project or sampling information. A sufficient number of logbooks will be assigned to a project to ensure that each field team has a logbook at all times.

4.2 FIELD LOGBOOK IDENTIFICATION

Field logbooks shall be bound books with consecutively numbered pages. Logbooks will be permanently assigned to field personnel for the duration of a project, or sampling event. When not in use, the field logbooks are to be stored in site project files. If site activities stop for an extended period (2 weeks or more), field logbooks will be stored in the project files in the appropriate Tanaq office. The field logbooks will also be scanned and stored electronically in the proper project file located on SharePoint.

The cover of each logbook will contain the following information:

- Organization to which the book is assigned (Tanaq),
- Project number (if different than site number),
- Book number, and
- Site name.

4.3 LOGBOOK ENTRY PROCEDURES

Every field team will have a logbook, and each field activity will be recorded in the logbook by a designated field team member to provide daily records of significant events, observations, and measurements during field operations. Beginning on the first blank page and extending through as many pages as necessary, the following list provides examples of useful and pertinent information that may be recorded (optional).

- Serial numbers and model numbers for equipment that will be used for the project duration,
- Formulas, constants, and example calculations,
- Useful telephone numbers, and
- County, state, and site address.

Entries into the logbook may contain a variety of information. At a minimum, logbook entries must include the following information at the beginning of each day:

- Date,
- Site name, site location, and project number,
- Start time,

Field Logbook Use and Maintenance	SOP No.: 4.07
	SOP Category: Environmental Services
	Revision No.: 2
	Revision Date: July 2017
	Review Date: July 2019

- Weather,
- Field personnel and subcontractors present and directly involved,
- Level of personal protective equipment being used on the site,
- Equipment used and calibration procedures followed, and
- Any field calculations.

In addition, information recorded in the field logbook during the day will include, but is not limited to, the following:

- Sample description including sample numbers, time, depth, volume, containers, preservative, and media sampled;
- Information on field quality control samples (e.g., duplicates);
- Sample courier airbill numbers and associated chains of custody;
- Observations about site and samples (odors, appearances, etc.);
- Information about any activities, extraneous to sampling activities, that may affect the integrity of the samples;
- Any public involvement, visitors, or press interest, comments, or questions; as well as times present at site;
- Equipment used on site including time and date of calibration along with calibration gas/fluid lot numbers and expiration dates;
- Background levels of each instrument and possible background interferences;
- Instrument readings for the borehole, cuttings, or samples in the breathing zone and from the specified depth of the borehole, etc.;
- Field parameters (pH, specific conductivity, etc.);
- Unusual observances, irregularities, or problems noted on site or with instrumentation used;
- Maps or photographs acquired or taken at the sampling site, including photograph numbers and descriptions;
- A description of the investigation-derived waste (IDW) generated, the quantity generated, and the manner of IDW storage employed;
- A photograph log that lists subject and persons, distance to subject, person taking photograph, distance, direction, time, photograph number, and noteworthy items for each photograph; and
- Forms numbers and any information contained therein used during sampling (Note that a form does not take the place of the field logbook.).

Field Logbook Use and Maintenance	SOP No.: 4.07
	SOP Category: Environmental Services
	Revision No.: 2
	Revision Date: July 2017
	Review Date: July 2019

All logbook entries will be made in indelible black or blue ink. No erasures are permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark and initialed and dated by the originator. Entries will be organized into easily understandable tables if possible. A sample format is shown in Attachment 1.

All logbook pages will be initialed and dated at the top of each page. Times will be recorded next to each entry. No pages or spaces will be left blank. If the last entry for a day is not at the end of a page, a diagonal line will be drawn through the remaining space and the line will be initialed and dated.

Logbooks can become contaminated when used in the field. Every effort should be made by the field team to avoid contaminating the logbook. Logbooks can be kept in seal-top poly bags or temporary plastic covers may be used.

4.4 REVIEW

The assigned project leader or an approved designee will check field logbooks for completeness and accuracy on an appropriate site-specific schedule determined by the project leader. Any discrepancies in these documents will be noted and returned to the originator for correction. The reviewer will acknowledge that these review comments have been incorporated by signing and dating the applicable reviewed documents.

ATTACHMENTS

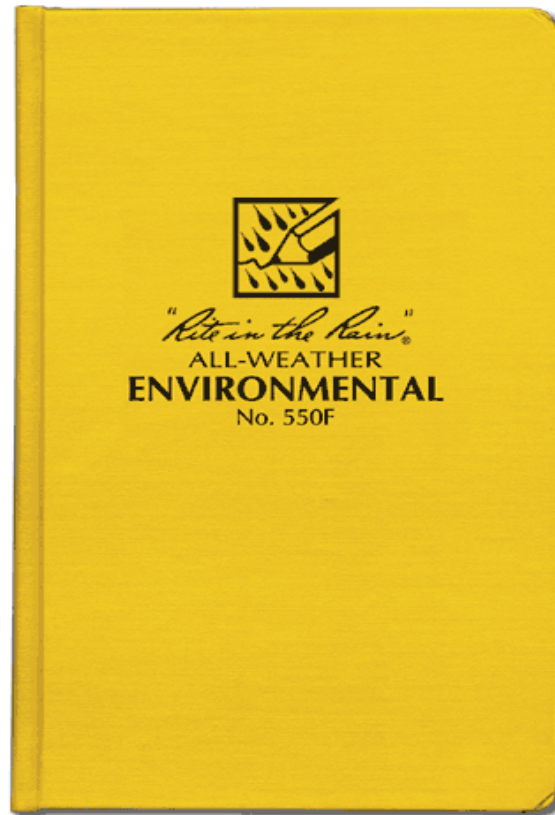
Attachment 1 – Example Field Logbook

ATTACHMENT 1
EXAMPLE FIELD LOGBOOK

This page was intentionally left blank.

ATTACHMENT 1

Example Field Logbook



ENVIRONMENTAL				4 x 4 to the inch with heading			
Location _____		Date _____		Location _____		Date _____	
Project / Client _____				Project / Client _____			

INFORMATION RECORDED IN THE FRONT OF LOG

DOES OPTIONAL

- serial model # of equipment (sensors)
- formulas, conversions, example calculations
- useful phone #s
- site address

DAILY RECORDING REQUIREMENTS

- Initials and date (top of every page)
- start time
- weather
- field methods (you may cross reference a previous days method if identical)
- personnel present on site
- pipe
- signatures of individual recording info
- equipment/procedures used
- sample descriptions (time, depth, volume, containers, preserve, etc.)
- GC samples (field and lab)
- observations
- field parameters
- maps/photos drawn or taken
- form #s
- handwritten paperwork

Photo log:

Subject of photos.
distance to subject.
person taking photo.
distance between on.
Time / place / weather.
Measuring them.

When using a field form information recorded in the field does not need to be written twice. Cross reference the field form # in the log book and record the information only on the appropriate field form.

DO NOT LEAVE ANY BLANK SPACES/PAGES.

If a page is accidentally left blank or there is unused space at the end of a day's entry draw a diagonal line through the space and initial and date the line.

Ann Vogel
11/10/95

November 6, 1995, AX1015.13.00

pH Meter

Hook

Model # = 12345

Serial # = 6789

PH

Conductivity Meter

Hook

Model # = 12345

Serial # = 6789

$C^2 = a^2 + b^2$

If $a = 3$

If $b = 4$

Then: $a^2 + b^2 = 3^2 + 4^2$

$a^2 = 9$

$b^2 = 16$

$c^2 = 25$

$c = 5$

$r = 8.14159$

PH

Anna Vogel home # 123-4567

105 Denver Office # 203/2096-9700

105 San Francisco # 415/774-2300 (home)

PH

Smith Site

Badger County, Colorado

Address: 1234 W. Main Street

Manitou, Colorado 80000

Directions to Site:

West on I-70

Exit 95B

Head South approx. 3 miles

Site is on east side of dirt road.

AV 11/6/95

2

November 6, 1995 Site Visit

0700 Arrive on site

Weather: 80°, sunny, slight breeze
(~5 mph) from southwest

UOS Field Team: EPA OSC:

M.R. Smith

K.W. Wagner

P.R. Lane

PRP representative, L.M. Stein, will
be accompanying the UOS Field Team.

Personal Protective Equipment - LEVEL D
will be used on-site (refer to site-
specific health & safety plan).

All equipment will be decontaminated as
follows:

- Brush equipment scrub-brush to
remove gross particulates.
- Scrub thoroughly with Alconox/
water solution.
- Rinse with reagent-grade distilled
water.
- Rinse with reagent-grade Methanol.
- Rinse with reagent-grade distilled
water.

Allow equipment to gravity drain
wrap equipment in tinfoil if not
immediately used.

Sample procedure:

All surface water samples will be
taken using a clean decontaminated
TEFLON scoop; stainless steel spoon
and stainless steel bowl will be
used for sediment samples.

AV 11/6/95

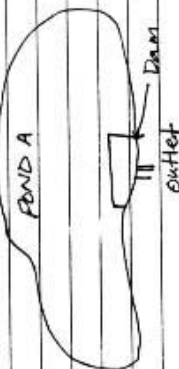
3

The samples will be taken from the
ponds at the center of the dam
opposite the outlets. (see below);
refer to sample plan.

All total suspended solids (TSS) samples
will be collected in a 500 ml
polystyrene bottle - No preservative
is necessary.

All VOA samples will be collected in
two 40-ml amber glass vials and
will be collected first. Preservation
will be 4°C (ice).

→ Meters (pH) Decon = Rinse with
reagent-grade distilled water



0730: Leave trailer. Go to sample
location SS-1 @ Pond A.

0745: Arrive @ Pond A.
Decon. equipment as described -
on page 2 of this logbook.

Calibrate pH meter - Rinse probe

Time	STD	Reading
0753	7.00	7.00 Rinse probe
0754	4.00	4.00 Rinse probe
0756	Calibrate Conductivity meter using 10000 STD - Rinse probe	

11/6/95 AV
5

AV 11/6/95
4

FIELD PARAMETERS		
TIME	PH	CONDUCTIVITY
0924	6.00	590
Decon meters as noted on page 3 of this logbook.		
Fill out surface water quality sheet.		
0940 - Leave Pond B - head back to trailer to pack samples for shipment.		
0952 - Arrive at Trailer.		
0959 - Complete chain-of-custody forms for samples to be shipped.		
Wrap samples according to VAS TSOB.		
1020 - Seal Cooler and attach Custody seals.		
1030 - Take cooler to Federal Express for shipping.		
CAL # 1234567.		
1035 - Leave Federal Express.		
Sampling complete.		
Time Sample # Label #		
0802	V0A	81008 V0A 101
0803	TSS	81008 TSSA 103*
Decon equipment (scoop only)		
* Label 102 fell in mud - destroyed it.		
Field parameters		
Time	PH	Conductivity
0815	6.35	610
Decon equipment (meters only)		
Fill out surface water quality sheet.		
Note - wind speed is picking up - The ponds became turbulent.		
0839 - Leave Pond A - go to Pond B.		
0840 - Arrive at Pond B		
Pond B sampling procedure.		
0842 - Decon equipment.		
Calibrate PH meter		
Time	STD	Reading
0844	4.00	4.00 Rinse probe
0845	7.00	7.00 Rinse probe
0847 Calibrate conductivity meter using 10000 STD - Rinse probe.		
Decon sampling equipment (scoop).		
Time Sample # Label #		
0902	V0A	81008 V0ABD 106
0903	TSS	81008 TSS BD 107
0903	Decon scoop.	
Rinse Samples		
Time Sample # Label #		
0920	V0A	81008 V0AR 107-108

Standard Operating Procedure No. 073 for Sampling for Per- and Polyfluorinated Alkyl Substances

Prepared by

Tanaq Environmental, LLC
2480 W. 26th Street, Suite B-26
Denver, CO 80211

Revision 2
August 2022

This page intentionally left blank

PROJECT-SPECIFIC VARIANCE FORM

This form is to be completed to indicate if there are client-, project-, or site-specific variances to this Standard Operating Procedure (SOP) (**check Box A**), or if this SOP is being used with no changes (**check Box B**). This form should be archived with the project files.

- ☐ **A. Variances required; cite section(s) of the SOP to which there is a variance**

☐ **B. No variances**

[illegible]

Project Manager (Name)

Project Manager (Signature)

Date

This page intentionally left blank

CONTENTS

	<u>Page</u>
DOCUMENT REVISION HISTORY	ii
1. SCOPE AND APPLICATION.....	1
2. ACCEPTABLE MATERIALS.....	1
3. PROCEDURES.....	3
3.1 GENERAL CONSIDERATIONS	3
3.2 EQUIPMENT DECONTAMINATION	4
3.3 SAMPLE COLLECTION AND PRESERVATION	5
3.4 SOIL/SEDIMENT SAMPLING CONSIDERATIONS	5
3.5 GROUNDWATER SAMPLING CONSIDERATIONS	5
3.6 SURFACE WATER AND POREWATER SAMPLING CONSIDERATIONS ...	6
3.7 FIELD QUALITY CONTROL SAMPLES.....	6
4. MAINTENANCE	7
5. PRECAUTIONS	7
6. REFERENCES	7

DOCUMENT REVISION HISTORY

ORIGINAL (MASTER) DOCUMENT REVISION HISTORY				
Revision Number	Revision Date	Revision Summary	Revised By	Reviewed By
1	April 2019	PPE prohibited for use during PFAS sampling.	N. Stoecklein	S. Richmond
2	August 2022	Systematic update and review	Clement Smith	Madeline Manfre

1. SCOPE AND APPLICATION

The objective of this Standard Operating Procedure (SOP) is to delineate protocols for collecting environmental samples for analysis of Per- and Polyfluorinated Alkyl Substances (PFAS), also known generally as perfluoroalkyl compounds or chemicals (PFCs).

This SOP includes sampling procedures and requirements specific to analysis of PFAS, which are ubiquitous and have a high potential for cross-contamination from common consumer products and sampling materials, even when new and clean. This SOP should be used in combination with appropriate SOPs applicable to the target medium and sampling methodology (e.g., but not limited to SOP No. 007 Surface Water Sampling, SOP No. 013 Collection of Monitoring Well Samples, SOP No. 21 Sediment Sampling, SOP No. 25 Soil Sampling, or SOP No. 047 Direct-Push Technology Sampling).

This SOP was developed primarily based on guidance from the U.S. Army Corps of Engineers *Appendix A: Sampling and Analysis Plan, Standard Operating Procedure 047: Per/Poly Fluorinated Alkyl Substances (PFAS) Field Sampling* (2022) and the Interstate Technology Regulatory Council (ITRC, 2020).

2. ACCEPTABLE MATERIALS

Table 1 provides a summary of Prohibited Items that should NOT be used or present during sampling for PFAS because they may contain PFAS, along with Acceptable (PFAS-free). Alternatives that may be used if appropriate for project specific requirements. In general, in the context of sampling events, PFAS are commonly found in waterproof and nonstick materials (including food packaging, rain gear, and anything containing Teflon®), personal care products, and certain plastics (e.g., Low-Density Polyethylene [LDPE]) and synthetic fibers.

If a plastic product or chemical not included in the Acceptable Alternatives column of Table 1 is proposed for use, it is recommended that Safety Data Sheets and other references be reviewed prior to use to confirm that the material does not contain PFAS. Indications of potential PFAS ingredients, in addition to the items listed in Table 1, include the following materials (ITRC, 2020):

- Polytetrafluoroethylene (fluorocarbon solids such as Teflon)
- Waterproof coatings containing PFAS
- Fluorinated ethylene propylene
- Ethylene tetrafluoroethylene
- Low-density polyethylene
- Polyvinylidene fluoride
- Pipe thread compounds and tape
- Generally, any other ingredient names containing the prefix “fluoro.”

Table 1. Prohibited Items and Acceptable Alternatives for Use during PFAS Sampling

Prohibited Items	Acceptable Alternatives
Field Equipment	
Teflon-containing or LDPE materials (including tubing, bailers, tape)	HDPE or silicone materials
Waterproof field books, plastic clipboards, binders, or spiral hard cover notebooks	Loose paper (non-waterproof) on aluminum or Masonite clipboards
Sharpies®/markers, waterproof pens	Non-waterproof pens or pencils
Sticky notes (e.g., Post-It®) and glues	Not applicable
Re-usable chemical (blue) ice packs	Regular ice in polyethylene bags (double bagged)
Aluminum foil	Thin HDPE sheeting
Plastic spoons used in soil/sediment sampling	Stainless steel trowels/spoons
Reusable core liners	Single-use PVC or acetate liners
LDPE HydraSleeve	HDPE HydraSleeve
Field Clothing and Personal Protective Equipment	
New cotton clothing; synthetic water resistant, waterproof, or stain- treated clothing; clothing containing Gore-Tex™	Well-laundered clothing, defined as clothing that has been washed 6 or more times after purchase, made of natural fibers (preferably cotton)
Clothing laundered using fabric softener	No fabric softener
Boots (e.g., steel-toed or waders) containing Gore-Tex™ or waterproof coatings	Boots made with polyurethane or PVC with no waterproof coating
Coated Tyvek® suits, <u>SARANAX® suits</u> <u>Gloves containing PFAS, such as Viton® gloves</u>	Uncoated/plain Tyvek suits not containing PFAS
Cosmetics, shampoo, conditioner, body gel, moisturizers, hand cream, waxed dental floss, or other personal care products used <u>on the day of sampling</u> .	Use bar soap not containing moisturizers and rinse well on the day of sampling (including for hand washing). Use any other required products the night before (rather than the day of) sampling.
Paper towels	Air dryers (for hand drying)
No sunscreens or insect repellents except approved 100% natural products such as those noted in the Alternatives column.	Acceptable Sunscreens: Alba Organics Natural Sunscreen, Yes To Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss My Face, “free” or “natural” sunscreens for babies Acceptable Insect Repellents: Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect Repellent, Herbal Armor, California Baby
Sample Containers	
LDPE or glass containers	HDPE containers (or polypropylene if required)
Teflon-lined caps	Unlined HDPE (or polypropylene if required) caps
Rain Events	
Rain gear that has been treated to make it waterproof/resistant and breathable (e.g., Gore-Tex™ treated)	PVC or polyurethane- or wax-coated rain gear that is confirmed not to contain PFAS or utilize a gazebo tent that is only touched or moved prior to and following sampling activities.
Equipment Decontamination	

Prohibited Items	Acceptable Alternatives
Decon 90	Alconox [®] , Liquinox [®] and/or Citranox [®]
Water from an onsite monitoring well	Potable water from municipal drinking water supply (not containing PFAS), and "PFAS-free" deionized water for final rinse
Food Considerations	
All food and drink, with exceptions noted in the Alternatives column. Paper food packaging (e.g., fast food wrappers, drink cups, paper bags) and foil, in particular, often contain PFAS.	Bottled water and hydration drinks (i.e., Gatorade [®] and Powerade [®]) to be brought and consumed only in the staging area
NOTES: HDPE = High-density polyethylene. PVC = Polyvinyl chloride.	

3. PROCEDURES

As stated above, this SOP includes procedures specific to analysis of PFAS, and should be used in combination with the appropriate SOPs applicable to the target medium and sampling methodology.

3.1 GENERAL CONSIDERATIONS

Materials listed in the Prohibited Items column of Table 1 and other materials containing PFAS ingredients should not be used. However, in some cases, these materials must be used due to factors outside the control of the scope of the work or utility of the project team (e.g., health and safety requirements where other hazardous chemicals are present, or where the sampling requirements are prescriptive, unexpected, or time-sensitive). In these cases, the sampling team should purge/rinse equipment adequately with PFAS-free water where available, and collect additional quality control samples (Section 3.7) to assess the degree of cross-contamination associated with the use of known or suspected PFAS-containing materials during sampling.

NOTE: Most steel-toed boots are made from coated leather and synthetic fibers. PVC or polyurethane are preferred PFAS-free materials for boots. If not possible to obtain PFAS-free footwear that comply with specified health and safety requirements for personal protective equipment, then field personnel should minimize contact with footwear while in the sampling area, and always change gloves after touching footwear.

Disposable nitrile gloves shall be worn at all times during PFAS sampling activities. A new pair of nitrile gloves shall be donned after contacting potential contaminants including all non-decontaminated surfaces. New gloves shall also be donned before touching containers used for storage of PFAS samples, decontaminating re-usable sampling equipment, or handling quality control samples (Section 3.7).

Food shall not be eaten within 10 meters of any sampling area. Before eating or drinking, sampling personnel shall remove their gloves and any outer garments (e.g., coveralls) and leave the work area. When finished, sampling personnel shall wash their hands, remove any visible residue, and put new gloves and any outer garments back on prior to returning to the work area.

PFAS-containing stain resistant products are often applied to vehicle seats that have fabric upholstery. Therefore, if no outer garments (e.g., coveralls) will be worn, or if the outer garments will be worn in the field vehicle then, if feasible, the seats of the vehicle should be covered in a well-laundered cotton blanket to avoid contact between clothing and the seats.

Visitors to the sampling area shall remain at least 10 meters at a distance.

As indicated in Table 1, sampling personnel shall not use the personal care products or cosmetics (other than bar soap) prior to or during sample collection on any day. Additionally, clothes worn during sampling should be well-washed natural fibers.

Other personnel who come within 2-3 meters of the sample collection area should follow the guidelines above and in Table 1.

Fluids used during laboratory or fieldwork (e.g., drilling for monitoring well installation or for deep soil sampling) should be confirmed PFAS-free.

When sampling on a surface water body, associated gear (e.g., waders, life preservers) should be confirmed PFAS-free.

3.2 EQUIPMENT DECONTAMINATION

Wherever possible, dedicated or disposable equipment shall be used to avoid the need for decontamination, which introduces additional potential for cross-contamination.

Large field equipment (e.g., drill rigs) should be decontaminated with potable water using steam or high-pressure water. Laboratory-certified “PFAS-free” water should be used to perform a final rinse of portions of the sampling equipment that will be in direct contact with samples, wherever practical.

Hand-held, non-dedicated sampling equipment, which is used at multiple field sampling locations, shall be decontaminated using the following procedure:

- Rinse with a non-PFAS-containing detergent (e.g., Alconox, Liquinox, or Citranox)
- Rinse with “PFAS-free” water.
- Final rinse with laboratory-provided, “PFAS-free” deionized water.

The Safety Data Sheet for the selected detergent should be reviewed to ensure that it does not contain fluoro-surfactant ingredients.

Wherever possible, equipment should be rinsed with “PFAS-free” water immediately prior to use at each sampling location.

3.3 SAMPLE COLLECTION AND PRESERVATION

The sampling team shall coordinate with the analyzing laboratory regarding requirements for sample bottle, volume, and preservation requirements for samples for PFAS analysis, and the laboratory should provide certified “PFAS-free” containers. HDPE bottles with unlined caps are typically used for collection of samples for PFAS analyses. Polypropylene may also be used for specific applications (e.g., collection of drinking water samples to be analyzed for the short list of PFASs by Method 537) (Department of Defense Environmental Data Quality Workgroup, 2017).

Containers for collection of PFAS samples shall never be left uncapped, either before or after sample collection, and the lid/cap shall be kept in a gloved hand and not be set down while removed from the container.

Sampling personnel shall put on a clean pair of nitrile gloves immediately prior to collection of each sample for PFAS analyses, prior to removing the lid from the sampling container. After the sample is collected and the container is closed, pens or pencils, but not markers, shall be used in completing sample labels or in the vicinity of samples during collection.

Following sample collection and addition of preservative (if required), sample containers for PFAS analyses shall be placed in coolers with new, double-bagged ice and not re-usable chemical ice packs unless confirmed PFAS-free and regulatorily accepted, such that meltwater does not contact sample containers during transport.

3.4 SOIL/SEDIMENT SAMPLING CONSIDERATIONS

Surface soil and sediment samples for PFAS analyses should be collected using a clean, stainless-steel tool (e.g., a trowel or spoon or Ponar grab sampler).

For field collection of soil and sediment cores, single-use PVC, HDPE, or acetate liners shall be used, and samples for PFAS analysis should be collected from the cores directly or using a stainless-steel tool.

3.5 GROUNDWATER SAMPLING CONSIDERATIONS

It is recommended that, where feasible, measurements of monitoring well water levels and well depths be performed after sampling for PFAS to avoid possible cross-contamination.

HDPE or silicone tubing shall be used for purging and sample collection, where applicable. Teflon and LDPE shall NOT be used. During sampling, sampling personnel shall ensure that no tubing or other equipment contacts the inside or rim of the sample bottle. Any foaming observed in the sample during collection should be noted on the chain-of-custody form that accompanies the samples to the analytical laboratory.

If analyses to be performed by the laboratory include less common PFAS chemicals that have relatively high volatility (including fluorotelomers and sulfonamide/alcohols such as fluorotelomer alcohols, fluorotelomer acrylates, and methyl/ethyl fluorosulfonamides and sulfonamidoethanols), then precautions should be taken during sample collection to minimize loss of volatiles (e.g., minimizing turbulence in water as it flows into the sample container).

If use of passive/no-purge sample collection technology is to be utilized, it is critical to confirm that the sampling device does not contain LDPE (e.g., HydraSleeves made of HDPE rather than LDPE may be requested for PFAS sampling).

Filtration is not recommended because the filter may sorb PFAS or be a source of PFAS contamination.

3.6 SURFACE WATER AND POREWATER SAMPLING CONSIDERATIONS

Capped surface water sample containers shall be rinsed multiple times with site surface water prior to sampling.

Because PFAS tend to accumulate at the air/water interface, specific procedures for surface water sampling shall be followed. After rinsing, the capped container shall be lowered into the surface water, with the top pointed down. The container shall then be reoriented with the top pointed upward and opened under water at the depth targeted for sampling, ideally at least 10 centimeters from both the sediment surface and the water surface. During sample collection, the sample collection point shall be positioned upstream of the sampler, gloves, etc. If an extension rod must be used due to the depth of sampling, the rod shall be made of clean, PFAS-free material.

For porewater sampling, the common stainless-steel and PVC samplers, with HDPE and silicone tubing, are acceptable. The samplers should not be reused at multiple sampling locations.

As for groundwater samples, filtration is not recommended.

3.7 FIELD QUALITY CONTROL SAMPLES

It is recommended that field blanks and equipment (i.e., rinsate) blanks be collected at least daily, using laboratory supplied “PFAS-free” water, to detect any cross-contamination that occurred despite precautions taken during sampling. If a submersible pump is used for sample collection, then at least one equipment blank should be collected by pumping “PFAS-free” water through the pump with clean HDPE tubing.

Field duplicates should also be collected to assess the precision of the results.

Analysis of trip blanks may be advisable on a project-specific basis, particularly if relatively volatile PFAS chemicals will be analyzed.

The same precautions taken during collection of specified samples should be taken during the collection of quality control samples.

4. MAINTENANCE

Not applicable.

5. PRECAUTIONS

See detailed precautions noted above.

6. REFERENCES

Department of Defense Environmental Data Quality Workgroup. 2017. *Bottle Selection and other Sampling Considerations When Sampling for Per-and Poly-Fluoroalkyl Substances (PFAS)*. Revision 1.2. July.

Interstate Technology Regulatory Council (ITRC). 2020. *Fact Sheet: Site Characterization Considerations, Sampling Precautions, and Laboratory Analytical Methods for Per- and Polyfluoroalkyl Substances (PFAS)*. April.

U.S. Army Corps of Engineers. 2022. *Appendix A: Sampling and Analysis Plan, Standard Operating Procedure 047: Per/Poly Fluorinated Alkyl Substances (PFAS) Field Sampling*. June.

This page intentionally left blank

APPENDIX E: ACCIDENT PREVENTION PLAN/SITE SAFETY AND HEALTH PLAN

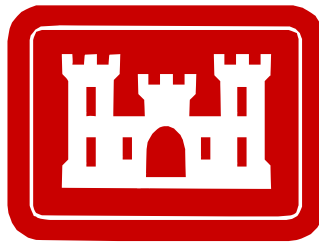
This page was intentionally left blank.

ACCIDENT PREVENTION PLAN, UPDATE 1

Optimized Remediation Contract
at
Avon Park Air Force Range, Florida

December 2023 – Revision 0

Prepared for:



**U.S. Army Corps of Engineers
Mobile District
109 St. Joseph St
Mobile, AL 36602-0001**

In Accordance with:

**Contract No.: W9127821D0063
Delivery Order No.: W9127821F0305
Florida DEP ID#: DOD_1_3338**

Prepared by:



**Tanaq Environmental, LLC
2480 W. 26th Avenue, Suite B-26
Denver, Colorado 80211**

This page was intentionally left blank.

EMERGENCY INFORMATION – AVON PARK AFR

To facilitate the quick retrieval of information in the event of an emergency, this summary has been placed in the front of this Accident Prevention Plan (APP). A copy must be posted in a conspicuous location onsite. In the event of any situation or unplanned occurrence requiring assistance, the appropriate contact(s) should be made from the list below. For emergency situations, telephone contact should be made with the site point of contact who will then contact the appropriate response teams. In the event of a serious, life-threatening emergency, emergency personnel should be contacted prior to contacting the site point of contact.

Emergency Telephone Numbers and Project Contacts

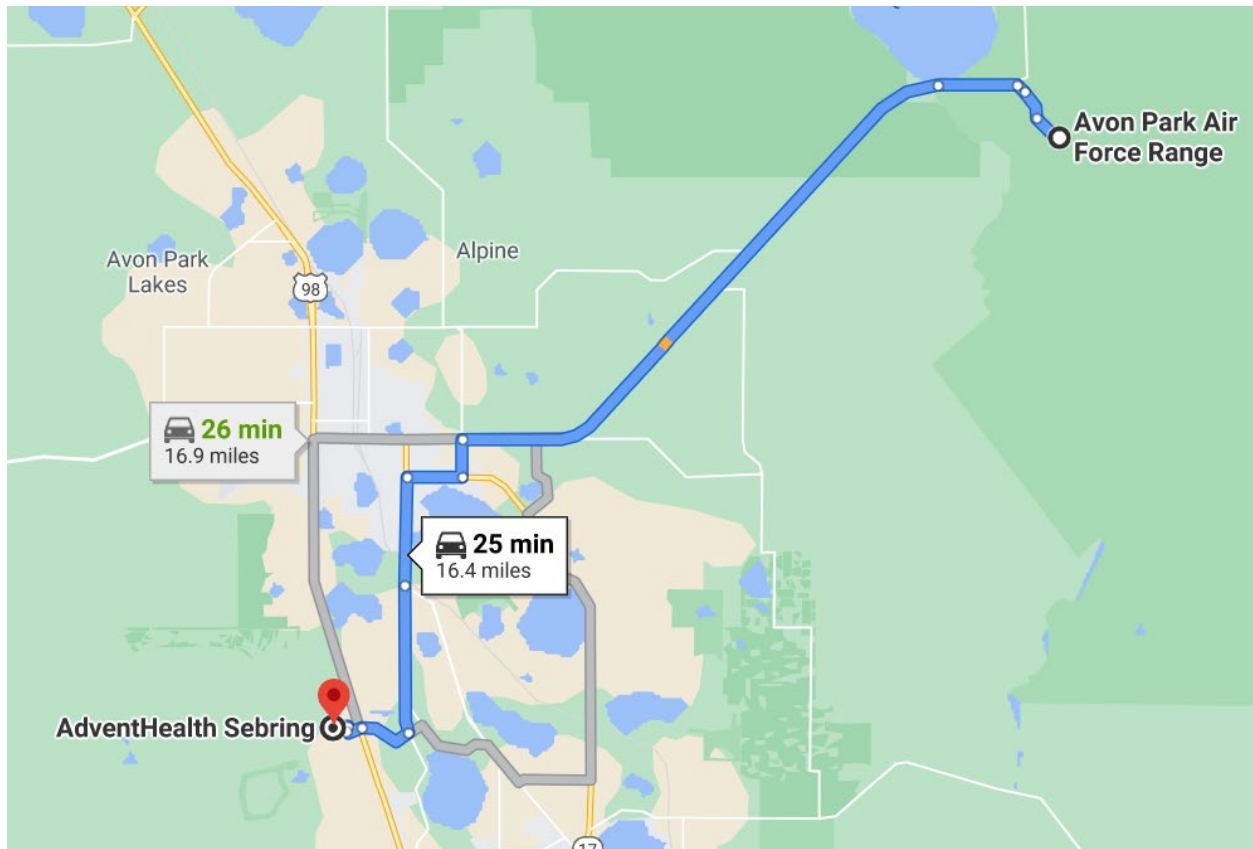
AGENCY	POC	PHONE
Fire, Police, Emergency Medical Services	Fire, Police, Ambulance	911 - tell them you are at Avon Park Air Force Range [APAFR]
Off-Base Emergency Medical Care	AdventHealth Sebring	(863) 314-4466
APAFR Remedial Project Manager	Kristy Snyder	(813) 716-4293
Florida Department of Environmental Protection Environmental Specialist III	Opeyemi Kehinde	(850) 245-8887
Client U.S. Army Corps of Engineers Project Manager	Bradley Jackson, PG, CHMM	(251) 694-3670
Tanaq Environmental, LLC Contacts		
24/7 Emergency number	Melaina Pierce, PMP	Cell: (860) 881-5292
Program Manager	Meriam Senoussi, PG	Cell: (773) 504-4406
Project Manager	Melaina Pierce, PMP	Cell: (860) 881-5292
Site Superintendent	Brantley Rudd	Cell: (404) 944-1077
Field Team Lead/Field Supervisor	Mark Lawrence, GIT	Cell: (727) 301-5865
Site Safety and Health Officer	Sarah Kwon	Cell: (325) 660-1738
Health and Safety Manager (to be contacted for all work related injuries and illnesses)	Nicole Easter, CDGP, CSP	Cell: (813) 732-8691

This page was intentionally left blank.

DIRECTIONS TO NEAREST HOSPITAL FROM AVON PARK AIR FORCE RANGE

AdventHealth Sebring
4200 Sun N Lake Boulevard
Sebring, Florida 33872

16.4 miles, 25 minutes
(863) 314-4466



- Continue onto Wrainright Way – 0.1 miles
- Take County Rd 64 and Memorial Dr to Sun N Lake Blvd – 14.9 miles
- Continue on Sun N Lake Blvd to AdventHealth Sebring – 0.5 miles

Evacuation and rally points for severe weather: Tanaq Environmental, LLC will coordinate a safe place of refuge with APAFR personnel (Brent Bonner) to include rally points and evacuation methods to be identified onsite.

This page was intentionally left blank.

ACCIDENT PREVENTION PLAN ACKNOWLEDGMENT

I have read, understand, and agree to abide by the provisions as detailed in this Accident Prevention Plan prepared by Tanaq Environmental, LLC. Failure to comply with these provisions may lead to disciplinary action that may include dismissal from the work site, termination of employment or, for subcontractors, termination of the work contract.

PRINTED NAME	COMPANY	SIGNATURE	DATE

PRINTED NAME	COMPANY	SIGNATURE	DATE

TABLE OF CONTENTS

Emergency Information – Avon Park AFR.....	i
Accident Prevention Plan Acknowledgment.....	v
Table of Contents.....	vii
List of Tables	xi
List of Figures	xi
List of Appendices.....	xi
List of Acronyms.....	xiii
Signature Sheet.....	xv
1.0 Background Information	1-1
1.1 Contractor	1-1
1.2 Contract Number	1-1
1.3 Project Name	1-1
1.4 Project Description	1-1
1.5 Projection Location.....	1-1
1.6 Contractor Accident Prevention Experience.....	1-1
1.7 Phases of Work and Hazardous Activities Requiring AHAs/Phases/Activities/ Definable Feature of Work.....	1-2
2.0 Statement of Safety and Health Policy	2-1
2.1 Corporate Health and Safety Policy Statement	2-1
3.0 Responsibilities and Lines Of Authority	3-1
3.1 Job Responsibilities.....	3-1
3.2 Lines Of Authority.....	3-5
3.3 Subcontractor/Supplier Safety Responsibilities	3-5
4.0 Training	4-1
4.1 Safety Indoctrination and Tailgate Safety Meetings.....	4-1
4.2 Mandatory Training and Certifications.....	4-2
4.3 Emergency Response Training.....	4-2
4.4 Outline Of Training Requirements.....	4-3
5.0 Safety and Health Jobsite Inspections	5-1
5.1 Personnel Responsible for Site Safety Inspections.....	5-1
5.2 Inspector Training Qualifications.....	5-1
5.3 Frequency Of Inspections	5-1
5.4 Inspection Forms.....	5-2
5.5 Deficiency Tracking System	5-2
5.6 Competent Persons or Qualified Persons Requirements	5-2
5.7 External Inspections.....	5-2
6.0 Safety and Health Expectations, Incentive Programs, and Compliance	6-1
6.1 Health and Safety Programs Goals	6-1
6.2 Non-Compliance With Safety Requirements.....	6-1
6.3 Management Accountability.....	6-2
7.0 Accident/Mishap Reporting.....	7-1
7.1 Exposure Data (Labor-Hours Worked).....	7-1
7.2 Accident Investigations, Reports, and Logs	7-1
7.3 Immediate Notification Requirements	7-2

8.0	Plans Required by the USACE Safety Manual	8-1
8.1	Fatigue Management Plan	8-1
8.2	Emergency Response Plan	8-2
8.3	Plan for Prevention of Alcohol and Drug Abuse	8-5
8.4	Site Sanitation Plan	8-5
8.5	Medical Support Plan	8-6
8.6	Bloodborne Pathogen Plan	8-6
8.7	Bloodborne Pathogen Exposure Control Plan	8-6
8.8	Site Layout Plan for Temporary Structures	8-7
8.9	Access and Haul Road Plan	8-7
8.10	Hearing Conservation Program	8-7
8.11	Respiratory Protection Plan	8-7
8.11.1	General Respiratory Protection Requirements	8-7
8.12	Health Hazard Control Program and Biological Hazard Review	8-8
8.13	Process Safety Management Plan for Highly Hazardous Chemicals	8-18
8.14	Lead Abatement Plan	8-18
8.15	Asbestos Abatement Plan	8-18
8.16	Radiation Safety Program	8-18
8.17	Abrasive Blasting Plan	8-18
8.18	Heat/Cold Stress Management	8-19
8.19	Indoor Air Quality Management	8-21
8.20	Mold Remediation Plan	8-21
8.21	Chromium (VI) Exposure Evaluation	8-21
8.22	Crystalline Silica Assessment	8-21
8.23	Lighting Evaluation	8-21
8.24	Light Plan for Night Operation	8-21
8.25	Traffic Control Plan	8-21
8.26	Fire Prevention Plan	8-22
8.27	Wild Land Fire Management Plan	8-23
8.28	Arc Flash Hazard Analysis	8-23
8.29	Assured Equipment Grounding Control Program	8-23
8.30	Hazardous Energy Control Plan	8-23
8.31	Lockout/Tagout	8-24
8.31.1	Electric Tools, Extension Cords, and Electrical Work Monitoring	8-24
8.32	Standard Pre-Lift Plan	8-25
8.32.1	Overhead Electrical Lines	8-25
8.33	Critical Lift Plan	8-25
8.34	Naval Architectural Analysis	8-25
8.35	Floating Plant and Marine Activities Contingency Plan for Severe Weather	8-25
8.36	Man Overboard/Abandon Ship	8-25
8.37	Float Plan	8-26
8.38	Fall Protection	8-26
8.39	Demolition/Renovation Plan	8-26
8.40	Safe Access Program/Ladders, Stairs, and Railings	8-26
8.41	Excavation/Trenching Plan (Intrusive Activities)	8-26
8.41.1	Underground Utilities	8-26
8.42	Underground Construction Fire Prevention and Protection Plan	8-26

8.43	Compressed Air Work Plan for Underground Construction	8-26
8.44	Form Work and Shoring Erection and Removal Plans	8-26
8.45	Precast Concrete Plan	8-26
8.46	Lift Slab Plans	8-26
8.47	Masonry Bracing Plan	8-26
8.48	Steel Erection Plan	8-27
8.49	Explosives Safety Site Plan	8-27
8.50	Blasting Safety Plan.....	8-27
8.51	Underwater Dive Operation Plan	8-27
8.52	Tree Felling/Maintenance Program	8-27
8.53	Aircraft/Airfield Construction Safety and Phasing Plan	8-27
8.54	Site Safety and Health Plan.....	8-27
8.55	Confined Space Entry Program	8-27
8.56	Cumulative Trauma Disorder Prevention	8-27
9.0	Risk Management Processes	9-1
10.0	References	10-1

This page was intentionally left blank.

LIST OF TABLES

Emergency Telephone Numbers and Project Contacts (located in the front of this APP)

Table 8.1	Poisonous Plants
Table 8.2	ACGIH Screening Criteria and Action Limit for Heat Stress Exposure (WBGT Values in Degrees Celsius/Fahrenheit)
Table 8.3	Equivalent Chill Temperature (°F) at Various Air Temperatures and Wind Speeds
Table 8.4	Work/Warming Schedule for a 4-Hour Shift
Table 8.5	Minimum Clearance from Energized Overhead Electric Lines

LIST OF FIGURES

Hospital and Medical Facility Route Map (located in the front of this APP)

Figure 1	APAFR Range Site Locations
Figure 2	OSHA 300A
Figure 3	Tanaq Team Organizational Structure

LIST OF APPENDICES

Appendix A	Site Safety and Health Plan
	<i>Attachment 1 AHAs / Blank Form and Completed Baseline</i>
	<i>Attachment 2 Safety Personnel Proof of Training and Competency and Certifications of Employee Medical Surveillance Program Participation</i>
	<i>Attachment 3 Contaminants of Interest and Potential Acute Health Effects</i>
	<i>Attachment 4 APAFR Emergency Notification Signals and Actions</i>
	<i>Attachment 5 Emergency Contact List and Hospital Route Map</i>
Appendix B	Health and Safety Field Forms
Appendix C	Tanaq Environment, Health and Safety Program

This page was intentionally left blank.

LIST OF ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AHA	activity hazard analyses
ANSI	American National Standards Institute
APAFR	Avon Park Air Force Range
APP	Accident Prevention Plan
CFR	Code of Federal Regulations
HSMCOR	Contracting Officer's Representative
CPR	cardiopulmonary resuscitation
dBA	decibels on the A scale
DEET	N,N-Diethyl-m-toluamide
DFW	definable feature of work
ECT	equivalent chill temperature
EM	Engineer Manual
EMS	emergency medical service
FS	field supervisor
GDA	government-designated authority
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCP	Hazard Communication Program
HSM	Health and Safety Manager
HSP	health and safety program
HTRW	hazardous, toxic, or radioactive waste
mph	miles per hour
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PFD	personal flotation device
PM	project manager
POC	point of contact
PPE	personal protective equipment
RAC	risk assessment code
SCBA	self-contained breathing apparatus
SDS	Safety Data Sheet
SPF	Sun Protection Factor
SSHO	Site Safety and Health Officer
SSHPP	Site Safety and Health Plan
Tanaq	Tanaq Environmental, LLC
TLV	threshold limit value (8-hour, time-weighted average)

TSM	tailgate safety meeting
USACE	U.S. Army Corps of Engineers
WBGT	wet bulb globe temperature

SIGNATURE SHEET

Prepared by:

Melaina Pierce, PMP
Project Manager
Tanaq Environmental, LLC
(860) 881-5292

Date

Approved by:

Meriam Senoussi, PG
Program Manager
Tanaq Environmental, LLC
(773) 504-4406

Date

Review/Concurrence:

Nicole Easter, CDGP, CSP
Corporate Safety and Health Director
Tanaq Environmental, LLC
(813) 732-8691

Date

This page was intentionally left blank

1.0 BACKGROUND INFORMATION

1.1 Contractor

Tanaq Environmental, LLC (Tanaq)

Corporate Headquarters: 3201 C Street, Suite 602, Anchorage, AK 99503

Denver Office: 2480 West 26th Avenue, Suite B-26, Denver, Colorado 80211

1.2 Contract Number

Contract Number: W9127821D0063

Delivery Order No: W9127821F0305

1.3 Project Name

Central Florida Optimized Remediation Contract for Avon Park Air Force Range (APAFR), FL.

1.4 Project Description

This Accident Prevention Plan (APP) applies to long-term monitoring (LTM) at six IRP sites at Avon Park Air Force Range (APAFR). Activities include groundwater sampling and land use control inspections.

The following project sites are identified as:

- OT045 – Stressed Vegetation Site
- OT059A – Cattle Dip Vat
- OT059C – Cattle Dip Vat
- OT059D – Cattle Dip Vat
- ST065 – Former Government Vehicle Refueling Area
- OW500 – Pesticide and Hazardous Waste Storage Site – Building 73/Oil Water Separator

1.5 Projection Location

The long-term monitoring cover multiple sites at APAFR in Avon Park, Florida, within Highlands County. APAFR sits approximately 100 miles east-southeast of MacDill Air Force Base. A map of the site locations is included in **Figures 1** and **2**.

1.6 Contractor Accident Prevention Experience

Tanaq is committed to providing its employees with a safe and healthy workplace. Tanaq has an environmental, health, and safety program that requires project managers (PMs) to implement effective programs in these areas. Tanaq's goal is zero accidents and zero injuries with work tasks designed to minimize or eliminate hazards to personnel, equipment, and the general public. We plan to perform the work in a manner that integrates safety and health considerations so that we eliminate risk of workers' injuries or illnesses, environmental releases/impacts, or property damage. No employees should ever

perform tasks that may endanger their own safety and health or that of others. Tanaq's Occupational Health and Safety Administration (OSHA) 300A forms are included as Figure 3.

1.7 Phases of Work and Hazardous Activities Requiring AHAs/Phases/Activities/ Definable Feature of Work

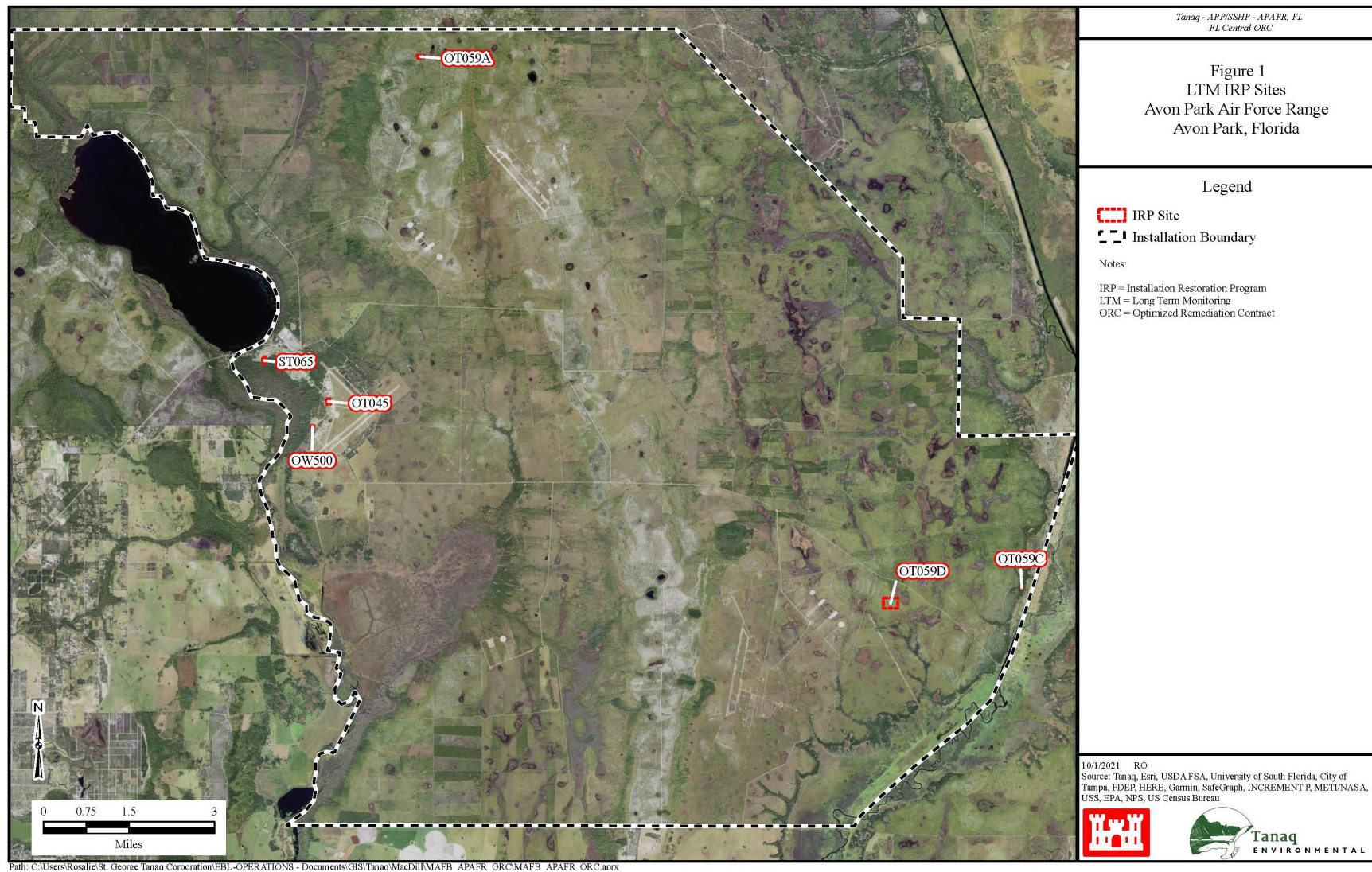
The following are the anticipated definable features of work (DFWs) requiring activity hazard analyses (AHAs):

- General Site Hazards
- Mobilization/Demobilization
- Vehicle Operations
- Environmental Sampling
- Groundwater Sampling
- Decontamination of Equipment
- COVID-19 Exposure
- The following list of equipment is anticipated to facilitate completion of the above DFWs:
 - Pickup trucks
 - Sampling equipment

Any AHA not included with the Accident Prevention Plan (APP)/Site Safety and Health Plan (SSHP) will be developed, added to, and/or updated in the field.

On U.S. Army Corps of Engineers (USACE) projects, the DFWs will have three phases of control – Phase 1: Preparatory (requirement review, site inspection, and preparatory meeting); Phase 2: Initial (job ready inspection before work begins and then again shortly after work has begun); and Phase 3: Follow-up Phase (site supervisor performs daily monitoring of work to assure all job requirements are met). Preparatory review and inspections are referenced in the AHAs.

Tanaq project and safety management personnel will take steps to determine that the subcontractors are performing their operations in accordance with the provisions of this APP/SSHP and the subcontractor's AHAs, if needed. Subcontractors are expected to contribute to and must abide by Tanaq's APP/SSHP. Tanaq will integrate subcontractor work activities and hazard controls into the APP/SSHP and require that subcontractors follow provisions of the APP/SSHP during their work activities.



This page was intentionally left blank.

Figure 2 - OSHA 300 A

OSHA's Form 300A (Rev. 01/2004) Summary of Work-Related Injuries and Illnesses

Year 2022
U.S. Department of Labor
Occupational Safety and Health Administration

All establishments covered by Part 1904 must complete this Summary page, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete and accurate before completing this summary.

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the log. If you had no cases write "0."

Employees former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
<u>0</u>	<u>0</u>
(K)	(L)

Injury and Illness Types

Total number of ... (M)		
(1) Injury	<u>0</u> (4) Poisoning	<u>0</u>
(2) Skin Disorder	<u>0</u> (5) Hearing Loss	<u>0</u>
(3) Respiratory Condition	<u>0</u> (6) All Other Illnesses	<u>0</u>

Establishment Information

Your establishment name Tanaq Environmental LLC - Tanaq Environmental LLC
Street 3201 C St
City Anchorage State AK ZIP 99503
Industry Description
Non-Profit
Standard Industrial Classification

North American Industrial Classification (NAICS)
562910

Employment Information

Annual average number of employees 34.00
Total hours worked by all employees last year 55,124

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate and complete.

Sarah A. Waite
Company executive

Vice President, HR & Administration
Title

907-272-9886
Phone

January 31, 2023
Date

This page was intentionally left blank.

2.0 STATEMENT OF SAFETY AND HEALTH POLICY

2.1 Corporate Health and Safety Policy Statement



TANAQ ENVIRONMENTAL, LLC – HEALTH AND SAFETY POLICY

It is Tanaq Environmental, LLC's environmental, health and safety policy to perform our work safely, and in an environmentally conscientious manner regardless of the importance or urgency of the project.

Tanaq implements health and safety practices and creates work environments that enable our personnel to work injury and illness free.

We continuously:

- Assure managers and employees are trained and accountable for preventing work-related injuries and illnesses.
- Provide a safe and healthy work environment for all employees in all aspects of their work.
- Develop safety awareness among employees engaged in work so that accidents, personal injuries, property damage, and occupational illnesses, will be reduced to a minimum or eliminated altogether.
- Require that all staff, at all levels, take an active role in improving the safety program.
- Comply with all applicable regulatory requirements.
- Implement programs and processes to achieve optimal protection of human health and the environment.

Edward R. Fleming
Edward R. Fleming
General Manager

Signature: Edward R. Fleming
Edward R. Fleming, (Pen. St. 2022 ID: 00000001)
Email: efleming@tanaq.com

This page was intentionally left blank.

3.0 RESPONSIBILITIES AND LINES OF AUTHORITY

This section provides information on the project team, particularly those with worker health and safety responsibilities, competent persons, and the lines of authority for implementing this APP/SSHP.

Tanaq and its subcontractors have very specific roles and responsibilities on a construction site. The contractor, as the controlling employer, has ultimate responsibility for the development and implementation of the site-specific SSHP; the identification of personnel responsible for safety; the obligation to provide a safe and healthy workplace for its employees; and the duty to periodically inspecting the worksite, documenting deficiencies, and ensuring that those deficiencies are promptly corrected.

The subcontractor, as a potential creating and exposing employer, is responsible for the means and methods of construction. As such, the subcontractor must be vigilant to avoid creating safety or health hazards and exposing its own employees, as well as employees of other entities, to the hazard. The subcontractor must adhere to the contractor's site-wide health and safety program (HSP), SSHPs, and effective task-specific hazard controls. The subcontractor is expected to review and suggest, to the contractor, corrections/improvements to the SSHP and AHAs as necessary.

The subcontractor is expected to provide personnel who are trained on construction safety issues and control methods and are properly equipped with construction equipment that has been inspected and found to be safe and operational. The subcontractor will staff the project with a site safety representative who has the authority to correct safety and health hazards and coordinate safety activities with the contractor.

All staff, of both the contractor and the subcontractor, has stop-work authority, i.e., the authority to temporarily stop work if they observe an unsafe act or condition.

3.1 Job Responsibilities

Tanaq will manage health and safety activities on this project in accordance with their corporate health and safety procedures and project-specific documents.

Personnel Identification and Accountability

The following personnel are designated to perform the stated health and safety functions:

- Tanaq PM: Melaina Pierce, PMP
- Tanaq Contractor Quality Control System Manager (CQCSM): Brantley Rudd
- Tanaq Field Supervisor (FS): Mark Lawrence, GIT
- Tanaq Site Safety and Health Officer (SSHO): Sarah Kwon
- Tanaq Health and Safety Manager (HSMHSM): Nicole Easter, CSP, CDGP

Applicable certifications for key field project personnel responsible for safety are included in Attachment 2 of the SSHP.

Tanaq policies and procedures regarding non-compliance with safety requirements follow Performance Improvement Policy No. 45 (disciplinary procedures), which involves a three-step process of identification, performance improvement, and employment action.

Employees who violate a company policy, whose actions pose a threat to co-workers, whose actions constitute harassment, or who violate the law may have their employment terminated without following the Performance Improvement Policy.

All Personnel

Each person is responsible for completing tasks in a safe manner, and for reporting any unsafe acts or conditions to the SSHO. All persons onsite are responsible for continuous adherence to the APP/SSHP provisions during the performance of project work. All employees/personnel have the authority and responsibility to stop work on the site if an imminent hazard is observed. Even when a hazard is not imminent, employees/personnel should intercede if unsafe behavior or conditions are observed.

Program and Project Managers

The Tanaq program manager is the single point of contact (POC) for the USACE Contracting Officer's Representative (COR). The Tanaq PMs are the primary POCs for the USACE technical manager. The PMs have overall responsibility for the health and safety of personnel on the project, including the following:

- Ensuring the project team adherence to company policy and this APP/SSHP.
- Confirming the proper review and distribution of health and safety documents.
- Communicating with the HSMHSMHSM for any variances or modifications in a timely manner.
- Verifying the following for personnel assigned to the project:
 - Current participants in the medical surveillance program.
 - Current (within the last calendar year) respiratory fit test, if applicable.
 - Completed required safety and health training.
- Determining subcontractors have submitted required health and safety documents to the SSHO.
- Maintaining and reporting records of exposure hours and work-related accidents, injuries, and illnesses of Tanaq and subcontractors.

Field Supervisor

The FS directs site activities in accordance with the approved work plan; the APP/SSHP; and applicable federal, state, and local laws and regulations. The FS has the responsibility and authority to halt or modify any working condition and to remove from the site any person who refuses to comply with the APP/SSHP or whose behavior endangers his or her own safety or the safety of others. Should the FS become aware that a subcontractor is not following the APP/SSHP, the FS will notify the subcontractor and require that the subcontractor begin immediate corrective actions. The FS may also have collateral duties as the SSHO if there is no exposure to mechanical or explosive hazards (Examples: field walkovers, surface soil sampling, long-term water sampling).

Site Safety and Health Officer

The Site Safety Health Officer (SSHO) will always be present when field activities are being performed.

The SSHO will provide day-to-day safety support, provide site safety orientations and training, confirm appropriate personal protective equipment (PPE) selection, conduct tailgate safety meetings (TSMs) and daily site safety inspections, confirm work zone delineations, verify training and medical clearances of Tanaq onsite personnel, and report activities to the PM and HSMHSM. The SSHO is the main contact in any onsite emergency. The SSHO is responsible for facilitating and coordinating the field implementation of the APP/SSHP and has the responsibility and authority to halt or modify hazardous activities or working conditions. The SSHO has the authority to request, in accordance with the chain of command, the removal from the site of any person who refuses to comply with the APP/SSHP or whose behavior endangers his or her own safety, or the safety of others. Should the SSHO become aware that a subcontractor's employee is not following the APP/SSHP, the SSHO will notify the most senior member of the relevant subcontractor's field team and require that the subcontractor begin immediate corrective actions.

The SSHO will oversee and conduct job steps involved with safety such as briefings, training, and inspections. Specific tasks assigned to the SSHO include the following:

- Verifying that Tanaq and subcontractors follow the APP/SSHP and AHA.
- Verifying the training and medical clearances of Tanaq onsite personnel.
- Verifying that the specified PPE is available and used.
- Participating in accident/incident and near-miss investigations.
- Reviewing pertinent safety and health documentation from the field for compliance with this APP/SSHP.
- Updating and reviewing AHAs, as indicated.
- Developing a schedule for safety observations and inspection checklists.
- Establishing appropriate site control zones and controlling the entry and exit points.
- Conducting or presenting initial site training.
- Conducting and documenting regular updated training and TSMs.
- Conducting site safety inspections.
- Monitoring the field team for signs of thermal stress, fatigue, and exposure symptoms.
- Monitoring site weather conditions (heat, cold, inclement weather) and implementing hazard controls as needed.
- Knowing emergency procedures, evacuation routes, shelters, and emergency telephone numbers.
- Reporting all near-miss, injury, illness, and vehicle accidents or incidents to the PM and HSMHSM within 24 hours and confirming that an Accident Investigation Form is completed.

- Holding a safety stand-down meeting to conduct training any time a deviation or degradation of safety warrants a review.
- Seeking guidance from the HSMHSM when unanticipated conditions develop.
- Stopping work if any operation threatens worker or public safety or health.

Corporate Health and Safety Director

HSMThe HSM will advise the PM and SSHO on safety and health issues that may have an impact on project operations. The HSMHSM will provide technical assistance to the project team based upon a review of the APP/SSHP and contributing documents. The HSMHSM also are responsible for reviewing and approving the APP/SSHP, suggesting modifications to the APP/SSHP, and reviewing and approving all changes and updates suggested by the field team. In addition, the HSMHSM is responsible for the following:

- Providing general safety and health program administration.
- Conducting field safety and health audits for APP/SSHP conformance.
- Establishing air-monitoring parameters based on expected contaminants.
- Establishing employee exposure monitoring notification programs.
- Establishing random and for cause drug and alcohol testing, as warranted.
- Providing technical assistance to the PM and the FS/SSHO.
- Investigating significant incidents, illnesses, and near-misses.
- Providing support for evaluation of subcontractor actions as they pertain to protecting the safety and health of workers and the public.

Occupational Medicine Physician

The occupational physician's responsibilities include the following:

- Performing medical surveillance as directed by 29 CFR 1910.120.
- Determining if medical clearance per 29 CFR 1910.120 is needed on an annual or biennial basis.
- Providing medical review officer services for drug and alcohol test results review.
- Providing clinical consultation to injured employees prior to them traveling to an emergency room and consulting with treating physicians, as necessary.
- Maintaining contact with injured employees to determine if there are issues or barriers to rapid healing, rehabilitation, and return to full duty status.
- Providing technical support, as needed, for determination of project-specific medical monitoring.

Subcontractors

The management organization of each subcontractor is responsible for the compliance of its personnel with applicable laws and regulations, applicable provisions of the Tanaq APP/SSHPs, and its own safety

and health programs and AHAs. Subcontractors are directly responsible for the safety and health of their personnel. Tanaq will communicate significant site hazards and recommended controls to the subcontractor(s), review and comment on health and safety related document submissions and verify subcontractor staff qualifications to safely complete their tasks. Tanaq will monitor activities to confirm the subcontractors are performing their operations in accordance with the provisions of the Tanaq APP/SSHPs, relevant Tanaq AHAs, the subcontractor's AHAs, and the contract documents.

All the same APP/SSHP requirements that apply to Tanaq personnel (e.g., training, substance abuse screening, and incident reporting) also apply to subcontractors and their field personnel. Tanaq has the ultimate responsibility for the implementation of this APP for its own employees, all subcontractors, and all others on the worksite. This includes the strict enforcement of the plan.

Additional subcontractor safety responsibilities are detailed in Section 5.

Visitors

A site entry log for visitors will be maintained onsite on a form or in the field book (Appendix B). Visitors and unauthorized personnel will not be allowed within the regulated work area(s) without authorization from the site supervisor or FS or knowledge of the SSHO.

Visitors requesting authorization to enter a designated regulated area must meet the additional requirements for appropriate medical exams, training, and PPE as required by this APP/SSHP. All persons entering the site during site operations must first sign in and be given a site hazard briefing.

3.2 Lines Of Authority

The lines of authority and communication for this task order are presented in Figure 4. The PM has the overall responsibility for this project and will execute the contract in a manner consistent with this APP/SSHP and other contract-specific requirements. The PM will coordinate with the FS, SSHO, and HSMHSM to complete the work in a manner consistent with this APP/SSHP.

The FS directs site activities in accordance with the approved work plan, the APP/SSHP, and all federal, state and local laws and regulations. The FS is responsible for maintaining contact with the PM and the HSMHSM for matters regarding project health and safety. The FS reports to the PM.

The SSHO will monitor and confirm operations are conducted in accordance with this APP/SSHP, USACE requirements, and OSHA regulations. The SSHO communicates with the PM on technical matters during execution of project activities but reports directly to the HSMHSM with functional issues regarding safety.

3.3 Subcontractor/Supplier Safety Responsibilities

Lines of Authority

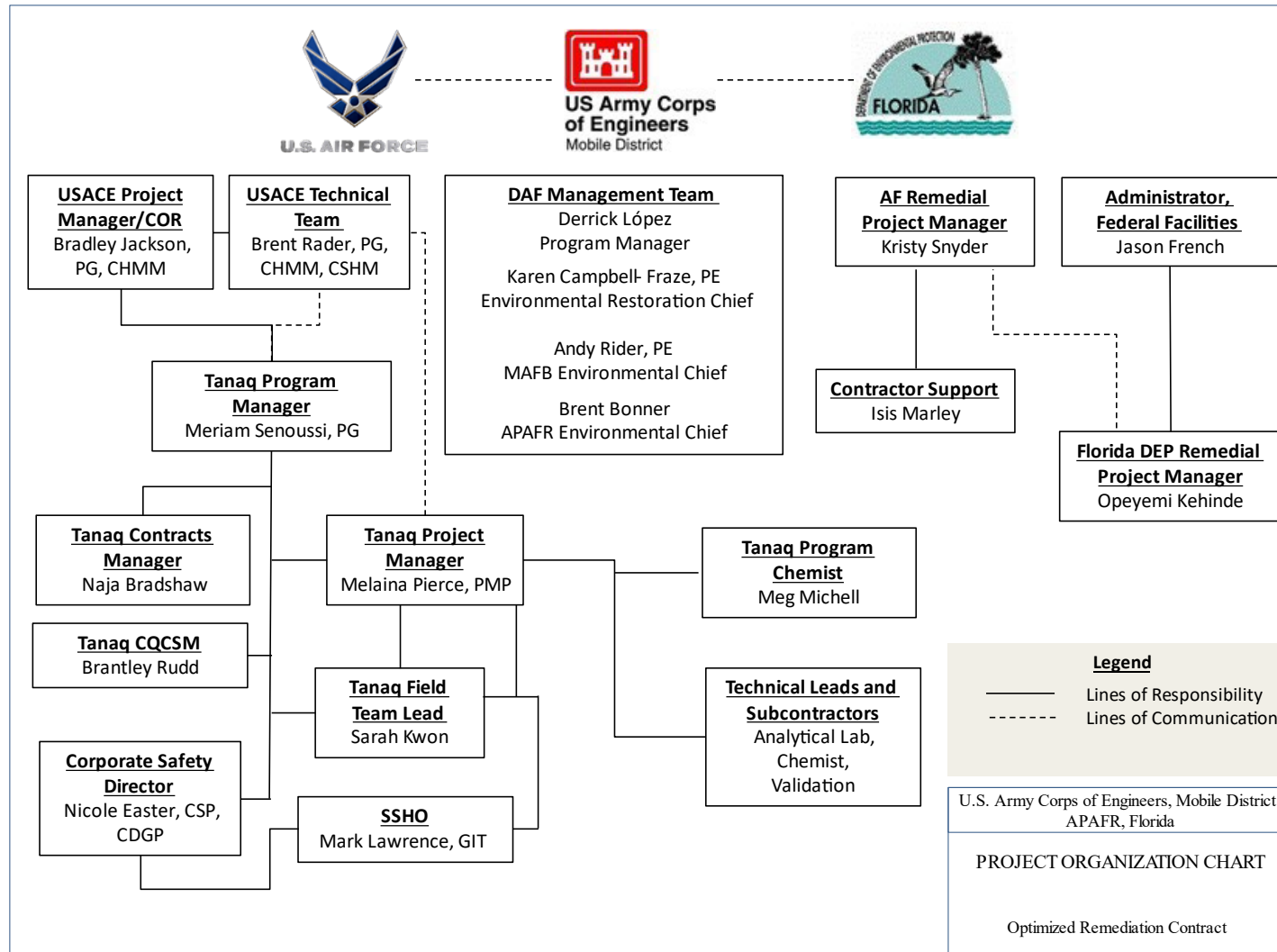
Subcontractors report to the Tanaq PM and the FS. Subcontractors conducting fieldwork on Tanaq projects shall establish an effective safety program applicable to their work and employees. Subcontractors will review and accept the Tanaq APP/SSHP and prepare their own safety AHAs for presentation to the Tanaq PM at least 10 days before site mobilization. All AHAs must be reviewed/accepted by the government-designated authority (GDA). At a minimum, the subcontractor must meet the requirements of this APP/SSHP and provide safety equipment and safeguards suitable for

the tasks and hazards involved. Subcontractors must provide the appropriate safety and health hazards and controls information for their project tasks to their personnel.

Each subcontractor must do the following:

- Provide documentation of successful completion of applicable training for each onsite worker.
- Provide documentation of medical approval on an as-needed basis before the worker arrives onsite.
- Provide all PPE required by their employees for this project [subject to the provisions of 29 CFR 1910.132(h)].
- Provide awareness-level training to affected employees and other subcontractor workers regarding any material, equipment, or operation that may pose a hazard.
- Conduct any required industrial hygiene monitoring for their workers.
- Participate in the daily TSMs and in routine site inspection activities.
- Report immediately all unsafe conditions, faulty equipment, incidents, and close calls to the Tanaq SSHO so that lessons learned can be discussed at TSMs. All deficiencies must be tracked on the Safety and Health Deficiency Tracking Log through resolution.
- Document that all equipment brought to the site are new or in like new condition, are inspected before use and routinely during use, and maintained in safe working order.

Figure 3 - Tanaq Team Proposed Organizational Structure



This page was intentionally left blank.

4.0 TRAINING

4.1 Safety Indoctrination and Tailgate Safety Meetings

Before the start of the project, field personnel assigned to this project will participate in an initial meeting with the PM, FS, and SSHO to review and discuss the APP/SSHP and sign the APP acknowledgment form located at the beginning of the document. All new personnel assigned to the project after the initial safety meeting will review the APP, receive site-specific health and safety training, and sign the APP acknowledgement page. A record of all training will be maintained in the field book or on a Safety Meeting Training Log (Appendix B).

The following subjects will be discussed during the initial safety indoctrination:

- Lines of authority, organization, and responsibilities
- Communication methods and cell phone access locations
- Site facilities, locations of utilities, access/egress, and work zones
- Site contaminants
- Phases and sequence of work, equipment, and chemicals used
- Potential physical and chemical hazards, hazard controls, and safe work practices
- Potential weather-related hazards, controls, and monitoring
- Lifting and material handling, if applicable
- Required PPE
- Decontamination procedures
- Hospital route
- Evacuation routes, emergency response plan, places of safe refuge, and route to hospital
- Emergency notifications
- Emergency contact information
- Onsite persons certified in first aid and cardiopulmonary resuscitation (CPR)
- First aid kits, and fire extinguishers
- Fire prevention
- AHAs

The SSHO will conduct a TSM with all Tanaq and subcontractor site personnel at least daily and more often as appropriate based on onsite activities and changing tasks or conditions. These briefings will be used as an opportunity to address site-specific safety issues, refresh workers on specific procedures, address new hazards and controls, and discuss any lessons learned. An example of the Safety Meeting Training Log is included in Appendix B.

Topics to be discussed at the TSM include the following:

- Day's activities and SOP review
- Potential health and safety issues
- Changes in activities and operations
- Changes in conditions
- Weather conditions and heat/cold stress or other precautions

- Methods of risk reduction
- Required PPE for each task
- Exposure monitoring results
- Recent significant incidents
- Biological hazards
- Changes to the SSHP
- Other applicable information that will increase safety awareness on the project

Employee feedback regarding health and safety will also be solicited. Documentation of each meeting will be retained.

4.2 Mandatory Training and Certifications

Because this project is classified as a hazardous, toxic, or radioactive waste (HTRW) site, in addition to the training listed above, workers will have the following:

- Successfully completed a (40-hour Hazardous Waste Operations and Emergency Response [HAZWOPER]) course and have 3 days of documented supervised field experience.
- Successfully completed an 8-hour HAZWOPER refresher training course on an annual basis.
- Successfully completed a first aid/CPR/automatic external defibrillator course every 2 years.

4.3 Emergency Response Training

The SSHO and FS will review site-specific emergency action procedures as part of the site safety orientation training and periodically as a component of site indoctrination and TSMs. All site personnel shall be trained in emergency response procedures. This training shall include the following:

- Identification of the emergency coordinator(s) and contacts
- Procedures for emergency communications and notifications
- Procedures for contacting emergency services
- Locations of functioning communication devices for personnel not equipped with cellular telephones and for personnel working in areas with limited or no cellular telephone reception
- Locations of communication service marshaling areas
- Locations of emergency telephone contact lists
- Locations of emergency medical facilities
- Site emergency evacuation procedures
- Locations of emergency evacuation rally points and safe refuge areas
- Identification of trained first aid and CPR providers

4.4 Outline Of Training Requirements

The HSM organizes and/or conducts yearly 8-hour HAZWOPER annual refresher training. Eight-hour supervisory training will also be developed and organized by the HSM and provided to supervisors and SSHOs. SSHOs will also have, in addition to the above training, OSHA 30-hour general industry or construction training. Records of due dates, certifications, 30-hour OSHA training cards, and 3-day supervised on-the-job training are maintained in the health and safety certifications and training database.

Topics covered in the annual training include the following:

- 29 CFR1910.120 overview
- Tanaq safety and health program
- Content of medical surveillance program
- Hazard communication standard
- Hazards (chemical, biological, and physical)
- Site controls
- PPE selection and use
- SSHP contents
- Roles and responsibilities
- Leadership and supervision
- Emergency response
- Spills
- Air monitoring equipment
- Respiratory protection
- Lessons learned and work experience
- OSHA recordables and incident review

This page was intentionally left blank.

5.0 SAFETY AND HEALTH JOBSITE INSPECTIONS

5.1 Personnel Responsible for Site Safety Inspections

Job site safety and health inspections (reviews and audits) can be conducted by SSHOs; quality control officers; PMs; and the HSM or designee. The following reviews shall be performed:

- The SSHO shall inspect the jobsite daily or more often if warranted by ongoing activities. Findings shall be documented in the field book or the Daily Project Safety Inspection Report (Appendix B).
- The PM or HSM, or designee, may conduct unannounced jobsite safety audits.
- The SSHO shall conduct quarterly facility safety inspections using the Facility Inspection Checklist that can be found in the Health & Safety Manual.

All safety deficiencies identified during the inspection processes shall be tracked until closed on the Safety and Occupational Health Deficiency Tracking Log (Appendix B), which will be retained in the field or facility office. The log will include the following:

- Date deficiency is identified
- Description of deficiency
- Name of person responsible for correcting deficiency
- Projected resolution date
- Date resolved

5.2 Inspector Training Qualifications

SSHO qualifications are as follows: OSHA HAZWOPER 40-hour training and annual refreshers, OSHA 30-hour Construction training, and CPR/First Aid.

5.3 Frequency Of Inspections

A site safety inspection will be conducted daily and recorded in the field book or a Daily Project Safety Inspection Report (Appendix B).

Portable Fire Extinguishers

The SSHO is responsible for performing monthly inspections of and obtaining annual service for portable fire extinguishers that are not mounted on vehicles or equipment. The inspections shall be documented in the inspection tag on each extinguisher. Vehicle and equipment operators are responsible for the daily inspection of fire extinguishers on vehicles or equipment. Each field crew will have one portable fire extinguisher (10-B:C) in their field vehicle.

First Aid Kits

First aid kits shall be inspected monthly by the SSHO, or designee. A seal may be placed on first aid kits to allow for less frequent inspections. If the seal is not broken, then an inspection is not required for up to 3 months.

Eye Wash

An emergency eyewash unit capable of delivering at least 0.4 gallons of water per minute for 15 minutes or more shall be located immediately adjacent to employees who handle hazardous or corrosive materials, such as treatment plant operational chemicals. The emergency eyewash units shall be inspected weekly by the SSHO. The inspection shall be documented in the inspection tag on each eyewash station.

5.4 Inspection Forms

See Appendix B for the Daily Project Safety Inspection Report form.

5.5 Deficiency Tracking System

All unsafe conditions, faulty equipment, incidents, and close calls will be immediately reported to the Tanaq SSHO so that lessons learned can be discussed at TSMs. All deficiencies will be tracked on the Safety and Health Deficiency Tracking Log through resolution.

5.6 Competent Persons or Qualified Persons Requirements

A competent person, as defined by 29 CFR 1926.651(k)(1), is required to supervise activities requiring excavation and trenching, fall protection, scaffolding, permit-required confined space entry, and lockout/tagout.

USACE Engineer Manual (EM) 385-1-1 also has additional requirements for competent persons for the following: cranes and rigging; trainers; rescuers; equipment operators; HTRW competent persons (lead, asbestos control, radiation); site safety and occupational health; hazardous energy; health hazard evaluation and control of chemical, physical, and biological agents; and PPE selection use and maintenance.

The following activities planned for this project require a competent person:

- None.

Subcontractors shall provide licensing/qualifications of equipment operators and provide letters on company letterhead stating the competency on the equipment for which they are qualifying and the name of the qualified person.

No work will be performed unless the competent person or the designated alternate competent person is present on the jobsite.

5.7 External Inspections

USACE or regulatory agencies may, at any time, perform inspections or audits of Tanaq's field health and safety practices. The PM and HSMHSM shall be immediately notified when a regulatory agency inspector requests access to a Tanaq work site for the purpose of a compliance inspection.

The PM shall immediately notify the COR of any regulatory agency inspection. The inspection should not be delayed due to the unavailability of the COR or their designee. If a citation is issued to Tanaq or its

subcontractors, a copy of the citation will be submitted to the USACE COR along with a corrective action plan.

This page was intentionally left blank.

6.0 SAFETY AND HEALTH EXPECTATIONS, INCENTIVE PROGRAMS, AND COMPLIANCE

6.1 Health and Safety Programs Goals

The goal of Tanaq's corporate HSP is to provide the education and tools required to deliver a safe and compliant work environment for its employees, project personnel, subcontractors, and the general public as the nature of the work allows. The HSP includes written policies and procedures; new employee orientation; project-specific training, refresher training, and customized classes; a project-specific medical monitoring program and worker exposure monitoring; an incident reporting system that includes reporting and evaluating near misses; review and approval of subcontractors' health and safety performance prior to hiring; and annual management-level health and safety performance goals and objectives. Worker safety is a priority.

Safety program goals, safety performance objectives, and accident prevention experience objectives are as follows:

- The written safety program, as reflected in the APP, SSHP, and AHAs, shall conform to the standards and expectations of Tanaq, client needs and expectations, and follow applicable regulations and consensus standards required by USACE EM 385-1-1.
- Permanent and temporary staff assigned to work at the site will have read, understood, been given the opportunity to question, and sign off on these safety program documents. Tanaq and subcontractor staff will be briefed by the appropriate safety and health official before starting new or non-routine tasks on the field conditions to be faced, the tasks to be performed, the hazards expected, and the control methods that will be used to eliminate or control those hazards to an acceptable level of risk.
- No employee or subcontractor shall be allowed to work on a task unless they have been trained and/or certified in accordance with regulatory requirements and approved for safety related responsibilities by the SSO.
- Safety equipment shall be inspected within the frequency prescribed by the manufacturer, this APP, according to regulatory and consensus standards, and requirements of USACE EM 385-1-1. These inspections shall be documented.
- It is the goal that this project proceeds without accidents and injuries. This goal can be achieved if work is planned, the employees are properly equipped and trained, and management provides proper leadership and support.

6.2 Non-Compliance With Safety Requirements

Policies and procedures regarding non-compliance with safety requirements follow Human Resources Performance Improvement Policy (disciplinary procedures), which involves a three-step process of identification, performance improvement, and employment action. Intentional or egregious acts that pose a threat to co-workers or violate legal requirements may trigger immediate termination without following the performance improvement policy.

6.3 Management Accountability

Annually, written health and safety goals are developed for members of the senior, office, and project management team. The goals are designed to advance development of the health and safety program, involve all levels of employees, proactively address health and safety issues, and reinforce accountability for staff health and safety with the management team. Management personnel are held accountable for completion of these goals and compensation is tied to the success of an individual's performance in meeting the goals.

Tanaq holds managers and supervisors accountable for safety through implementation of health and safety procedures and corporate policies. A partial list of those expectations is provided below:

- Be a role model for safety.
- Actively participate in safety and health activities at all levels.
- Promptly address any unsafe conditions or unsafe acts.
- Report all accidents, incidents, and near misses.
- Implement disciplinary procedures, as warranted, for those violating safety rules.

7.0 ACCIDENT/MISHAP REPORTING

7.1 Exposure Data (Labor-Hours Worked)

The PM is responsible for reporting and maintaining records of all exposure and accident experience incidental to the work and reporting same to USACE. At a minimum, these records shall include exposure work hours and equivalent as prescribed by 29 CFR 1904. This exposure data will be provided to USACE, upon request, using the USACE Prime Contractor Monthly Record of Work-Related Injuries/Illnesses and Exposure Form.

7.2 Accident Investigations, Reports, and Logs

Project personnel are required to report near misses, injuries, illnesses, and incidents to the FS and SSHO immediately. The SSHO will summon/arrange appropriate medical care if required. If an employee is injured or the HSM should be contacted as soon as practical, **(860) 881-5292**, after emergency care (if needed) has been initiated.

Except for rescue and emergency measures, the accident scene will not be disturbed until it has been released by the SSHO and the investigation is complete. This means that the accident scene will be left as it was immediately after the accident occurred. Apart from injured personnel, nothing at the scene will be moved, straightened up, thrown away, or cleaned. Photographs of the incident site will be taken, and any independent witness statements recorded as soon as safely possible. Witnesses are to be isolated and questioned separately if possible.

Onsite management personnel will investigate near misses, injuries, illnesses, incidents, and accidents to identify unsafe acts or conditions that occurred or existed at the time of the accident. Corrective actions will be determined and implemented to prevent recurrence of the incident, and responsibility for implementation of corrective actions will be assigned. The final report and required forms will be submitted to the PM for signature and forwarded to the USACE COR. ENG Form 3394 (Appendix B) will be completed and submitted to the COR within 5 working days of the incident.

If an accident results in an employee being sent to a doctor, a medical assessment/work capacity form will be completed by the attending physician on the date of treatment and will state one of the following conditions:

- Employee may return to full duty work
- Employee may return to limited duty (with type of limitations)
- Employee is unable to return to work

A copy of the completed medical assessment/work capacity report must accompany the completed accident reports.

At the discretion of the COR, Tanaq will provide a face-to-face briefing of all lost workday accidents to USACE within 5 days of the accepted ENG Form 3394. Tanaq management, the SSHO, and others deemed necessary will be present at the briefing.

7.3 Immediate Notification Requirements

The FS will make notifications to the PM, HSM, and others as required by Tanaq's incident reporting policy. The SSHO will complete and submit the Incident Report form within 24 hours. The PM will report incidents to the COR and USACE PM as soon as the facts are known, but no longer than 24 hours after the incident. The appropriate forms to be completed are in Appendix B and include the following:

- Automobile Accident Report
- Incident Report
- USACE Form 3394 – USACE Accident Investigation Report (Submitted within 5 days)

Subcontractors and other non-Tanaq employees shall report all close calls, equipment property damage, injuries, or illnesses. The subcontractor's safety personnel shall investigate and analyze the incident so that the situation can be corrected. A copy of the subcontractor's investigation report shall be made available to the PM. The PM will then forward the report to the HSM.

Immediate notification to USACE through the Tanaq PM is required for the following:

- A fatal injury.
- An Arc Flash incident.
- One or more individuals become ill or have a medical condition that is suspected to be related to a site condition, or a hazardous or toxic agent on the site (Note that as of January 1, 2015, OSHA must be contacted for the following: all work-related fatalities, all work-related in-patient hospitalizations of one or more employees, and all work-related amputations and eye loss. Employers must report work-related fatalities within 8 hours of finding out about it. For any in-patient hospitalization, amputation, or eye loss, employers must report the incident within 24 hours of learning about it. The HSM is responsible for contacting OSHA).
- The hospitalization of one or more people resulting from a single occurrence.
- Property damage of \$500,000 or more.

The Tanaq program manager will notify USACE immediately when the following injury classifications have been made:

- A permanent total disability.
- A permanent partial disability.

8.0 Plans Required by the USACE Safety Manual

The following sections address the plans required by USACE in the Safety and Health Requirements Manual (USACE, 2014).

8.1 Fatigue Management Plan

Excessive Work Hours

The following workday duration limitations for hours worked on the projects are in effect:

- Personnel working onsite, including those who are operating hoisting equipment or mobile construction equipment, may work up to 12 hours at the site, which does not include travel time to/from their home/motel or uncompensated lunch breaks. This workday duration is subject to reduction by the other requirements and factors described in the bullets below. The 12-hour limit is primarily due to motor vehicle driving restrictions.
- Personnel, while on duty, shall not operate motor vehicles after being in a duty status (regardless of their role or function) for more than 12 hours during any 24-hour period without at least 8 consecutive hours of rest. Personnel may work an additional 2 hours at the motel or their home (for a total 14-hour day), though still subject to reduction by the other requirements and factors described below. A minimum of 8 consecutive hours shall be provided for rest in each 24-hour period.
- No employee may drive continuously for more than 10 hours in any single on-duty period (continuous period of more than 10 hours in any 24-hour period without at least 8 consecutive hours of rest).

For each project effort, the SSHO is responsible for adjusting the workday duration within these limits. The following factors will be considered by the SSHO for adjusting the workday duration:

- Time of year (e.g., reduce workday duration because there is less daylight in winter).
- Temperature/weather (e.g., reduce workday duration when the temperature is very cold, very hot, or very windy).
- Type of work (e.g., reduce workday duration for personnel involved in physically demanding phases of work).
- Individual personnel limitations (e.g., reduce workday duration for personnel with minor head colds, suffering from temporary effects of allergies, or showing signs of heat stress).

The controls established at the worksite will include.

- Training that includes signs and symptoms of fatigue, habits, and actions the worker may take to avoid fatigue; actions workers should take if they observe fatigue in a co-worker; and controls in place to prevent fatigue.
- Discussion of driving to and from work and any possible mitigation of driving as a factor of fatigue.

- Discussion of controls for fatigue that will include work scheduling (limit number of consecutive night shifts), rotating jobs to prevent repetitive work, breaks at critical times in the work cycle, control of environmental factors (heat, cold, use of PPE), buddy check-in for individuals working alone, and alternate transportation for long commutes.

Because the period of performance for this project is 3 years, it is likely that fieldwork will be under way throughout all times of the year. Therefore, it is important to recognize the climate variability and prepare appropriately.

8.2 Emergency Response Plan

Pre-planning measures to avoid personal injury or exposure include employee training, fire and explosion prevention and protection, chemical spill and discharge prevention and protection, and safe work practices. If an emergency occurs, site personnel will assess the situation; and decide if they have the equipment, supplies, PPE, and tools to respond, contain or clean up the incident. If any aspect of an emergency response effort is missing, the SSHO will announce a site evacuation (emergency action) to the rally points detailed in the emergency action plan. Emergency response plans include the following:

- Emergency response team organization
- Communication means and protocols
- An evaluation of likely emergencies
- Staff training and capabilities
- Emergency response equipment
- A determination of likely emergencies that can be handled using internal resources and a list of likely emergencies needing outside emergency assistance.
- Steps to summon and coordinate outside emergency responders.
- Cleanup actions necessary after the immediate emergency has been contained.
- Provisions for a critical review of actual emergency response activities against the activities specified for that type of emergency in the emergency response plan.
- Editing changes into the written plan and briefing site personnel on the changes.

Emergency Action Plans limit site employee activities to the following:

- Emergency recognition
- Emergency notification inside the site and with outside emergency responders
- Communication means and protocols
- An evaluation of likely emergencies
- Staff training and capabilities
- Steps to coordinate with outside emergency responders onsite

- Evacuation routes and rally points
- Cleanup actions necessary after the immediate emergency has been contained
- Provisions for a critical review of actual emergency actions against the actions specified for that type of emergency in the Emergency Action Plan.
- Editing changes into the written plan and briefing site personnel on the changes.

Procedures and Testing and Contingency Plan for Severe Weather

Upon mobilization to the project, the FS and SSHO shall verify that personnel have an effective means of communications (cell phone or two-way radio) from every work area on the site. Before project fieldwork commences, the provisions for emergency response will be confirmed. Emergency communication equipment will be tested. The route(s) to the local medical facility(ies) will be confirmed to be accessible and practical. A designated site emergency assembly point will be established, and the location communicated to the field team during the initial site safety orientation.

If an emergency arises, the appropriate immediate response must be taken by the first person to recognize the situation. The field crew shall contact emergency response services by calling 911 (or location-specific emergency communication system) and then immediately notify the SSHO of the incident. The authority to order personnel to evacuate the area rests with the FS, SSHO or a qualified USACE representative.

If site evacuation is required, a continuous, uninterrupted horn will be sounded for approximately 10 seconds. Air horns in the work area or a vehicle horn will be used. Continuous communication will be maintained between the site and the main office. Emergency alert systems shall be tested periodically. If employees are working alone or in remote locations, a means of contact, such as a two-way radio or a cell phone, must be provided. Personnel shall evacuate to a designated safe, upwind location and the crew leader will perform a head count. Once the head count has been performed, the SSHO will be provided a status report of the event.

During any onsite emergency, work activities in the affected area will cease until the emergency is brought under control.

The SSHO or designated onsite personnel will be responsible for checking weather conditions at a minimum of twice daily. When there are warnings or indications of impending severe weather (heavy rains, thunderstorms, damaging winds, tornados, hurricanes, floods, lightning, etc.), weather conditions will be monitored using a weather station that is part of the National Oceanic and Atmospheric Administration weather radio all hazards network or similar notification system. Appropriate precautions shall be taken to protect personnel and property from the effects of the severe weather. A safe place of refuge will be discussed during the TSMs.

Thunder and lightning storms, hail, high winds, tornados, and blizzards may occur. Fog and lighting may pose potential problems in the work area as well. If lightning is observed, all outdoor work shall stop. A determination shall be made as to the storm proximity to the operation being performed. Once lightning is seen, count the number of seconds until you hear the thunder. Divide number of seconds by 5 to get the distance the lightning is away from you. If lightning is 10 miles away or less, work should stop until 30 minutes after the last audible thunder or visible flash of lightning.

An alternative approach is to use the “30-30 Rule” when visibility is good and there is nothing to obstruct the view of the thunderstorm. When lightning is seen, the time until thunder is heard is counted. If that time is 30 seconds or less, then the thunderstorm is within 6 miles and is dangerous. Activities with exposure shall cease at that time and shall not resume until at least 30 minutes after the last clap of thunder.

Work shall cease if fog or white out snow fall limits visibility during situations where accurate vision is required (i.e. driving, work around power lines, measuring, equipment spotting, and precise equipment operations).

The weather will be monitored routinely. It may be necessary to halt certain hazardous operations or stop work altogether to allow the situation to pass. The SSHO must decide what operations, if any, are safe to perform based on existing and anticipated conditions. In the case that immediate shelter is required, all personnel will go to the designated meeting location and wait until hazardous conditions pass.

Spill Plans

Based on the initial hazard assessment, it is not anticipated that a spill will occur that the field crew cannot handle. Should this occur, notification of the appropriate emergency response agencies will be carried out by the FS or SSHO in accordance with the procedures discussed in the SSHP (Appendix A).

It is, however, recognized that even incidental releases would create housekeeping hazards, slip, trip, fall hazards, and potential electrocution hazards. Therefore, incidental leaks (fittings) and spills will be controlled and cleaned up.

Potential spill areas include fueling operations while operating the vehicles or the boat. A spill pad for petroleum products should be placed under the service point to capture even incidental spills during fueling and lubrication activities. Store containers away from heat and ignition sources. Store only what is needed for immediate use.

All personnel will be instructed in the content of the Safety Data Sheets (SDSs) for all chemical products brought onsite. Personnel will employ the following for spill clean-up:

- Safety glasses,
- Nitrile supported gloves,
- Tyvek coveralls to avoid soiling work clothes for incidental cleanup measures, and
- Any PPE recommended by the SDS.

Leaks detected during operation will have secondary containment placed under the leak or have absorbent materials or spill pads placed below to control and contain. Clean up any materials released and place absorbent materials down on walking working surfaces. Notify the FS/SSHO.

Fire Fighting Plans

In the event of a fire or explosion, the SSHO will notify the [on-base or city] fire department and emergency medical services (EMS); contact the Tanaq PM; and escort the response personnel to the location of the fire or explosions. The SSHO will determine the extent of the fire, use available onsite fire extinguishers on incipient stage fires only and provide emergency first aid as needed. Site personnel will not fight fires

containing explosives. The responding fire department personnel will be informed of the nature of the fire and if explosives are present.

Posting of Emergency Telephone Numbers

To facilitate the quick retrieval of information in the event of an emergency, a summary has been placed in the front of this APP including emergency contact information and a map showing the route from the project site to the nearest hospital. A copy of this emergency information will be kept in all field vehicles and posted on onsite offices bulletin boards (as applicable).

Man Overboard/Abandon Ship

Not applicable.

Medical Support

See section 8.5

8.3 Plan for Prevention of Alcohol and Drug Abuse

Tanaq implements a Substance Abuse Deterrence Program in support of the corporate drug-free workplace policy and will enforce the requirements of a drug-free workplace. The program is designed to maintain a safe workforce and prohibits the following:

- Engaging in any drug activity that is prohibited by federal, state, or local law. This includes, but is not limited to, the possession, use, manufacture, distribution, or sale of illegal drugs at any time or at any place.
- Working under the influence of alcohol or illegal drugs.

The deterrence program includes post-offer/pre-employment drug testing, random testing, and post-accident testing when it appears that substance intoxication caused or contributed to the accident.

Failure to comply with any part of this policy may result in disciplinary action up to and including termination of employment.

8.4 Site Sanitation Plan

Tanaq shall maintain hygienic sanitation provisions during the duration of this project. General requirements for a temporary, mobile field crew include:

- Drinking water – bottled drinking water will be maintained onsite for use by all personnel.
- Washing and toilet facilities – There are facilities throughout the base. Hand washing facilities with soap, towels, and/or anti-microbial gels will be available onsite.
- Disposable materials (not classified as hazardous) such as latex gloves, used PPE, aluminum foil, paper towels, etc., will be placed and sealed in plastic garbage bags for disposal with sanitary waste from the site.

8.5 Medical Support Plan

The Tanaq occupational medical care provider will be available to provide patient-specific information in case medical treatment is needed. For injuries or illnesses requiring EMS, notification via the 911 system or equivalent system will be made by personnel at the scene. Emergency response personnel will determine the best course of treatment and the medical treatment facility where this will occur. Personnel may be transported to the nearest medical treatment facility as determined by EMS personnel.

For non-emergencies, the HSM should be contacted.

Qualified first aid and CPR providers may treat minor injuries onsite. Two field team members (Tanaq or subcontractor) must be trained to render both CPR and First Aid. Tanaq and its subcontractor(s) qualification relating to CPR and first aid training will be provided in the SSHP. Each Tanaq first aid/CPR certified employee is part of the Tanaq Bloodborne Pathogens Exposure Control Program.

A first aid kit (meeting American National Standards Institute [ANSI] Z308.1 content guidelines), including necessary protection against bloodborne pathogens, will be available in project vehicles or onsite. An adequate supply of fresh potable water for emergency eye wash purposes or portable emergency eyewash will be available.

If additional treatment beyond first aid is required, the injured personnel will be transported to the identified emergency medical care facility. If the injury is not serious or if the ambulance response time is excess, the injured party may be transported by the FS to the nearest emergency room using a Tanaq field vehicle. The Emergency Information Sheet and the map and directions indicating the fastest route to the hospital emergency room will be retained in each field vehicle. In all cases, the FS/site supervisor will accompany injured Tanaq workers to the hospital or medical care facility. A member of the subcontractor's field team will accompany subcontractor's workers to the hospital or medical care facility.

8.6 Bloodborne Pathogen Plan

Qualified first aid and CPR providers may treat minor injuries onsite. Two field team members (Tanaq or subcontractor) must be trained to render both CPR and first aid. If first aid response is necessary, all biological materials will be assumed to be infectious and universal precautions will be taken. First aid and CPR trained staff will wear PPE (nitrile gloves, eye protection, masks) dependent on exposure anticipated and will wash hands immediately after removing gloves. Each Tanaq first aid/CPR certified employee is part of the Tanaq Bloodborne Pathogens Program, which includes a Post Exposure Control Plan if exposed to bloodborne pathogens. The Post Exposure Control Plan covers instructions to seek medical attention within 2 hours and has provisions for a confidential medical examination and follow-up with occupational physician for the Hepatitis B vaccine series.

A first aid kit, including necessary protection against bloodborne pathogens, will be available in project vehicles. An adequate supply of fresh potable water for emergency eye wash purposes or portable emergency eyewash will be available.

8.7 Bloodborne Pathogen Exposure Control Plan

See Section 8.6

8.8 Site Layout Plan for Temporary Structures

Not applicable because temporary structures are not necessary to execute the fieldwork for this project.

8.9 Access and Haul Road Plan

An Access and Haul Road Plan is not required for this project as only existing roadways will be used. Truck routes will be established with Base Command to facilitate the transport of waste off-base and other supplies onto the base with minimal disruption to base operations.

8.10 Hearing Conservation Program

If personnel are expected to be exposed above 85 decibels (dBA) over an 8 hour work period, then they must be enrolled in a hearing conservation program. A hearing conservation program includes a written program, annual audiometric exams, training, and the use of hearing protection. Warning signs shall be posted in areas where noise greater than 85 dBA necessitates the use of hearing protection. The use of headphones for entertainment purposes is prohibited.

8.11 Respiratory Protection Plan

OSHA, in 29 CFR 1910.134, requires employers to develop and implement a written respiratory protection program when respirators must be used to protect employee health and safety. Respirators may be necessary for certain activities and the type of cartridge will be defined in a Site-Specific Health and Safety Plan, as required.

Tanaq will use the following administrative and engineering controls to minimize the need for respiratory protection onsite:

- Personnel shall be positioned upwind to avoid working in dust and released vapors when possible.
- Water shall be used to control dust.
- Natural and mechanical ventilation shall be used to reduce or eliminate exposures to dusts, gases, and vapors.

8.11.1 General Respiratory Protection Requirements

Respirators will be worn if the activity hazard analysis indicates the need for one. Only National Institute for Occupational Safety and Health (NIOSH)-approved respiratory protection equipment shall be used. When disposable particulate respirators are used, only approved N100 or P100 respirators shall be selected. All personnel using respiratory protection must be sufficiently trained in the use, limitations, proper fit, maintenance, and storage of respirators, have filled out a medical questionnaire reviewed by a licensed medical practitioner, and be fit tested in the make and size of respirator to be worn. A respirator change-out schedule will also be determined based on expected airborne concentrations.

Personnel with facial hair that interferes with the respirator's sealing surface will not be permitted to wear a respirator and will not be allowed to work in areas requiring respirator use. Respirators shall be inspected before each use by the wearer. Respirators shall be checked periodically by the SSHO. All

respirators and associated equipment, except disposable respirators, must be hygienically cleaned and properly stored after each use by the wearer. Only employees who have been medically cleared in accordance with Tanaq's Medical Surveillance Program shall be allowed to wear a respirator. Before being assigned a tight-fitting respirator, each employee will be fit-tested. Subcontractors that will be required to upgrade to respiratory protection will provide medical clearance letters and fit-test records.

8.12 Health Hazard Control Program and Biological Hazard Review

Jobsite operations, materials, and equipment involving potential exposure to hazardous or toxic agents or environments will be evaluated by the HSM and a hazard control program formulated. The hazard control program for this site consists of the following:

- AHAs
- Hazard/risk analysis
- PPE
- Standard safety procedures, work practices, and engineering controls

Exposure Monitoring/Air Sampling Program

Air monitoring may be conducted whenever work might generate or release gases, vapors, dust, fumes, mists, or other airborne hazardous materials. Because the task may be very short, little value is gained by implementing integrated monitoring, as work may be completed by the time laboratory results are received. Tanaq's approach is to conduct sampling with direct-reading instruments if possible.

Screening for the presence of volatile organic compounds (VOCs) while conducting fieldwork is generally performed with a handheld photoionization detector (PID).

Airborne exposure monitoring accomplishes the following objectives:

- Provides data that is used by the SSHO to select the proper PPE, work practices, and engineering controls used at the site.
- Measures real-time concentrations of hydrocarbon compounds so that the SSHO knows when levels may potentially exceed the air monitoring action levels.
- Using direct reading instruments, surveys and determines the location of potential vapor releases at the source and in the breathing zone.

The ionization detectors will be inspected and tested before use in the field. The instruction manual will be available for field equipment so that trouble-shooting and routine repairs can be conducted in the field. Also, the manufacturer's relative response tables for specific chemicals will be reviewed to determine the accuracy and reporting of concentrations. For PIDs leased from an equipment vendor, the electron volt (eV) of the lamp will be confirmed before use and documented in the logbook. The SSHO will record the daily air monitoring results and calibration information on the Real Time Air Monitoring Results Log or in the field book (Appendix B).

Air monitoring equipment used will be maintained in accordance with manufacturer's instructions. Calibration will occur before each use and documented in the field book or on the Calibration Log (Appendix B). Instrument calibration can be conducted in a clean environment similar to the actual work

environment in terms of temperature, pressure, humidity, and background noise. Before actual use, each instrument will be allowed enough time to warm up and will be “zeroed” as applicable. Any equipment that is out of calibration will be documented in the field book or on the Safety and Occupational Health Deficiency Tracking Log (Appendix B).

Calibration gases used for the PID will have properties similar to the contaminants anticipated. If the meter reading is greater than ± 15 percent of the response value of the calibration gas used, then the instrument will be red-tagged and returned for recalibration. This process is in accordance with U.S. Environmental Protection Agency (EPA) Standard Operating Procedure (SOP) #2114 for PIDs.

Any problems with the operation of the PIDs during the project will be documented along with corrective action and the results of performance verification. For critical operations, more than one ionizing detector and/or four-gas meter is procured to avoid project interruption if one instrument were to become disabled.

Field instrument maintenance is documented in the field logbook for each field instrument used during field activities. Field equipment is maintained when routine inspections indicate the need for maintenance. A list of the field equipment vendor points of contact and telephone numbers will be maintained onsite for use if a piece of equipment needs repair. Field equipment routine maintenance may include the following:

- Removing surface dirt and debris.
- Replacing/cleaning filters/membranes on a regular schedule.
- Arranging for equipment storage in accordance with the manufacturer’s instructions.
- Charging and discharging battery packs on a regular schedule.
- Maintaining spare and replacement parts in field to minimize downtime.

If excessive dust is generated, even after proper engineering controls are used, the SSHO may determine the need for air monitoring. Air monitoring will then be used to determine the need for more aggressive control methods. Only those individuals qualified to do so will operate monitoring instruments.

The site-specific exposure monitoring requirements and action levels are detailed in Section 4 of the SSHP.

When working in confined spaces, or at sites where landfill gases are present, Tanaq’s Respiratory Protection Plan calls for monitoring oxygen content. Action levels are detailed in Section 4 of the SSHP.

AHAs

The process for developing AHAs is discussed in Section 9. Tanaq’s FS and SSHO will continually review activities and work environments to identify hazards not addressed in the relevant AHAs. The FS, site supervisor, and/or SSHO will keep subcontractor personnel informed of changing conditions and any new hazards and requirements.

Hazard/Risk Analysis

The anticipated hazards and the recommended control measures are presented in Section 2.0 of the SSHP (Appendix A). Exposure through inhalation, skin absorption or physical contact to a chemical or biological agent in excess of the acceptable limits specified in the current American Conference of Governmental Industrial Hygienists (ACGIH) guideline, “Threshold Limit Values and Biological Exposure Indices,”

published Department of the Army or Department of Defense exposure limits, or by OSHA are prohibited. In cases where there is a conflict between these occupational exposure limits, the more stringent will generally apply. Tanaq's overall approach is to reduce and/or eliminate hazards when possible and feasible. If a hazard cannot be eliminated, then the National Institute for Occupational Safety and Health (NIOSH) hierarchy of controls should be applied, with substitution and engineering controls used preferentially over administrative controls and PPE. The NIOSH hierarchy is as follows:

- Elimination
- Substitution
- Engineering controls
- Administrative controls
- PPE

PPE

A summary includes the following minimum work clothing requirements.

Employees will wear clothing suitable for the weather; however, minimum requirements for work will be a short-sleeved shirt, long pants (excessively long or baggy pants are prohibited), and leather work shoes. If analysis determines that safety-toed or another protective footwear is necessary, they will be worn.

Eye and face protection shall be worn as determined by an analysis of the operations being performed.

Hearing protection will be worn by all those exposed to high noise level activities (noise over of 85 dBA). A good field rule is to wear hearing protection when normal conversation cannot be heard at arm's length. Hearing protection will have a minimum noise reduction rating (NRR) of 25 dBA.

Head protection will be worn when struck-by or overhead hazards exist. Hard hats will comply with ANSI Z89.1 and will be worn with the brim facing forward.

High visibility apparel will be worn by all workers exposed to vehicular or equipment traffic. The apparel will comply with ANSI/Industrial Safety Equipment Association 107, Class 2.

Specified gloves will be worn by those involved in activities that expose the hands to cuts, abrasions, punctures, burns, and chemical hazards.

When work is being performed in and around water and drowning is a hazard, a personal flotation device (PFD) will be provided and worn.

For HAZWOPER sites Tanaq uses the U.S. Environmental Protection Agency terminology for PPE, which consists of four recognized levels of protection.

Level A protection is required when the greatest potential for exposure to hazards exists; when the concentration and type of airborne substances is unknown; and when the greatest level of skin, respiratory, and eye protection are required. Level A clothing and equipment include positive-pressure, full face-piece self-contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA, totally encapsulated chemical- and vapor-protective suit, inner and outer chemical-resistant gloves, and boots.

Level B protection is required under circumstances requiring the highest level of respiratory protection, with lesser level of skin protection. Level B protection includes positive-pressure, full face-piece SCBA or

positive pressure supplied air respirator with escape SCBA, inner and outer chemical-resistant gloves, face shield, hooded chemical resistant clothing, coveralls, and outer chemical-resistant boots.

Level C protection is required when the concentration and type of airborne substances is known and the criteria for using air purifying respirators are met. Level C equipment includes full-face or half-face air purifying respirators, inner and outer chemical-resistant gloves, hardhat, and disposable chemical-resistant outer boots. The difference between Level C and Level B protection is the type of equipment used to protect the respiratory system, assuming the same type of chemical-resistant clothing is used. The main criterion for Level C is that atmospheric concentrations and other selection criteria permit wearing an air-purifying respirator.

Modified Level D protection is required where there is a potential for skin and clothing contact but little potential for airborne exposures. Modified Level D ensemble includes all the PPE listed in Level D below plus Tyvek®-type coveralls for dry contaminated matrices or poly-coated Tyvek® or Saranex®-type coveralls for wet contaminated matrices. Modified Level D has the advantage of being quickly upgraded to a Level C ensemble if conditions require it. The disadvantage is that both types of coveralls subject the wearer to higher levels of heat and heat stress incidents.

Level D protection is the minimum protection required. Level D protection may be enough when no contaminants are present or work operations preclude splashes, immersion, or the potential for unexpected inhalation or contact with hazardous levels of chemicals. Level D protective equipment includes long pants, sleeved shirts, work gloves, coveralls, safety glasses, and boots or shoes with steel or composite toes for crush protection. When working near roadways or alongside heavy equipment, Type 2 reflective vests and/or outer clothing must be worn. Hardhats will be worn if there are struck-by or overhead hazards present.

While these are general guidelines for typical PPE to be worn in certain circumstances, other combinations of protective equipment may be more appropriate, depending on specific site and task characteristics. The specific PPE required for this site is detailed in Section 3.0 of the SSHP (Appendix A).

Standard Safety Procedures

Tanaq will implement work practices and engineering controls to eliminate or reduce the risk of exposure to recognized site hazards. The site-specific control measures are presented in Section 5.0 of the SSHP (Appendix A).

The identification and assessment of work hazards is a continual process. Personnel must be aware of their surroundings and the chemical, physical, biological, and radiological hazards that may be present. Individuals will be familiar with the physical characteristics of a site including the following: wind direction; accessibility to associates, equipment, vehicles, and communication; areas of known or suspected contamination; site access; and water sources. The number of workers will be limited to the minimum necessary to complete work tasks in a safe and efficient manner. Site personnel will perform only those tasks that they are qualified to perform.

The buddy system will be used whenever possible. At least two persons are required to be at the work area when work that might result in worker contamination or injury is possible. When only one person is working onsite, they will always carry a cell phone and keep it turned on while in the field and call in to the office at predetermined times to verify they are well. The predetermined call-in times from onsite will,

at a minimum, correspond to site arrival, mid-day, and site departure. The employee will also notify the client of their presence onsite upon arrival.

Biological Hazards

Personnel will be made aware of the various biological hazards that may be encountered while working at the sites including ticks, poisonous insects (i.e., fire ants, chiggers, and disease-bearing mosquitoes), poison ivy, and/or snakes, during the initial site safety orientation. Appropriate preventative measures should be employed to minimize potential exposure to biological hazards, including personnel designating a field member to watch for biological hazards.

The SSHO will be responsible for instructing personnel in avoiding or minimizing exposure to biological hazards. The keys to avoiding biological hazards are awareness of surroundings and general knowledge of the habits of various species, which may present a threat. In general, vertebrates will escape to avoid human contact when encountered. Reptiles will often seek out warm sunny locations during morning hours or cold weather. A reconnaissance of the site work area should be conducted every morning to identify the presence of potential threat species of plants, insects, and animals. Clearings of vegetation and soil excavation near burrows are activities that potentially disturb reptiles or hornet nests in proximity to personnel. Extra care and caution should be exercised in any work area that disturbs vegetation or soil, or when entering any vegetated area where one cannot always directly see the ground surface.

Nearly all work sites contain ticks, venomous spiders (black widow, brown recluse), chiggers, and venomous insects (wasps, hornets). Venomous insects and spiders are generally reclusive and the greatest potential for exposure arises when personnel are opening containers, structures, buildings, and well casings; and handling idle equipment or construction material stockpiles. Caution should be taken when opening the casing around monitoring wells.

Mosquitoes

Mosquitoes may carry diseases, such as the West Nile and Zika viruses, as well as be bothersome. They are attracted by heat, sweat, body odor, fragrances, and carbon dioxide. Site personnel should use insect repellent containing lemon eucalyptus oil or N,N-Diethyl-m-toluamide (DEET). Insect repellent should be reapplied at least every 4 hours.

The following suggestions should provide some protection from mosquitoes:

- Review the hazards associated with the West Nile and Zika viruses through exposure to mosquito bites periodically during the TSMs. Zika virus prevention is an important issue because contracting this virus during pregnancy appears to pose a significant risk of neurological birth defects including microcephaly. Infection appears to be much less dangerous for healthy adults. Get regular updates on transmission and controls from the Centers for Disease Control at www.cdc.gov/zika/
- Apply sunscreen first and then insect repellent.
- Increase protective measures when working at dawn, dusk, and in the early evening.
- Reduce the area of exposed skin when working outdoors.

- Use an insect repellent containing approximately 30 percent DEET. Use the repellent according to the manufacturer's directions provided on the container. Frequent reapplication or saturation is not necessary for repellent containing DEET to be effective. Avoid prolonged and excessive use of DEET. Caution: some individuals may be sensitive to DEET – always read and follow the manufacturer label directions. After returning from outdoor field activities, wash treated skin with soap and water.
- Use commercially prepared "clothing and gear" insect repellants containing 0.5 percent permethrin when additional protection against mosquitoes is necessary. These repellants, such as Repel Permanone™, are available in the sporting goods departments at major retailers. Clothing and gear insect repellants are not for use on skin. Use the repellent according to the manufacturer's recommendations provided on the container.
- Avoid using fragrances.

Chiggers

Chiggers are the larva of a type of mite found in tall grass and weeds. Chiggers move to a constriction, such as sock tops, waistbands, or armpits. Bites cause severe itching, red pimple-like bumps (papules or hives).

The following are suggestions that should provide some protection from chiggers:

- Stay out of areas where chiggers are likely to be present including wood lots, pastures, roadside ditches, or other areas with tall grasses and weeds. Chiggers are especially common in moist, low-lying areas.
- Wear loose-fitting clothing (if possible) when working outdoors. Vehicles should be vacuumed frequently to reduce the number of chiggers that may have been deposited.
- Spray an insect repellent containing approximately 30 percent DEET around pant legs and socks. Insect repellent containing DEET shall be available to personnel while working onsite. Use the repellent according to the manufacturer's directions provided on the container. After returning from outdoor field activities, wash treated skin with soap and water.
- Take a bath immediately after possible exposure to chiggers, thoroughly scrubbing the body with hot soapy water. This will kill or dislodge many of the chiggers. The clothes that were worn when the bite(s) occurred should be placed in a plastic bag for temporary storage until they can be laundered.
- Apply rubbing alcohol when bites begin to itch, followed by one of the following nonprescription local anesthetics: baking soda paste, calamine lotion, or product such as "After-Bite" or "Chigarid." Avoid scratching bites since this increases irritation and may lead to a secondary infection of the bite.

Fire Ants

Nests should not be allowed to form near structures and areas where personnel will continue to have a need for access. If bitten, personnel should wash the bite area with soap and water, apply cool compress to the area, elevate area on a pillow, and make a paste of baking soda and water for itching.

Stinging Insects

Workers should keep alert for bee and wasp activity and avoid wearing bright clothing and scented toiletries when working outside. Be wary of areas around structures where bees and wasps may live. If you see bee or wasp activity, avoid the area if possible. The use of insect repellants containing DEET is not effective in preventing stings. Anyone can have an allergic reaction to a bee sting, even if they were stung before with no reaction. Allergic reactions to bee stings may include swelling around the lips and eyes, rapid development of a rash, difficulty breathing, or signs of shock (pale skin, rapid pulse, and fainting). If any of these symptoms occur, call 911 immediately. If you have had a previous reaction, notify the SSHO before fieldwork begins and carry a “bee-sting kit,” EpiPen®, or Ana-Kit. All personnel shall immediately report stings to the SSHO.

Nests should not be allowed to form near structures and areas where personnel will continue to have a need for access. If stung, personnel should wash the bite area with soap and water, apply cool compress to the area, elevate area on a pillow, and make a paste of baking soda and water for itching.

Spiders

Black widow and brown recluse spiders, both venomous, may also be present in and around structures or vegetation. Spider bites from these species can cause swelling and intense pain and, in some instances, have caused death. If bitten, personnel should wash area with soap and water, apply cool compress to the area, elevate area on pillow, and call the nearest poison control center. The poison control center will monitor your condition and advise if medical attention is needed.

Ticks

Nearly all work sites on this project may contain ticks. Working in tall grass, especially in or at the edge of wooded areas, increases the potential for ticks to bite workers. Ticks can be particularly numerous in the spring and fall. Ticks are vectors of many different diseases, including Lyme disease. Ticks attach to the skin and feed on blood, creating an opportunity for disease transmission.

The primary symptoms of tick-borne diseases are high fever, head and joint aches, nausea, and vomiting. Additionally, persons develop rashes or experience occasional coughs, chest pain, and severe pneumonia. Lyme disease usually presents a distinctive bull’s eye rash at the site of the bite in addition to flu-like symptoms and swollen lymph nodes.

If ticks are prevalent, treat clothing with a permethrin-based product like Permanone as directed by the manufacturer. Use an insect repellent containing approximately 30 percent DEET on any bare skin. Insect repellent will be available to personnel. Caution: some individuals may be sensitive to DEET – always read and follow label directions. Close pant legs with tape, elastic bands, or by tucking into socks. Tuck shirt into pants.

Periodically during the workday, employees should inspect themselves for the presence of ticks. If a tick is discovered, the following procedure should be used to remove it:

- Do not try to detach a tick with bare fingers. Bacteria from a crushed tick may penetrate even unbroken skin. Fine-tipped tweezers should be used.
- Grip the tick as close to the skin as possible and gently pull it straight away from you until it releases its hold.
- Do not twist the tick as you pull and do not squeeze its body. This may inject bacteria into your skin.
- Wash your hands and the bite area thoroughly with soap and water, and then apply an antiseptic to the bite area.

Snakes

Every snake should be treated as venomous and avoided. If bitten by a snake, a person should pay attention to the characteristics of the snake, including color and pattern. The bitten person should be transported immediately to a medical facility, and the snake should be described to the attending physician. If immediate transportation to a medical facility is not possible, the victim should be placed at rest, and the extremity of the bite should be splinted.

To minimize contact with snakes, individuals walking onsite shall avoid tall grass and vegetation and avoid placing hands in concealed areas. The following precautions should be followed:

- Learn to identify venomous snakes. This process shall be reviewed during site-specific safety training.
- Be aware of your surroundings always. Learn to check around with a sweeping glance to scan for camouflaged snakes in woodlands, weeds, trails, bushes, and other cover habitat.
- Avoid specific snake habitats such brush piles, rock piles, crevices, debris mounds, logjams, root systems, abandoned buildings, and watery areas. If movement of materials (such as rocks or brush) is necessary, use a remote means to initially relocate the material. Before entering an area, look and listen carefully.
- Never climb or step over obstacles anywhere without first carefully checking for snakes.
- Watch where you sit, where you place your hands and feet, and where you step. Use caution when exiting a vehicle parked off-road.
- Wear snake gaiters or chaps when walking in suspected snake country.
- Never try to capture or kill ANY snakes.
- Never handle “dead” snakes; they may not be completely dead.

What to do if bitten by a venomous snake – According to the American Red Cross, these steps should be taken:

- Keep the patient physically and emotionally calm. Help them take deep breaths to keep stress levels down. Unless it is unavoidable, DO NOT allow the patient to walk. Avoid any activity that would increase the heart rate.
- Gently wash the bite site.

- Apply an elastic roller bandage for a bite from an elapid snake (e.g., coral snake), after washing the wound.
- Splint bitten extremities, keeping the bite site at approximately the level of the patient's heart.
- Try to identify the snake (but ONLY if safe to do so) to inform the medical facility.
- Have the snakebite evaluated by a health care provider as soon as possible.

What NOT to do if bitten by a venomous snake:

- DO NOT permit removal of pressure dressings or elastic bandage until at a facility ready and able to administer anti-venom. As soon as the dressings are released, the venom will spread. The hospital must be prepared to immediately administer the antidote (antivenom).
- Do NOT eat or drink anything unless permitted by medical professionals.
- Do NOT engage in strenuous physical activity.
- Do NOT apply oral (mouth) suction to bite.
- DO NOT cut, suck, apply a constricting band or apply cold to a bite from a pit viper (e.g., rattlesnake, copperhead, or cotton mouth).
- Do NOT drink any alcohol or use any medication.
- Do NOT apply either hot or cold packs.
- Do NOT apply a narrow, constrictive tourniquet such as a belt, necktie, or cord.
- Do NOT have a snake bite kit (the American Red Cross does not advocate use of kits).

Allergenic Plants










The best preventative measure for poisonous plants is recognition and avoidance. Three or five leaves radiating from a stem is the rule of thumb for identifying poison ivy, poison oak, and poison sumac. Poison ivy is a vine that attaches to trees, fence posts, power poles, or other vertical structures; or it may be low-lying. Poison oak and sumac are bush-like. Table 8.1 shows poison ivy and poison sumac leaves during seasonal variations.

All these plants can produce a delayed allergic reaction. Nearly everyone is allergic or capable of becoming allergic. These plant tissues have an oleoresin, which is active in live, dead, and dried plants. The oleoresin may be carried through smoke, dust, contaminated articles, animal hair, or saw dust. Symptoms usually occur 24 to 48 hours after exposure, resulting in rashes that itch and blister. Should exposure to these plants occur, wash/rinse the affected area within one-half hour after contact, using Technu™, rubbing alcohol, Neutrogena™ acne wash/skin cleanser or similar product. Do not scrub. Do not use soap with lotions or emollients, as this will cause spreading of the allergenic plant oils. Seek medical attention as necessary. The use of disposable gloves and Tyvek® coveralls or barrier creams (applied in advance of exposure), and care in laundering clothing (segregating clothing) worn onsite can help prevent skin contact with these plants.

The best defense in dealing with these plants is preventing the direct physical contact that can lead to allergic reactions. This can be accomplished using a skin barrier. Effective barriers include clothing (which should be handled carefully when laundering) and/or barrier cream.

The irritants can also be transported in smoke if these plants are burned and can be released into the air and when these plants are ground up, such as in mowing or mulching. These exposures may affect the respiratory tract as well as the skin.

Table 8.1 - Poisonous Plants

COMMON POISON IVY (Rhus Radicans)				
<ul style="list-style-type: none">• Grows as a small plant, vine, and shrub.• Grows everywhere in the United States except California and parts of adjacent states.• Eastern oak leaf poison ivy is one of its varieties.• Leaves always consist of three glossy leaflets.• Also known as three-leaf ivy, poison, creeper, climbing sumac, poison oak, markweed, picry, and mercury.				
				
Spring	Summer	Fall	Winter	
POISON SUMAC (rhus vernix)				
<ul style="list-style-type: none">• Grows as a woody shrub or a small tree from 5 to 25 feet tall.• Grows in most of eastern third of the United States.• Also knows as swamp sumac, poison elder, poison ash, poison dogwood, and thunderwood.				
				

Hazard Communication Program

Tanaq's Hazard Communication Program (HCP) was developed to meet the requirements of the OSHA Hazard Communication Standard, Title 29 CFR 1910.1200 - 1201 including the 2012 amendments based on the Globally Harmonized System and is located at Appendix C. OSHA requires that employers make information available to employees about hazardous chemicals they may be exposed to in the workplace. This information includes, toxicology, physical, and chemical hazards, means of detection, and protection against exposure.

For hazardous chemicals brought to the site, Tanaq makes this information available to staff members through a written HCP, lists of chemicals in use, current copies of SDSs, container labeling, and staff training.

As a part of the HCP, the project SSHO is responsible for the following:

- Bringing current SDSs for each hazardous chemical Tanaq introduces to the site.
- Developing and maintaining a comprehensive list of hazardous chemicals Tanaq introduces to the job site and making it accessible to all staff onsite.
- Reviewing the SDSs that accompany incoming shipments and maintaining the SDSs in project files onsite.
- Contacting the source of the hazardous chemicals if the SDSs are not complete or if an SDS is not supplied with an initial shipment.
- Labeling temporary and permanent hazardous chemical containers.
- At multi-employer sites, telling the other employers the location of the written Tanaq HCP and copies of SDSs for the site.
- Communicating with other employers (e.g., owner, contractors, subcontractors) to obtain information about the location of their written HCP(s), labeling program, and SDSs, and, if applicable, information on the hazardous chemicals they may produce or introduce to the jobsite that Tanaq employees may be potentially exposed to.

8.13 Process Safety Management Plan for Highly Hazardous Chemicals

A process safety management program is not applicable under the current work scope, as no highly hazardous chemicals will be used.

8.14 Lead Abatement Plan

A lead abatement plan is not applicable under the current work scope, as no lead will be encountered during the field activities.

8.15 Asbestos Abatement Plan

An asbestos abatement plan is not applicable under the current work scope, as no asbestos will be encountered.

8.16 Radiation Safety Program

A radiation safety program is not applicable under the current work scope, as no radiation will be encountered.

8.17 Abrasive Blasting Plan

An abrasive blasting plan is not applicable under the current work scope, as no blasting will occur.

8.18 Heat/Cold Stress Management

Heat Stress

In hot environments, the following guidelines will be followed to prevent heat-related injury.

- Drinking water will be made available to employees and employees will be encouraged to frequently drink small amounts, e.g., one cup every 15 to 20 minutes. The water will be kept reasonably cool.
- Toolbox training will include training on the symptoms of heat-related problems, contributing factors to heat-related injuries, and prevention measures.
- When possible, work will be scheduled for cooler periods during the day.
- A buddy system will be established to encourage fluid intake and watch for symptoms of heat-related injury.
- SSHO will monitor those individuals who have had a previous heat-related illness, are known to be on medication, or exhibit signs of possibly having consumed large amounts of alcohol in the previous 24 hours, for signs or indicating symptoms of heat-related illness.
- Breaks in shaded or air-conditioned areas will be taken at intervals to prevent harmful heat stress.
- Non-acclimated field team members must be allowed to follow the 20% work per day rule if they so choose, and therefore should not be expected to complete 100% of their workload until the fifth working day. If by the fifth day, the team member still does not feel confident in their ability to complete 100% of their expected workload, the field team lead and project manager should work together to find a solution where all field staff members have an acceptable workload. Additional measures will be taken, as needed, to minimize heat stress. These measures may include pop-up tents over the work area, personal cooling products such as water-retentive bandanas and neck wraps, etc.

Heat Stress Monitoring

The SSHO will monitor heat stress and will adjust heat stress controls to control the hazard to personnel. This monitoring will include visual monitoring of work and worksite conditions, as well as feedback from work crews. The SSHO will use local reports of heat index and the OSHA/Centers for Disease Control and Prevention/NIOSH Heat Safety Tool application.

If impermeable clothing is worn in hot environments, additional controls such as cooling vests will be implemented.

Cold Stress

The SSHO will monitor cold stress and will adjust cold stress controls to control the hazard to personnel. This monitoring will include visual monitoring of work and worksite conditions, as well as feedback from work crews. The SSHO will assess the potential for cold stress before fieldwork begins, primarily through local weather reports, but using thermometers or wind speed measuring equipment on-site as needed.

The following will be provided to personnel:

- Employees will receive training on the dangers and symptoms of cold-related injury and the work rules adopted to prevent it.
- Site workers will be warned that older individuals and people with circulatory problems might be at increased risk for cold-related injury, and that added precautions might be necessary to protect them.
- Each employee will be under protective observation by someone else during work (i.e., use of the “buddy system” will be required).
- Employees who experience pain in the extremities or evident shivering will be removed from exposure to the cold work environment.
- Work must be halted if frostbite cannot be prevented. Continuous skin exposure will not be permitted when the equivalent chill temperature (ECT) is -25°F or less (Zones B and C on the ECT table [not anticipated during this project]).
- Tasks should be scheduled to avoid long periods during which workers must sit or stand still.
- Work expectations for new employees should be adjusted downward for the first few days, to permit acclimatization to the cold conditions.
- Dehydration, which decreases blood flow to the extremities, should be avoided. Employees will be encouraged to replenish water lost to perspiration and respiration. The SSHO will provide soups and warm sweet drinks as appropriate.
- The SSHO will develop procedures that reduce the likelihood of soaking of the clothing by other means during project work. Such precautions should apply to any work with liquids like gasoline, alcohols, solvents, or cleaning fluids.
- The SSHO will plan for any likely scenarios that would lead to wet clothing (soaking by rain, etc.), and provide for quick changing into dry clothing and treatment for hypothermia.
- Emergency plans will give special attention to the prevention of cold-related injury (hypothermia and freezing of damaged tissues).

Workers should wear cold-protective clothing appropriate for the environmental conditions and the level of physical activity. The following considerations should guide the selection and use of protective clothing:

- Layered clothing shall be used to preserve body heat. An easily removable outer windbreak garment should be worn in windy conditions.
- Inner garments and underwear shall be made of fabrics that dry quickly and wick moisture away from the body.
- Outer garments shall be made with provisions for easy ventilation to prevent inner layers to be wetted by sweat.

- An employee shall not enter or remain in a cold work environment if his or her clothing is wet because of sweating. If clothing is wet, then the employee shall change into dry clothing before returning to the cold environment.
- Gloves and/or mittens shall be used as necessary to protect the hands, and employees shall be warned not to touch very cold objects and surfaces with bare skin.
- Workers shall routinely change socks and removable felt insoles to reduce moisture around the feet.
- Eye protection suitable to the type of hazard shall be used. Special precautions against ultraviolet light and glare might be necessary in snow-covered terrain.

Hardhat liners shall be used. If work must be done on slippery surfaces, then shoe attachments that enhance traction shall be used.

8.19 Indoor Air Quality Management

Not applicable since indoor work will not be performed under the current work scope.

8.20 Mold Remediation Plan

Not applicable since this type of work will not be performed under the current work scope.

8.21 Chromium (VI) Exposure Evaluation

Not applicable since work involving products containing chromium (VI) will not be performed under the current work scope.

8.22 Crystalline Silica Assessment

A Crystalline Silica Monitoring Plan is not anticipated; however, if the concrete demolition and restoration cannot be done using wet methods for dust suppression, an air monitoring plan for respirable silica will be developed and upgrades in PPE described. The crystalline silica monitoring plan, if needed, will be developed and attached as an addendum to the SSHP.

8.23 Lighting Evaluation

A review of the lighting requirements for the project-specific tasks or operations will be evaluated as part of the AHA.

8.24 Light Plan for Night Operation

A night operations lighting plan is not applicable as all work will be scheduled during daylight hours.

8.25 Traffic Control Plan

If work in active traffic areas is required, workers will wear ANSI Class 2 high-visibility vests. If work in a public roadway is required, workers will wear ANSI Class 3 high-visibility vests and Tanaq will implement

a traffic control plan which must meet the U.S. Department of Transportation Federal Highway Administration's Manual on Uniform Traffic Control Devices.

8.26 Fire Prevention Plan

This section details fire prevention and protection procedures/resources to be used at the project. This information is to be included in the site health and safety indoctrination.

Workplace Fire Hazards

The primary fire hazards at the project consist of brush and range fires, flammable and combustible liquids, electrical fires, waste materials, combustible wastes, fueling operations, storage of fuels and other flammable liquids at the project site, and welding and cutting activities.

Potential Ignition Sources

The significant ignition sources at the project include smoking materials (matches and lighters), welding/cutting equipment, vehicle/equipment exhaust, and catalytic converters.

Fire-Control Systems, Equipment, and Procedures

Depending on the nature and extent of any fire, the following fire-control systems and equipment shall be evaluated or provided for at the project:

- Contact information for the fire department (listed at the beginning of this APP).
- Fire extinguishers shall be maintained in all vehicles and in specific areas of concern (e.g. near electrical work or areas of hot work). Where flammable or combustible materials in quantities greater than 5 gallons are present and where hot work will be performed, 10-pound extinguishers rated 4A:60B:C will be present in the immediate area. At least one dry chemical fire extinguisher having a minimum Underwriter's Laboratories rating of 1A5BC will be available in all vehicles and trailers.
- A hot work permit is required before a flame or spark-producing activity is to commence.
- Flammable wastes will be stored or disposed of in metal containers, clearly marked as containing flammable materials.
- Storage of combustible materials will be kept to a minimum.
- Flammable and oxidizing materials shall be stored in marked (No Smoking, Matches, or Open Flame) areas with fire extinguishers available.
- Smoking shall be permitted only in designated areas. Personnel shall never discard cigarette butts into the environment while working at the site.
- Open flames are prohibited.
- Vehicles and equipment will not be left idling or parked in areas where catalytic converters may ignite vegetation.

- Project personnel are only permitted to extinguish small fires in their incipient stages, only provided that the person has been trained and feels comfortable doing so.

Fire-Control Equipment Maintenance Responsibilities

The SSHO is responsible for performing the monthly inspections of portable fire extinguishers and obtaining annual service for all fire extinguishers that Tanaq provides for use at the project site. The subcontractor is responsible for performing the monthly inspections and obtaining annual service for all subcontractor-provided fire extinguishers used at the project site. Vehicle and equipment operators are responsible for the daily inspection of fire extinguishers on vehicles/equipment.

In the event of a fire in any Tanaq field or site office, field vehicle, or treatment plant, only attempt to extinguish the fire if it is containable. If it is containable and extinguished by the onsite personnel, summon the fire department to confirm the fire will not reignite. If the fire is not containable, then all personnel will evacuate immediately following the posted emergency evacuation routes and go to the designated rally point. A head count will be taken by the senior person present to account for all personnel. The SSHO will contact the fire department, base contact, and the Tanaq PM. Contact information is listed at the beginning of this APP.

8.27 Wild Land Fire Management Plan

Wild land fires will be responded to as indicated in Section 8.26 of the APP.

8.28 Arc Flash Hazard Analysis

Not applicable since no electrical work is planned.

8.29 Assured Equipment Grounding Control Program

All portable electrical equipment and extension cords shall be protected with a ground fault circuit interrupter as part of the circuit. Use only hard or extra hard, outdoor usage extension cords that are rated (in watts or amps) at least equal to the sum of the connected loads. Extension cords, power tools, and lighting equipment shall be inspected before each use, protected from damage, and kept out of standing water.

All electrical installations shall be made as required by National Fire Protection Association (NFPA) 70, National Electrical Code (NFPA, 2012) or local code, whichever is more protective. Only qualified electricians may work on electrical circuits. Qualified personnel shall be trained with the proper use of the special precautionary techniques, PPE, arc flash, insulating and shielding materials, and insulated tools and test equipment.

8.30 Hazardous Energy Control Plan

Hazardous energy is any energy, including but not limited to mechanical (e.g. power transmission apparatus, counterbalances, springs, pressure, gravity), pneumatic, hydraulic, electrical, chemical, nuclear, thermal) energies that could cause injury to employees. Applicable OSHA standards for electrical power (29 CFR 1926, Subpart K); Section 12 of the *Safety and Health Requirements Manual* (USACE, 2014);

and the NFPA 70 E (NFPA, 2012), Standard for Electrical Safety in the Workplace apply to the work performed at the project site.

8.31 Lockout/Tagout

Equipment and machinery can present many hazards to workers, from electrical, mechanical, pneumatic or hydraulic sources. Disconnecting or making the equipment safe involves the removal of all energy sources and is known as isolation. The steps necessary to isolate equipment is the lockout/tagout procedure. The isolation procedure generally includes the following tasks:

1. Identify the energy source(s).
2. Isolate the energy source(s).
3. Lock and Tag the energy source(s).
4. Prove that the equipment isolation is effective.

The locking and tagging of the isolation point informs others to not de-isolate the device.

When employees or subcontractors are working on equipment or in areas where the activation of the equipment might endanger the worker's safety, a site-specific written lockout/tagout procedure will be followed. The SSHO is responsible for coordinating the lockout/tagout procedure. Only authorized and trained employees will perform lockout/tag out. Personnel working with or around an isolated system will be trained as either an Affected or Authorized employee, as appropriate.

8.31.1 Electric Tools, Extension Cords, and Electrical Work Monitoring

Employees working in areas where electrical hazards are present shall be provided with and shall use double-insulated hand tools, rubber insulating gloves, protective clothing, and PPE that is designed and constructed for the specific part of the body to be protected and for the work to be performed, as specified by Section 130.7 of NFPA 70 E (NFPA, 2012). Employees and subcontractors shall use insulated tools when working inside the limited approach boundary of exposed live parts where tools or handling equipment might make accidental contact. Insulated tools shall be protected to prevent damaging the insulating material.

All portable electrical equipment and extension cords shall be protected with a GFCI as part of the circuit. Use only hard or extra hard, outdoor usage extension cords that are rated (in watts or amps) at least equal to the sum of the connected loads. Extension cords, power tools, and lighting equipment shall be inspected before each use, protected from damage, and kept out of wet areas.

All electrical installations shall be made as required by NFPA 70, National Electrical Code (NFPA, 2012) or local code, whichever is more protective. Only qualified electricians may work on electrical circuits. Qualified personnel shall be trained with the proper use of the special precautionary techniques, PPE, arc flash, insulating and shielding materials, and insulated tools and test equipment.

Before starting each electrical job, the qualified employee in charge shall conduct a job briefing with the employees involved. The briefing shall cover such subjects as hazards associated with the job, work procedures involved, special precautions, energy source controls, and PPE requirements. Live parts to which an employee might be exposed shall be put into an electrically safe work condition (de-energized)

before an employee works on or near them. This rule applies to all electrical work, including changing light bulbs.

8.32 Standard Pre-Lift Plan

8.32.1 Overhead Electrical Lines

Equipment shall maintain a safe distance from overhead lines. Clearances will be adequate for the movement of vehicles and for the operation of construction equipment. A minimum clearance of 20 feet will be implemented unless otherwise specified in Table 8.5 below. A spotter, located so that they have a different line of sight than the equipment operator, shall be used as needed to identify the location of the lines. When equipment operations must be performed closer than 20 feet from overhead power lines, the HSM must be notified. If authorization to proceed is received from the HSM, the electric utility company must be contacted to turn the power off or physically insulate (protect) the lines if the operation must be performed closer than 20 feet of the power line.

Table 8.5 - Minimum Clearance from Energized Overhead Electric Lines

Nominal System Voltage (kilovolts)	Minimum Rated Clearance (feet)
0 – 50	10
51 – 200	15
201 – 300	20
301 – 500	25
501 – 750	35
751 – 1,000	45
Over 1,000	As established by the utility owner/operator

8.33 Critical Lift Plan

Not applicable because no lifts will be used for this work.

8.34 Naval Architectural Analysis

Not applicable since this type of work will not be performed under the current work scope.

8.35 Floating Plant and Marine Activities Contingency Plan for Severe Weather

Not applicable since this type of work will not be performed.

8.36 Man Overboard/Abandon Ship

Not applicable since this type of work will not be performed.

8.37 Float Plan

Not applicable since this type of work will not be performed.

8.38 Fall Protection

Not applicable since this type of work will not be performed under the current work scope.

8.39 Demolition/Renovation Plan

Not applicable since this type of work will not be performed under the current work scope.

8.40 Safe Access Program/Ladders, Stairs, and Railings

Not applicable since work involving ladders, stairs, and railings will not be performed under the current work scope.

8.41 Excavation/Trenching Plan (Intrusive Activities)

No intrusive activities are planned in the scope of work for this project.

8.41.1 Underground Utilities

No intrusive activities are planned in the scope of work for this project.

8.42 Underground Construction Fire Prevention and Protection Plan

Not applicable since underground construction will not be performed under the current work scope.

8.43 Compressed Air Work Plan for Underground Construction

Not applicable since work requiring a compressed air work plan will not be performed under the current work scope.

8.44 Form Work and Shoring Erection and Removal Plans

Not applicable since construction involving form work and shoring will not be performed under the current work scope.

8.45 Precast Concrete Plan

Not applicable since precast concrete will not be used under the current work scope.

8.46 Lift Slab Plans

Not applicable since lift slab work will not be performed under the current work scope.

8.47 Masonry Bracing Plan

Not applicable since this type of work will not be performed under the current work scope.

8.48 Steel Erection Plan

Not applicable since steel erection work will not be performed under the current work scope.

8.49 Explosives Safety Site Plan

Not applicable since explosives activities will not be performed under the current work scope.

8.50 Blasting Safety Plan

Not applicable since blasting work will not be performed under the current work scope.

8.51 Underwater Dive Operation Plan

Not applicable since diving work will not be performed under the current work scope.

8.52 Tree Felling/Maintenance Program

Not applicable since this type of work will not be performed under the current work scope.

8.53 Aircraft/Airfield Construction Safety and Phasing Plan

Not applicable since this type of work will not be performed under the current work scope.

8.54 Site Safety and Health Plan

The SSHP is included as Appendix A of this APP.

8.55 Confined Space Entry Program

Not applicable since this type of work will not be performed under the current work scope.

8.56 Cumulative Trauma Disorder Prevention

Injuries may occur from hand digging with shovels, clearing, and grubbing tools, hand augers, and concrete cutting tools. Workers will be instructed to avoid over-reaching, lifting, and twisting while moving equipment, and to make sure that footing is solid before lifting commences. The following actions will be taken to minimize ergonomic risks:

- Use a hand truck or other mechanical aids to move heavy objects.
- Push do not pull, whenever possible.
- Readjust the load before moving or reposition yourself before lifting, if you find that you must twist or stretch to reach the load to be handled.
- Consider the size, shape, and weight of the object to be lifted. No individual employee is permitted to lift any object that weighs over 50 pounds. Multiple employees or the use of mechanical lifting devices is required for objects over the 50-pound limit.

- Consider that the safe lifting zone is between the knees and shoulders. If the object is below knee level, bend the knees and lift with the legs. If the load is above the shoulders, use a sturdy step ladder.
- Inspect the anticipated path to the destination for the presence of slip, trip, and fall hazards, and clear obstacles before commencing to move the load/object. Feet shall be placed far enough apart for good balance and stability (typically shoulder width).
- Get as close to the load as possible. Legs shall be bent at the knees.
- Keep the back as straight as possible and abdominal muscles should be tightened.
- Avoid twisting motions when performing manual lifts.
- Straighten legs from their bent position to lift the object.
- Take small turning steps without twisting the knees or the back if it is necessary to turn with the load.
- Never carry a load that cannot be seen over or around.

9.0 RISK MANAGEMENT PROCESSES

Detailed project-specific hazards and controls for each major DFW/activity will be addressed in task-specific AHAs. The AHAs define the job steps to be performed for each activity; the specific anticipated hazards associated with each job step; and the equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk. The AHAs will include site-specific training requirements, inspection schedules, and the names of competent and qualified personnel. AHAs required for the project will be approved by the HSM and if necessary, will be submitted for approval to the GDA 15 days prior to the commencement of the work covered by the AHA. Work shall not begin until the AHA for that activity has been accepted by the HSM and discussed with all subcontractor personnel engaged in the activity. The AHAs are to be considered living documents and are intended to be created in the field and updated by the workers as needed. A risk assessment code (RAC) associated with each activity will be determined. RACs are defined by probability and severity of occurrence.

AHAs will be revised, as necessary when unforeseen circumstances arise, or worksite conditions change. Any revisions will be immediately communicated to the affected site workers. If the need to complete an unplanned task becomes necessary at any point throughout the day, the AHA will be revised.

Project-specific hazards and controls are discussed in Section 2.0, Hazard/Risk Analysis, of the SSHP.

This page was intentionally left blank.

10.0 REFERENCES

Code of Federal Regulations (CFR), 2003a. Title 29, Part 1904, Occupational Safety and Health Standards, Recordkeeping, Government Printing Office, Washington, D.C., at URL <http://www.access.gpo.gov/nara/cfr/index.html>.

CFR, 2003b. Title 29, Part 1910, Occupational Safety and Health Standards, U.S. Government Printing Office, Washington, D.C., at URL <http://www.access.gpo.gov/nara/cfr/index.html>.

U.S. Army Corps of Engineers (USACE). 2014. *Safety and Health Requirements Manual, Safety, EM 385-1-1*. November 30.

This page was intentionally left blank.

APPENDIX A – SITE SAFETY AND HEALTH PLAN

This page was intentionally left blank.

Appendix A – Site Safety and Health Plan Avon Park AFR, Florida		
Job Name: Central Florida Optimized Remediation Contract for Avon Park Air Force Range (AFR), Florida		Project Manager: Melaina Pierce, PMP
Worksite Location(s): Central Florida Optimized Remediation Contract for Avon Park AFR, FL.		SSHP Update 1, Revision No. 0
Project and Site Description: This Site Safety and Health Plan (SSHP) applies to environmental remediation services and long-term monitoring (LTM) activities at six IRP Avon Park Air Force Range (APAFR) sites. Field activities include groundwater sampling and land use control inspections.		
Site location maps are provided in the Quality Program Plan (QPP) and the Accident Prevention Plan (APP)		
This SSHP supplements the APP and contains additional project/task order-specific information. Additional safety and health requirements are found in the Activity Hazards Analysis (AHA) forms, associated project plans, Health and Safety (H&S) Procedures, and project-specific standard operating procedures (SOPs) as identified below. If hazards or conditions are identified that are not covered by this SSHP, contact your supervisor or the Site Safety and Health Officer (SSHO). This SSHP is Appendix A of the project APP written in compliance with the United States Army Corps of Engineers (USACE) Health Requirement Manual EM 385-1-1 (Nov. 2014).		
SSHP Organization		
Section	Item	Content
1.0	Site-Specific Safety Personnel and Training	List of Safety Personnel, Specific Training Requirements, Competent Person(s)
2.0	AHAs/Risk Analysis	Hazards of Concern, AHAs for each Definable Feature of Work (DFW), Contamination Characterization, Operational Chemicals, Referenced Tanaq H&S procedures, project specific SOPs (as needed), and Applicable Project Plans
3.0	Personal Protective Equipment	General and Additional Requirements
4.0	Health Hazard Monitoring	Medical Surveillance, Contaminant Exposure Monitoring, Heat and Cold Stress, Noise
5.0	Work Practices and Site Controls	Site Rules and Prohibitions, Work Permits, Work Zones, Engineering and Special Work Practices to Control Site Contaminants
6.0	Site Sanitation and Decontamination	Site Sanitation Plan, Personnel Decontamination, Equipment Decontamination
7.0	Emergency Planning	Emergency Conditions, Rally Points, Emergency Information, Emergency Equipment/Information, Rescue Plans, Spill Plan
8.0	Crosswalk to Plans Required by EM-385-1-1	Cross-reference to requirements of USACE EM 385-1-1 and applicable sections of the APP
Attachment 1 – Activity Hazard Analyses		
Attachment 2 – Personnel Proof of Training and Competency and Certifications of Employee Medical Surveillance Program Participation		
Attachment 3 – Contaminants of Interest and Potential Acute Health Effects		
Attachment 4 – Emergency Contact List and Hospital Route Map		

1.0 Site-Specific Safety Personnel and Training	
Key Project Personnel Responsible for Safety	Name
Project Manager (PM)	Melaina Pierce, PMP
Contractor Quality Control System Manager (CQCSM)	Brantley Rudd
Field Supervisor (FS)	Sarah Kwon
SSHO	Mark Lawrence, GIT
Corporate Health and Safety Director (CHSD)	Nicole Easter, CSP, CDGP
Proof of training and competency and medical program participation for project personnel are included in Attachment 2.	
<p>Training Requirements - See APP Section 4 for Tanaq corporate training requirements.</p> <p>For all tasks involving potential exposure to contaminated groundwater, the requirements for Hazardous Waste Operations and Emergency Response (HAZWOPER) training, medical surveillance and site management will be implemented. Designated HAZWOPER work tasks include the following: Groundwater sampling.</p> <p>For these activities, a HAZWOPER-trained supervisor will be on site to ensure continued compliance with safety and health regulations. Pre-entry site briefings/site access will be conducted prior to site activity for employees and visitors. Tanaq procedures for periodic reviews, inspections, deficiency tracking, corrective action and disciplinary actions will be enforced.</p> <p>HAZWOPER training requirements may be waived for certain subcontractor tasks if contact with contaminated media will not occur. Consult with the CHSD for specific guidance.</p>	
<p>Additional Training Requirements (Note: training listed below is additional training that is not already specified in Section 4 of the APP; if no additional training is necessary, the "none" check box is checked).</p>	
<input checked="" type="checkbox"/> None	
<input type="checkbox"/> Project/ task specific respiratory protection training program	
<input type="checkbox"/> Other:	
<p>Competent Persons Required (Boxes will be checked and individuals' names listed next to the activity, if required)</p> <p><input type="checkbox"/> NOT REQUIRED</p> <p><input checked="" type="checkbox"/> SSHO: Mark Lawrence, GIT <input checked="" type="checkbox"/> Collateral duty SSHO: Brantley Rudd</p> <p><input type="checkbox"/> Designated Representative</p> <p><input type="checkbox"/> Safety Point of Contact</p> <p><input type="checkbox"/> Fall Protection</p> <p><input type="checkbox"/> Scaffolding</p> <p><input type="checkbox"/> Permit-Required Confined Space Entry:</p> <p><input type="checkbox"/> Lockout/Tagout:</p> <p><input type="checkbox"/> Other (please specify)</p>	
<p>The designated Competent Person(s) will also be listed on the appropriate AHAs</p>	

**Appendix A – Site Safety and Health Plan
Avon Park AFR, Florida**

2.0 Activity Hazard Analysis/Risk Analysis

Hazards of Concern/Risk Analysis: [check all that apply]

Physical Hazards

- ☒ Biological: irritant plants, insects, animals, snakes*
- ☐ Cold Stress*
- ☐ Excavation/Trenching
- ☐ Extended work shift/night work/fatigue*
- ☐ Falls
- ☐ Flying debris/ Struck-by*
- ☐ Hazardous Electrical Energies: lockout/tag out
- ☒ Heat Stress/Ultraviolet*
- ☒ Heavy Equipment
- ☒ Heavy Lifting/cumulative trauma*
- ☐ Intrusive Activities*
- ☒ Motorized Traffic/Vehicle accidents*
- ☐ Noise*
- ☐ Radiological (will need radiation safety program)
- ☐ Steam/ burn hazards from pressure washers
- ☒ Severe Weather*
- ☒ Slips, Trips, and Falls, soft and uneven ground*
- ☐ Unwanted entry*
- ☒ Use of Hand Tools, Power Tools and Cutting Tools*
- ☐ Other **Specify:**

Atmospheric/inhalation/skin hazards

- ☐ Confined Space Entry: O2 deficiency/Lower Explosive Limit/Toxics
- ☒ Contaminated clothing – take home toxics (irritant plant resins, ticks, soil)
- ☒ Volatiles/Toxics/Dust/Irritants/Sensitizers/Allergens*
- ☐ Lead (will need a lead control plan if checked)
- ☐ Asbestos (will need an asbestos control plan if checked)
- ☐ Crystalline silica (will need assessment plan if checked)
- ☐ Chromium VI (will need exposure evaluation if checked)

Chemical/Explosive hazards

- ☒ Chemicals (chemical tools, preservatives, treatment technologies, contaminants): carcinogenic polycyclic aromatic hydrocarbons (cPAH), acids, and metals.
- ☐ Explosive/Flammable (Fuels, solvents, reactive materials): gasoline, diesel fuel
- ☐ Spills/leaks*
- ☒ UXO
- ☐ Chemical Warfare Materiel (CWM): Thiodiglycol, 1,4-Dithiane (mustard agent degradation products)
- ☐ Other **Specify:**

Overall Hazard Evaluation:

- ☐ High ☐ Medium ☒ Low

*These hazards are covered in AHA - General Site Hazards.

Activity Hazard Analyses

AHAs will be reviewed with the work crew before starting work and will be revised as necessary to incorporate additional task-specific considerations. AHAs are to be reviewed periodically to confirm that the work processes have not changed and that the hazards are addressed and controlled. Employees will be briefed on any changes made to AHAs.

The AHAs needed for this project are provided in Attachment 1 of this SSHP. Additional AHAs will be prepared as appropriate for new tasks using the AHA template provided in Attachment 1.

Contamination Characterization:

The main chemical contaminants presenting a potential occupational and environmental health hazard during the work are metals and pesticides in groundwater.

Metals – The primary exposure pathway to metals in groundwater in the occupational setting is incidental ingestion and skin contact. The most likely exposure routes of these contaminants are through incidental ingestion and dermal contact during groundwater or surface water/sediment sampling. Precautions will be taken to control exposure routes using proper PPE (such as gloves, proper eye protection, face shield) and engineering controls (such as limit splashing and unnecessary open filled containers)

Pesticides – The primary exposure pathway to pesticides in groundwater in the occupational setting is incidental ingestion and skin contact. The most likely exposure routes of these contaminants are through incidental ingestion and dermal contact during groundwater sampling. Precautions will be taken to control exposure routes using proper PPE (such as gloves, proper eye protection, face shield) and engineering controls (such as limit splashing and unnecessary open filled containers)

**Appendix A – Site Safety and Health Plan
Avon Park AFR, Florida**

2.0 Activity Hazard Analysis/Risk Analysis

The table in Attachment 3 presents the chemical exposure limits and characteristics of the primary chemicals of concern and other chemicals that site workers might encounter while performing the activities described in the Performance Work Statement. Section 3 provides a summary of personal protective equipment (PPE) requirements. Section 4 provides a summary of health hazard monitoring requirements using proper PPE and engineering controls.

Operational Chemicals

Substances that may be brought to the site include the following: sample containers with hydrochloric acid, nitric acid, and Alconox®.

Safety Data Sheets (SDSs) will be kept onsite for each potentially hazardous material (other than waste) that may be brought onsite. Tailgate safety meetings will include discussion of these chemicals, the associated hazards, and hazard controls.

Applicable Tanaq Health and Safety Manual Procedures/SOPs

<input checked="" type="checkbox"/> Hazard Communication Program	
<input checked="" type="checkbox"/> Incident Reporting Procedures/Forms	
<input type="checkbox"/> Fall Protection Program	
<input type="checkbox"/> Electrical Safety Program	

Applicable project plans

<input checked="" type="checkbox"/> Site-Specific Work Plan	<input checked="" type="checkbox"/> UFP-QAPP
<input checked="" type="checkbox"/> Project Management Plan	

**Appendix A – Site Safety and Health Plan
Avon Park AFR, Florida**

3.0 Personal Protective Equipment

General Requirements

Based on known site conditions, planned tasks, and the level of contaminants, it is anticipated that work will begin in Modified Level D PPE. Upgrades in protection will comply with Section 8.12 of the APP. Level D PPE consists of the following:

- Standard work clothing (mandatory long pants and sleeved).
- High-topped shoes/boots with steel or non-conductive protective toe caps.
- Safety glasses with side shields (whenever a splash potential exists or when clearing and grubbing).
- Hard-hat (in drilling areas or if overhead or struck-by hazards exist).
- Leather or similar work gloves for material handling and any task that poses cut or pinch hazards.
- Disposable nitrile (Nitri-solve® [11 mil]) or equivalent gloves whenever there is reasonable potential for contact with harmful chemicals including contaminated groundwater, hazardous chemical tools or equipment that may contain contamination.
- Hearing protection (whenever it is difficult to carry on a conversation with a person when they are standing at arm's length away) approximately 85 decibels (dBA).
- High visibility vest (when working near traffic, and heavy equipment).
- Long-sleeved shirts (whenever there is the potential for contact with poison oak or poison ivy).

Additional PPE Requirements – Some site activities may require additional levels of PPE.

- Decontamination of Equipment – Modified Level D

Respiratory: ☐ Level C respiratory protection possible upgrade
☒ None/Not applicable
☐ APR Full face: Concrete coring, demolition and restoration (if necessary); soil and groundwater sampling (if necessary)
☐ Cartridge/Filter type: P100, OV, or tandem as appropriate
☐ Change out schedule (daily or describe other)
☐ Escape Mask
☐ SCBA, Airline
☐ Other

Protective Clothing:
☒ None/Not Applicable
☐ Apron
☐ Cloth Coverall
☐ Encapsulated Suit
☐ Splash Suit
☐ Tyvek Coverall
☐ Other

Other:
☐ None/Not Applicable
☐ Face Shield
☐ Overboots
☐ Overgloves
☐ Rubber Boots
☐ Undergloves
☒ Other Chemical Resistant Gloves (nitrile)
☒ Personal Flotation Device
☐ Full Body Harness/Fall Protection

**Appendix A – Site Safety and Health Plan
Avon Park AFR, Florida**

4.0 Health Hazard Monitoring

Medical Surveillance

Tanaq personnel are required to participate in the medical surveillance program, which is managed by the Corporate Health and Safety Director (CHSD). The program includes initial and routine medical exams (annual or biennial) provided by a licensed physician at a WorkCare approved clinic. These exams are used to establish an initial baseline of the employee's health and then used to monitor their future health as they pertain to potential occupational exposures to hazardous agents and fitness to work. Subcontractors to Tanaq must also provide documentation of medical approval on an as-needed basis before the worker arrives onsite.

Personnel working in areas where contact with contaminated water are possible, or who wear respiratory protection, will be certified as fit to work before working in those areas. Documentation of medical qualifications will be retained on site. See Attachment 2.

Any injury or illness (whether on or off the job) may require work accommodations before the employee returns to work. If the injury or illness requires medical care, the attending physician must complete a Medical Assessment/Work Capacity Form and it must be provided prior to an employee returning to work.

Exposure Monitoring

Contaminant/ Environment	Action Level Concentration	Location	Response
Total organic vapor* <input type="checkbox"/> Monitoring Required <input checked="" type="checkbox"/> None/Not Applicable (Known concentrations in media will not present an airborne health hazard)	>10 ppm above background in breathing zone	Vapors not anticipated for this project.	Suspend the task, withdraw from the area of elevated readings, and evaluate the situation to determine cause(s) of elevated readings. Correct cause(s) if possible. Options include, natural ventilation, powered ventilation, changing work schedules, working upwind, altering the task/method, changing schedule, and if none of the preceding options are effective, notify the SSHO. Re-test the area and if concentration is below action level, resume work. If elevated concentrations continue to occur, notify the project manager and corporate H&S personnel before upgrading to respiratory protection. Report readings to Contract Officer (CO) or Contract Officers Representative (COR).
Oxygen <input type="checkbox"/> Monitoring Required <input checked="" type="checkbox"/> None/Not Applicable	<19.5% >23.5 %	Confined Space entry is not anticipated for this project.	Do not enter the confined space in an oxygen enriched or deficient atmosphere.
Explosive gases <input type="checkbox"/> Monitoring Required <input checked="" type="checkbox"/> None/Not Applicable	>5% of LEL (Lower explosion limit)	Confined Space entry is not anticipated for this project.	STOP WORK and consult with CIH or SSHO for further recommendations.
Noise <input type="checkbox"/> Monitoring Required <input checked="" type="checkbox"/> Monitoring Not Applicable	>85 dBA (Whenever it is difficult to carry on a conversation with a person when they are standing at an arm's length away).	Active work areas	Require use of hearing protective devices at >85 dBA.

**Appendix A – Site Safety and Health Plan
Avon Park AFR, Florida**

4.0 Health Hazard Monitoring

Contaminant/ Environment	Action Level Concentration	Location	Response
Dust <input type="checkbox"/> Monitoring Required <input checked="" type="checkbox"/> Monitoring not required	10 mg/m ³ Nuisance dust	Visible dust will always be controlled in active HAZWOPER work areas.	If dust levels exceed 10 mg/m ³ , work will cease and the APAFR SSHO will be contacted. This action guideline is based on the TLV for nuisance dust. It should be noted that airborne dust is visible at approximately 2 – 2.5 mg/m ³ .
	0.025 mg/m ³ Respirable silica	Not anticipated for this project.	If additional controls are required, implement a Crystalline Silica Plan.

Heat and Cold Stress

Tanaq's Heat and Cold Stress Monitoring Plan is provided as Section 8.18 of the APP.

**Appendix A – Site Safety and Health Plan
Avon Park AFR, Florida**

5.0 Work Practices and Site Controls

General Site Rules and Prohibitions

- A hazard communication program will be implemented, which includes retention of SDSs, container labeling, and personnel training.
- All personnel are authorized and are expected to report or correct unsafe and potentially unsafe conditions.
- Conducting pre-entry site briefings/site access prior to any site activity for employees and visitors is required.
- Personnel are required to work using the buddy system at all times unless stated otherwise.
- Individuals must be alert to potentially dangerous situations, such as the presence of strong, irritating, unusual, or nauseating odors.
- PPE must be worn as specified. Individuals will be alert to decreased performance capabilities such as poor tactile skills when wearing gloves.
- Visitors will be escorted by qualified personnel at all times.
- Consuming food and beverages, using tobacco products, and carrying matches or lighters are prohibited in potentially contaminated areas.
- Contact with potentially contaminated substances will be avoided. Walking through stained soils, puddles, pools, or mud, or handling soils without protective clothing is prohibited. Whenever possible, kneeling on the ground, leaning, or sitting on equipment is prohibited.
- Wearing jewelry, which may become entangled in equipment, is prohibited.
- Running and horseplay are prohibited in all areas of the site.
- Equipment will be bonded and grounded, spark proof and explosive resistant at appropriate.

Site-Specific Rules and Prohibitions

List any site-specific requirements.

Required Work Permits or Plans [Attach required forms – If needed] or see APP for Plans checked.

- | | |
|---|--|
| <input type="checkbox"/> No work permits are required for this site. | <input type="checkbox"/> Confined Space Entry Permit |
| <input type="checkbox"/> Hot work | <input type="checkbox"/> Excavation/Trenching |
| <input type="checkbox"/> Lead | <input type="checkbox"/> Cr VI |
| <input type="checkbox"/> Silica | <input type="checkbox"/> Asbestos |
| <input type="checkbox"/> Radiation | <input type="checkbox"/> Lock out/tag out (Hazardous energy control) |
| <input type="checkbox"/> Fatigue management plan (extended work shifts or night work. See 8.1 of APP) | <input type="checkbox"/> Other: |

Work Zones

Work zones for the well abandonment portion of this project in high traffic areas will be marked off with cones. For the range sites (OT059A, OT059C, and OT059D), access is restricted due to their location on the active range. If needed, the work area will be divided into an exclusion zone (EZ), a contamination reduction zone (CRZ), and a support zone. The SSHO shall be responsible for designation of the zones. Work areas shall be established and protected so that the public or workers working in peripheral areas shall be prevented from entering the regulated work area.

The EZ will include any area where chemical contamination may be encountered and will be marked with barrier tape or other means to warn personnel of the hazards. The EZ will be large enough to prevent contamination from leaving the marked area. Immediately adjacent to the EZ, a CRZ with a decontamination area for equipment and personnel will be established. This area will also be delineated with traffic cones and/or barrier tape. The CRZ will be large enough to provide a safety zone to prevent the movement of contaminants from the EZ into the support zone. Only personnel who have completed the appropriate training, have a current medical clearance for hazardous waste site operations, and are wearing the proper PPE will be allowed within an EZ or CRZ.

The remainder of the project area will be designated as the support zone. No special markings or warning labels are required for this area.

**Appendix A – Site Safety and Health Plan
Avon Park AFR, Florida**

5.0 Work Practices and Site Controls

Engineering and Special Work Practices to Control Site Contaminants

During designated HAZWOPER work activities that involve potential exposure to site contaminants, only HAZWOPER-trained and certified personnel will complete these specific tasks.

Multiple types of communication systems will be available for workers assigned to field projects. Face-to-face communication will be possible for the field workers in the work and support areas. In addition, cell phones will be used for worker communication and emergency notifications. In the event that cell phone reception cannot be accessed in all areas of the work site, a communication muster point where there is known cell phone reception will be established at each installation. As a backup, telephones located at the installations (if available) can be used to contact emergency assistance.

During well abandonment and groundwater sampling, and other LTM activities, procedures will be implemented to contain contaminated groundwater and to prevent the spread of potential contaminants.

Spill containment and cleanup supplies will be available to contain any spills of fuel, hazardous materials, and potentially contaminated groundwater.

**Appendix A – Site Safety and Health Plan
Avon Park AFR, Florida**

6.0 Site Sanitation and Decontamination

Site Sanitation Plan (See also Section 8.4 of the APP)

Drinking water	Bottled drinking water will be maintained onsite for use by all personnel.
Washing and toilet facilities	The nearest facilities will be identified at the daily TSM depending on the location of the day's activities.
Eyewash/ Shower Facilities	Emergency eye wash equipment will be available when there is potential exposure to corrosives, strong irritants, or toxic chemicals. Showers are not expected to be necessary for this project.
Vermin Control	Local pest management services will be contacted if needed.

Waste Disposal

Disposable materials (not classified as hazardous) such as latex gloves, used PPE, aluminum foil, paper towels, and similar items, will be placed and sealed in plastic garbage bags for disposal with sanitary waste from the site.

Personnel Hygiene and Decontamination

Personnel decontamination will be instituted to minimize the possibility of exposure to chemical hazards and COVID-19. All field personnel will wash their hands frequently for at least 20 seconds and before eating, drinking, and leaving the site for the day. A shower will be taken as soon as possible after leaving the field. Field personnel will practice social distancing to the extent practicable, and will wear a mask if a minimum of 6 ft cannot be obtained.

The SSHO will be responsible for assessing the effectiveness of decontamination procedures. Should the SSHO deem the decontamination procedures to be ineffective, the SSHO will consult the SHM for guidance.

Personnel Dry Decontamination Procedure

Place all disposable PPE in a garbage bag as removed in the following order:

- (1) Brush off work boots, remove disposable over boots, or booties, if used
- (2) Remove gloves
- (3) Remove safety glasses
- (4) Remove Tyvek or cloth coverall, if used
- (5) Remove respirator, if used
- (6) Remove inner gloves
- (7) Wash hands/face before eating/drinking

Personnel Wet Decontamination Procedure

- (1) Wash overboots in soapy water and rinse
- (2) Remove overboots or booties
- (3) Remove gloves
- (4) Remove safety glasses
- (5) Remove Tyvek or cloth coverall, if used
- (6) Remove respirator, if used
- (7) Remove inner gloves
- (8) Wash hands/face before eating/drinking

☒ **Not Needed**

Sampling Equipment Decontamination

Equipment decontamination will be performed in accordance with FDEP SOPs.

For sampling, new equipment will be used at each location and equipment decontamination will not be required.

☒ **Not Needed**

Heavy Equipment Decontamination

Pressure washing for decontamination of earth-working equipment is not anticipated. If dry contamination procedures are not adequate, pressure washing equipment will likely be used.

☒ **Not Needed**

**Appendix A – Site Safety and Health Plan
Avon Park AFR, Florida**

7.0 Emergency Response Plan

Conditions potentially leading to emergency:

The emergency response plan consists of adequate planning measures, emergency notification procedures, and response plans for spills, fires, and severe weather are provided in Section 8.2 of the APP (Emergency Response Plans).

Evacuation and Rally Points: Refer to Section 8.2 of APP.

If site evacuation is required, a continuous, uninterrupted air horn will be sounded for approximately 10 seconds. Air horns in the work area or a vehicle horn will be used. Continuous communication will be maintained between field staff. Emergency alert systems shall be tested periodically. If employees are working alone in remote locations, a means of contact, such as a two-way radio and/or a regular check-in schedule, must be provided. Personnel shall evacuate to a designated safe, upwind location and the crew leader will perform a head count. When the head count has been completed, the SSHO will be provided a status report of the event.

Thunder and lightning storms, hail, high winds, tornados, and hurricanes may occur. Fog and lighting may pose potential problems in the work area as well. The weather will be monitored routinely. It may be necessary to halt certain hazardous operations or stop work altogether to allow the situation to pass. The SSHO must decide what operations, if any, are safe to perform based on existing and anticipated conditions. If lightning is observed within 5 miles of the project location, all work shall stop, and individuals will seek shelter. Work will remain shut down for 30 minutes or until lightning is outside of 5 miles.

Contact the MAFB Weather Service (813.995.2701) for local weather forecasts and consultation on active warning information. Severe weather warnings are broadcast over handheld radios that are required to enter the Air Force Range. In the case that immediate shelter is required, all personnel will go to the designated meeting location and wait until hazardous conditions pass. Permanent shelter points will be identified on a case-by-case basis at tailgate safety briefings.

During a tornado warning or shelter-in-place warning at APAFR, Tanaq and subcontractor personnel should take shelter in a building or a vehicle. Notify the SSHO or PM once you are safe and keep them updated throughout the situation.

Emergency Contact List and Hospital Route Map (First two pages of APP)

Post a copy in each site field office and in each site vehicle.

Emergency Equipment/Information

Emergency equipment and information brought onsite will include, but is not limited to the following:

- An effective means of communication (hard-wired or cellular telephone, two-way radio, etc.) to call 911 or other emergency response sources.
- A minimum of one working vehicle to effectively transport injured worker.
- The telephone numbers of physicians, hospitals, and ambulances.
- A map delineating the best route to the nearest medical facility.
- A minimum of one ANSI Z308.1, Type III first aid kit for portable outdoor settings.
- A minimum of one approved fire extinguisher.
- A spill kit.
- Air horn or car horn to be used to signal an emergency. Uninterrupted 10 second horn indicates site evacuation. Short blasts of horn (3) indicates injury.

First aid kits will be maintained onsite in vehicles and in areas where their use may be needed, such as chemical handling areas, areas where contact with potentially contaminated material is possible, or areas where hand tools are used. The contents of first aid kits will be checked prior to their use onsite and at least every 3 months when work is in progress so that when they are needed, they are complete, in good condition, and have not expired.

In addition, when a medical facility or physician is not accessible within 5 minutes of the work site, a minimum of two personnel on each shift will be qualified to administer first aid and CPR.

**Appendix A – Site Safety and Health Plan
Avon Park AFR, Florida**

7.0 Emergency Response Plan

Spill or Release Plan

Potential for spills of hazardous material exists with (1) contaminated groundwater sampling and (2) fuels and hydraulic fluids during equipment fueling and operation.

Spill Kit Supplies: Absorbent materials in sufficient quantities to absorb liquids, chemical-resistant gloves, chemical splash goggles and/or face shields, absorbent booms, hand tools/squeegees/brooms, boot covers, wastewater pumps for larger spills, and drums to contain spilled liquids.

**Appendix A – Site Safety and Health Plan
Avon Park AFR, Florida**

8.0 Crosswalk to Plans Required by EM-385-1-1

Plans Required by EM 385-1-1	EM 385 Reference	If Required, Location or Reference
Fatigue Management Plan	01.A.20	APP Section 8.1
Emergency Response Plans	01.E.01, 01.E.05, 03.A.02, 03.D, 19	APP Section 8.2, SSHP Section 7.0, Emergency Contact List and Hospital Route Map provided in front of APP
Plans for Prevention of Alcohol and Drug Abuse	01.C.02	APP Section 8.3
Site Sanitation Plan	02	APP Section 8.4, SSHP Section 6.0
Medical Support Plan	03.A; 03.D	APP Section 8.5
Bloodborne Pathogen Exposure Control Plan	03.A05	APP Sections 8.6 and 8.7
Layout Plans	04.A.01	APP Section 8.8
Access and Haul Road Plan	04.B	APP Section 8.9
Hearing Conservation Program	05.C	APP Section 8.10
Respiratory Protection Plan	05.G	APP Section 8.11
Health Hazard Control Program	06.A	APP Section 8.12, SSHP, AHAs
Hazard Communication Program	06.B.01	APP Section 8.12
Process Safety Management Plan	06.B.04	APP Section 8.13
Lead Abatement Plan	06.C.02	APP Section 8.14
Asbestos Abatement Plan	06.C.03	APP Section 8.15
Radiation Safety Program	06.F.03.a	APP Section 8.16
Abrasive Blasting Plan	06.I.01	APP Section 8.17
Heat/Cold Stress Monitoring Plan	06.J.02	APP Section 8.18
Indoor Air Quality (IAQ) Management Plan	06.L	APP Section 8.19
Mold Remediation Plan	06.L.03	APP Section 8.20
Chromium (VI) Exposure Evaluation	06.M	APP Section 8.21
Crystalline Silica Monitoring Plan	06.N	APP Section 8.22
Lighting Plan	07.A	APP Section 8.23
Night Operations Lighting Plan	07.A.09	APP Section 8.24
Traffic Control Plan	08.C.05	APP Section 8.25
Fire Prevention Plan	09.A	APP Section 8.26
Wild Land Fire Management Plan	09.L	APP Section 8.27
Arc Flash Hazard Analysis	11.B	APP Section 8.28
Assured Equipment Grounding Control Program	11.D.05, App E	APP Section 8.29
Hazardous Energy Control Plan	12.A.01	APP Section 8.30
Lockout/Tagout	12.E.04	APP Section 8.31
Standard Pre-lift Plan	16. A.03; 16.L.15	APP Section 8.32
Critical Lift Plan	16.H 16.A.03, 16L.15	APP Section 8.33
Naval Architectural Analysis	16.L	APP Section 8.34
Floating Plant and Marine Activities: Contingency Plan for Severe Weather	19.A.03	APP Section 8.35
Man Overboard/Abandon Ship	19.A.04	APP Section 8.36
Float Plan	19.F.04	APP Section 8.37
Fall Protection Program	21.C	APP Section 8.38
Demolition Renovation Plan	23.A.	APP Section 8.39

**Appendix A – Site Safety and Health Plan
Avon Park AFR, Florida**

8.0 Crosswalk to Plans Required by EM-385-1-1

**Appendix A – Site Safety and Health Plan
Avon Park AFR, Florida**

8.0 Crosswalk to Plans Required by EM-385-1-1

Safe Access Program/Ladders, Stairs and Railings	24.H.01	APP Section 8.40
Excavation/Trenching Plan	25.A.01	APP Section 8.41
Underground Construction Fire Prevention Plan	26. D.01	APP Section 8.42
Compressed Air Work Plan	26.I.01	APP Section 8.43
Formwork and Shoring	27.C	APP Section 8.44
Precast Concrete Plan	27.D	APP Section 8.45
Lift Slab Plans	27.E	APP Section 8.46
Masonry Bracing Plan	27.F.01	APP Section 8.47
Steel Erection Plan	28	APP Section 8.48
Explosives Safety Site Plan (ESSP)	29.A.01	APP Section 8.49
Blasting Safety Plan	29.A; 26.J	APP Section 8.50
Underwater Dive Operation Plan	30.A.13	APP Section 8.51
Tree Felling/Maintenance Program	31.A	APP Section 8.52
Airfield/Aircraft Construction Safety and Phasing Plan	32A	APP Section 8.53
SSHP	33.B	APP Section 8.54, this SSHP (APP Appendix A)
Confined Space Entry Program	34.A	APP Section 8.55
Cumulative Trauma Disorder Prevention	06.K	APP Section 8.56

ATTACHMENT 1

ACTIVITY HAZARD ANALYSES

This page was intentionally left blank.

ACTIVITY HAZARD ANALYSIS

Activity/Work Task: Decontamination of Equipment

Project Name/Location: Avon Park AFR, Florida

Contract number: W91278-21-D-0063

Date Prepared: September 9, 2021

Updated: October 2, 2023

Prepared By: Sarah Kwon

Corporate Health and Safety reviewer: Nicole Easter, CSP, CDGP

Notes: (Field notes, review comments, etc.)

Overall Risk Assessment Code (RAC) (Use highest code)

L

Risk Assessment Code (RAC) Matrix

Severity

Probability

Frequent

Likely

Occasional

Seldom

Unlikely

Catastrophic

E

E

H

H

M

Critical

E

H

H

M

L

Marginal

H

M

M

L

L

Negligible

M

L

L

L

L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.

RAC Chart

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

E = Extremely High Risk

H = High Risk

M = Moderate Risk

L = Low Risk

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each **"Hazard"** on AHA. Annotate the overall highest RAC at the top of AHA.

Job Steps	Hazards	Controls	RAC
Determine location for set up	Traffic-Struck by hazards	<ul style="list-style-type: none"> Select location away from traffic Place barricades for work site protection, if necessary Keep all unnecessary personnel out of the work area and in an upwind location Wear high visibility vest 	L
	Driving over soft ground Uneven terrain	Choose location with level and firm soils	L

Job Steps	Hazards	Controls	RAC
	Heat Stress: Exposure to high ambient temperatures See also General Site Work AHA	<ul style="list-style-type: none"> • Acclimatize to work in hot weather by gradually working in heat and taking more frequent breaks, systematically building up tolerance to heat. • Conduct field activities in the early morning if possible to avoid heat or inclement weather. • Have enough water onsite so that each worker can consume at a minimum, one quart per hour per shift. • Review with personnel, by frequent reminders, to take water breaks so that each person can consume enough water. • Provide access to shade (i.e., blockage from direct sunlight), that is reasonably close to the work area. Keep in mind that a vehicle or other enclosed area with no air conditioning is NOT considered shade. The area must be a well-ventilated area or have air conditioning. • Conduct training on risk factors, signs and symptoms of heat illness, importance of hydration and acclimatization, and importance of reporting symptoms and what to do in case of heat illness emergency and contacting emergency medical services (see APP Heat Stress Monitoring Plan). • Follow the requirements for physiological monitoring. (e.g., During work in temperatures above 90 adjusted temperature, perform physiological monitoring—and document on the heat stress physiological monitoring form. • Be conscious of your individual tolerance to work in hot weather. • Monitor yourself and co-workers for signs and symptoms of heat stress. <p>Take breaks as necessary in shady or cool areas and drink plenty of liquids. If a colleague recommends that you take a break, listen to them.</p>	L
Handle equipment and materials.	Slip, trip and fall hazards	<ul style="list-style-type: none"> • Cover the importance of housekeeping in Safety Briefings • Wear slip resistant footwear • Keep work area picked up and as clean as feasible and free of tripping and fall hazards. 	L
	Flying debris-Eye hazards	<ul style="list-style-type: none"> • Wear safety glasses at all times when sampling or handling samples • Ensure eyewash is available 	
Personal Decon	Take home toxics	<ul style="list-style-type: none"> • Decon per SSHP • Remove all contaminated clothing and materials and leave on-site. • Shower as soon as possible 	L

Job Steps	Hazards	Controls	RAC
<i>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</i>			

Equipment	Training	Inspection
<u>Personal Protective Equipment:</u> PPE Level D: Safety Glasses Safety-Toed Boots Work Gloves/Chemical resistant gloves ANSI Class 2 reflective warning vests <u>Other Equipment:</u> Fire Extinguishers Emergency Eyewash First Aid Kit Insect repellent- DEET Hand tools Spill containment supplies First aid supplies Containers as needed Drinking water Weather radio and/or smart phone apps for temperature and noise Heat stress monitoring Alconox/cleaning brushes/buckets/as needed	Competent Person (CP) / Qualified Person (QP): CP/SSHO _____ QP/First Aid and CPR _____ QP/First Aid and CPR _____ Training Requirements (as determined by the SSHO): HAZWOPER 40 hour Site safety orientation Tailgate meetings Emergency procedures Hazard communication Fire extinguisher use Biological hazard identification and control Tornado shelter location Lightning safety procedures Heat stress prevention and heat stroke treatment	Daily inspection (SSHO) _____ Housekeeping (daily) Fire extinguisher (monthly) Vehicle inspection (daily) Eye Wash Equipment and tools inspection (daily and before use) Survey areas for poisonous plants, insects, and animals (each work area) Check body for ticks (each evening during tick season) Identify closest usable tornado shelter that is available (each work area)

ACTIVITY HAZARD ANALYSIS (AHA)						
Activity/Work Task: General Site Work Project Name/Location: Avon Park AFR Contract number: W91278-21-D-0063 Date Prepared: September 9, 2021 Updated: October 2, 2023 Prepared By: Melaina Pierce, PMP Corporate Health and Safety reviewer: Nicole Easter, CSP, CDGP Notes: (Field Notes, Review Comments, etc.)	Overall Risk Assessment Code (RAC) (Use highest code)				L	
	Risk Assessment Code (RAC) Matrix					
	Severity	Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L
	Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above)					
	Probability the likelihood the activity will cause a Mishap (near miss, incident or accident). Identify as: Frequent, Likely, Occasional, Seldom, or				RAC Chart	
Severity the outcome/degree if a mishap occurred. Identify as: Catastrophic, Critical, Marginal, or Negligible				E = Extremely High Risk		
				H = High Risk		
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.				M = Moderate Risk		
				L = Low Risk		
Job Steps	Hazards	Controls				RAC
Review—Health and Safety (H&S) needs, communication and preparatory instructions	Behavioral: Human error-Failure to plan/warn/train. Inadequate preparation can lead to personal injuries, property damage and project delays. Employees not trained in the safe execution of their assigned task may harm themselves or others.	Readiness Review. SSHO to identify applicable portions of SSHP and include those and AHAs in site specific job training for workers. SSHO to perform onsite verification that SSHP and AHAs capture all important site hazards and controls. SSHO to verify that access to the necessary equipment, to evaluate and control site hazards, is available and complete. and in good condition (i.e. equipment, tools, PPE, materials, etc. required to perform the tasks).				L
	Unfamiliarity with site, general site hazards, project safety rules, chain of command, emergency procedures. Adding new personnel to work team, visitors.	Conduct training and coordination with team. New employees will be trained and proficient before they are assigned to their jobs. Visitors will receive a site safety briefing and PPE.				

Job Steps	Hazards	Controls	RAC
	Emergency response unfamiliarity- Delay in response and treatment	SSHO to verify that emergency safety supplies and first aid supplies are available and complete. SSHO to review emergency procedures, contact numbers and evacuation plans, severe weather shelters and rally points. SSHO to confirm that all personnel know what to do in the event of an accident (personal or property damage).	
Transportation to site and site vehicle maneuvering	Struck by: Vehicle accidents/Traffic	Prohibit cell phone use by driver while vehicle is in motion. Practice defensive driving and wear safety restraints when vehicle is in motion. Adjust vehicle per personal specifications and confirm that it is in good working order and all cargo is secured and distractions are minimized. Familiarize yourself with the route and directions. Keep vehicle speed appropriate to road conditions. Be aware of the onset of driving fatigue and take breaks as needed. Perform a walk-around vehicle inspection at least daily.	L
	Weather: Poor road conditions, ruts, snow, ice mud puddles, poor traction	Monitor weather conditions and consider postponing travel or decreasing speed in poor travel conditions. Match driving speed to the conditions.	
	Struck by or against: Maneuvering in tight areas/potential vehicle or personnel damage	Use a spotter to help maneuver in tight areas. Avoid backing if possible. Check all blind spots before you attempt to move vehicle. Sound horn before backing and move slowly.	
Secure site	Unwanted entry: Security/Site access control	Establish positive site access control prior to on-site operations using barricades, signs, or fencing.	L
Material handling and set up	Strains, sprains, awkward bending/lifting/ positions and ergonomic hazards	Know your own limitations and ask for help if you need it. Size up the load before the lift. Use mechanical assistance or 2-person lift for loads greater than 50 pounds and for large awkward loads. Lift with the legs and keep back straight. DO NOT lift and twist torso at the same time. Confirm that the walking pathway is clear of depressions or debris. Limit repetitive awkward motions and unbalanced lifting as much as possible.	L

Job Steps	Hazards	Controls	RAC
Working around vehicles	Struck-by hazards, crushing hazards, caught-between, noise-hearing loss	<p>Select work location away from traffic.</p> <p>Discuss active work areas in daily briefings.</p> <p>Place barricades or stationary vehicles for work site protection, if necessary.</p> <p>Wear high visibility vest.</p> <p>STAY CLEAR of traffic and earth moving equipment.</p> <p>Make eye contact with operators of equipment to make sure they know your intentions.</p> <p>Never position yourself between moving and fixed objects</p> <p>Wear hearing protection if noise levels are > 85 dBA.</p>	L
Working around/ near other trades or contractors	Hazards caused by other trades-Failure to communicate hazards (various hazards: toxic dusts, chemicals, physical hazards, biological hazards)	<p>Coordinate with subcontractors and other personnel on a daily basis.</p> <p>Notify others of potential hazards posed by field work and ask them to do the same for us. Stop work or implement controls if the work of others poses a hazard for contractor or subcontractor personnel.</p> <p>Inform subcontractors of locations of warning signs, hazards and precautions that they should be taking. Provide specific hazard communication training tailored to the workplace.</p> <p>Inspect the work of subcontractors to verify safe operation and compliance with applicable requirements and require correction of deficiencies.</p> <p>Ask the “creating” employers (subcontractors) to correct hazards. NEVER tell the “creating” employer how to do their job but tell subcontractors to get the hazard corrected and hold them accountable.</p> <p>Ensure that all site workers have the required OSHA training.</p> <p>Require that each subcontractor be responsible for conducting inspections of their specific operations and equipment, conducting exposure monitoring for their workers and providing SDSs, PPE, medical surveillance and specialized worker training (e.g., fork lift, excavation and trenching, fall protection, etc.).</p> <p>Acquire documentation.</p>	L
	Fire	<p>Maintain at least one dry chemical fire extinguisher having a minimum UL rating of 1A5BC on site.</p> <p>Limit smoking to designated areas</p>	

Job Steps	Hazards	Controls	RAC
Working in remote areas.	Criminal activity, wild animals, falls leading to inability to self-evacuate Getting lost	Use the buddy system if possible, however if it cannot be used, follow the Lone Worker Procedure: Contact PM or alternate point of contact at work start, mid-day, and when leaving work site at end of day. Let others onsite non-contractor staff) know where you are working and establish a check in procedure. Bring a smart phone, topographic and/or site map, compass, GPS.	L
	Injuries and accidents from driving/walking over soft ground and uneven and rough terrain	Choose location with level and firm soils, when possible. Have gravel added to site roads to improve traction. Maintain vehicle speed corresponding to road conditions. Watch footing when walking in mud or wet soils	
	Unhygienic conditions	Confirm that restroom facilities, if installed onsite, are adequately provided and maintained. Maintain hand disinfectant, wipes, and wash stations.	
	Slip, trip, and fall hazards	Wear slip-resistant footwear. Inspect the work area for slip, trip and fall hazards Use sand or salt or slip-on traction aids to control ice slip hazards, as needed during winter months. Keep work area picked up and as clean as feasible Keep egress routes are as clear and unobstructed as possible.	

Job Steps	Hazards	Controls	RAC
General Site Work- Working outdoors. Walking onsite.	Biologicals—contact with poisonous and thorny plants, allergens, insects and animal hazards (for example: spiders, hornets, reptiles, snakes, deer ticks (Lyme disease), mosquitoes, bird and rodent droppings, biting and stinging insects, thorny plants, etc.). Specify below any site specific details and or review APP for specific biological hazards.	<p>Note: All personnel have the option to complete the Voluntary Allergy/Sensitivity/Medical Questionnaire.</p> <p>Conduct visual inspection before work begins and note (mark) areas of poisonous vegetation, insect (hornet wasp) nests and snake habitats.</p> <p>Use mosquito repellant with DEET and tick repellant with permethrin, as required.</p> <p>Treat clothing with permethrin-based products if ticks are prevalent.</p> <p>Know the local fauna and review emergency preparedness measures. Review potential animal dangers specific to the site and precautions (actions to take if run-in with wild animal occurs) and treatments.</p> <p>Inspect your body and clothing for ticks during outdoor activity and at the end of the day. Wear light colored clothing so ticks can be more easily seen. Remove ticks right away to prevent infections.</p> <p>When in areas with tick potential tuck pants into socks. Wear long-sleeved shirts that should be tucked in</p> <p>Review information for poison ivy/oak recognition and treatment, if plants are present.</p> <p>Use existing footpaths when possible.</p> <p>Avoid walking in un-cleared areas with poison ivy or biological hazard potential.</p> <p>Use barrier cream and cleaning products such as Zanfel, Ivy Block, Tecnu, IvyX if poison ivy or poison oak is prevalent.</p> <ul style="list-style-type: none"> • Wash hands using Ivy cleanser, prior to eating, using restroom, operating motor vehicle and after leaving the field • Do not touch face with hands or clothing while in the field • Remove contaminated work clothing with gloves. Store, bag and wash separately. <p>Use poison ivy cleansers (not lotion soap) to clean affected skin. Lotion soaps will spread the irritant oil on larger areas of the skin.</p> <p>Shower immediately upon leaving work.</p> <p>Wear snake chaps if poisonous snakes are present.</p>	L
General Site Work in heat and sun	UV exposure—sunburn Temperature stress: heat exhaustion, stroke	<p>Wear UVA/UVB SPF sunscreen (minimum 30 SPF) and reapply frequently.</p> <p>Wear hats and clothing that shield skin from direct sun.</p> <p>Implement heat stress controls when the heat index is greater than 75 degrees Fahrenheit (°F), when</p>	L

Job Steps	Hazards	Controls	RAC
		<p>the temperature is 75 °F or more with relative humidity of 55% or more:</p> <p>Acclimatize by gradually working in heat, systematically building up tolerance.</p> <p>Conduct field activities in the early morning, if possible, to avoid heat.</p> <p>Have enough water onsite so that each worker can consume at a minimum, one quart per hour per shift.</p> <p>Have frequent reminders to personnel, to take water breaks so that each person can consume enough water.</p> <p>Provide access to shade that is reasonably close to the work area.</p> <p>Take breaks as necessary in shady or cool areas and hydrate.</p> <p>Conduct training on risk factors, signs and symptoms of heat illness, importance of hydration and acclimatization, and importance of reporting symptoms and what to do in case of heat illness emergency, and contacting emergency medical services (see APP, Heat Stress Monitoring Program).</p> <p>Follow the requirements for physiological monitoring as stated in the APP. (e.g., During work in temperatures above 90 adjusted temperature, perform physiological monitoring—see safety plan if wearing Tyvek for when to start monitoring.)</p> <p>Be conscious of individual tolerances to work in hot weather and medication contraindication for heat exposure.</p> <p>Monitor yourself and co-workers for signs and symptoms of heat stress.</p>	L

Job Steps	Hazards	Controls	RAC
General site work in cold temperatures	Temperature stress: cold, hypothermia.	<p>Institute cold stress controls when air temperature or wind chill is, or may drop below 40° Fahrenheit (F), when parts of the body are or may become immersed in cold water, and when working in snow or ice.</p> <p>Train employees on the dangers and symptoms of cold-related illnesses and the applicable hazard controls.</p> <p>Train workers on the personal factors that may increase risk such as advanced age and circulatory problems and medications.</p> <p>Establish a buddy system and ensure that personnel watch each other for signs of cold related illnesses.</p> <p>Provide a warm break area and establish a schedule for warm-up breaks and increase the frequency of warm-up breaks with decreasing temperatures. Take warm-up breaks if personnel exhibit shivering or report pain in the extremities that might be due to incipient frostbite.</p> <p>Prevent or minimize exposure of bare skin if temperature or wind chill is less than minus (-) 25°F.</p> <p>Schedule tasks to avoid long periods during which workers must sit or stand still.</p> <p>Adjust work schedules or tasks for new employees to permit acclimatization to the cold conditions.</p> <p>Encourage personnel to drink adequate quantities of water, soup, or other fluids to ensure adequate hydration.</p> <p>Establish emergency plans to include immediately available dry clothing if there is a potential for personnel to be splashed or immersed in liquid.</p>	L
Repetition of work tasks for periods longer than 8 hours	Behavioral: Human error- Fatigue associated with extended work shifts including general drowsiness and associated driving fatigue.	<p>Motor vehicle operators must not exceed 10 hours of driving in any 24-hour period.</p> <p>Do not operate motor vehicles after working for more than 12 hours during any 24-hour period.</p> <p>Know personal physical and psychological limitations.</p> <p>Stop work/driving when necessary to take breaks and hydrate.</p> <p>Stop work all together if fatigue endangers your safety or the safety of others. If appropriate, find a replacement for your job tasks.</p> <p>Schedule more demanding tasks for when endurance and alertness is best.</p> <p>Postpone more demanding and hazardous jobs if you are fatigued.</p> <p>Follow guidelines of APP for work-rest regimens under adverse conditions of heat or cold stress.</p>	L

Job Steps	Hazards	Controls	RAC
Completion of work shift and clean-up	<p>Clothing contact with potentially irritant materials/insects.</p> <p>Take home toxics.</p>	<p>Decontaminate yourself and gear, as appropriate for contaminants and dust.</p> <p>If appropriate wear Tyvek as necessary and washable or disposable over-boots to keep personal clothing and boots, clean and free of any contaminated soils.</p> <p>Use liners to prevent contamination of truck.</p> <p>Shower immediately at end of workday.</p> <p>Check body for ticks, bites and signs of irritation or cuts.</p>	L

Job Steps	Hazards	Controls	RAC
<i>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</i>			

Equipment	Training	Inspection																																																																																																														
<p>PPE Level D:</p> <p>Safety glasses</p> <p>Safety-toed boots</p> <p>Work gloves/chemical resistant gloves</p> <p>ANSI Class 2 reflective warning vests</p> <p>Hearing protection, as necessary</p> <p>Other Equipment:</p> <p>Generator if needed</p> <p>Fire extinguishers</p> <p>Emergency eyewash bottle</p> <p>First aid kit</p> <p>Insect repellent–DEET and permethrin</p> <p>Hand tools</p> <p>Spill containment supplies, if needed</p> <p>Containers as needed</p> <p>Drinking water</p> <p>Weather radio/or</p> <p>Smart phone apps (temperature stress, noise, weather)</p>	<p>Competent Person (CP) / Qualified Person (QP):</p> <p>CP/SSHO _____</p> <p>QP/First Aid and CPR _____</p> <p>QP/First Aid and CPR _____</p> <p>Training Requirements (as determined by the SSHO):</p> <p>HAZWOPER 40 hour and current refresher</p> <p>Supervisor training (SSHO)</p> <p>OSHA 30 hour (SSHO)</p> <p>Site safety orientation</p> <p>Tailgate meetings</p> <p>Emergency procedures</p> <p>Hazard communication</p> <p>Hearing conservation</p> <p>Bloodborne pathogen</p> <p>Applicable AHAs</p> <p>Fire extinguisher use</p> <p>Biological hazard identification and control</p> <p>Severe weather shelter location</p> <p>Lightning safety procedures</p> <p>Temperature stress prevention, controls, treatment</p>	<p>Daily inspection (SSHO) _____</p> <p>Housekeeping (daily)</p> <p>Fire extinguisher (monthly)</p> <p>Vehicle inspection (daily)</p> <p>Equipment and tools inspection (daily and before use)</p> <p>Portable flexible cords or cables (daily)</p> <p>Eyewashes (monthly)</p> <p>Survey areas for poisonous plants, insects, and animals (each work area)</p> <p>Identify closest usable severe weather shelter (ex. tornado shelter) that is available in each work area)</p> <p>First Aid kit inspection every 3 months, if unopened they do not have to be opened for inspection.</p> <div><div>Requirements for Basic First Aid Unit Package</div><table><tr><th>Unit first aid item</th><th>Minimum Size or Volume (metric)</th><th>Minimum Size or Volume (US)</th><th>Item quantity per unit package</th><th>Unit package size</th></tr><tr><td>Absorbent Compress</td><td>208 cm²</td><td>32 in²</td><td>1</td><td>1</td></tr><tr><td>Adhesive Bandage</td><td>2.5 x 7.5 cm</td><td>1 x 3 in</td><td>16</td><td>1</td></tr><tr><td>Adhesive Tape</td><td>2.3 m</td><td>2.5 yd (total)</td><td>1 or 2</td><td>1 or 2</td></tr><tr><td>Antiseptic Wipe</td><td>2.5 x 2.5 cm</td><td>1 x 1 in.</td><td>10</td><td>1</td></tr><tr><td>Aspirin, Individually Wrapped</td><td>325 mg</td><td></td><td>2</td><td>2</td></tr><tr><td>Bandage Compress (2 in-4 in)</td><td>5 x 91 cm</td><td>2 x 36 in.</td><td>4</td><td>1</td></tr><tr><td>Burn Dressing</td><td>10 x 10 cm</td><td>4 x 4 in</td><td>1</td><td>1-2</td></tr><tr><td>Burn Treatment</td><td>0.9</td><td>1/32 fl. Oz.</td><td>6</td><td>1</td></tr><tr><td>Cold Pack</td><td>10 x 12.5 cm</td><td>4 x 5 in</td><td>1</td><td>1</td></tr><tr><td>*Combat style Tourniquet with Windlass</td><td>95.3 x 3.8</td><td>37.5 x 1.5 in. width</td><td>1</td><td>1</td></tr><tr><td>CPR Breathing Barrier</td><td></td><td></td><td>1</td><td>1</td></tr><tr><td>Eye Covering, with means of attachment</td><td>19 cm²</td><td>2.9 in²</td><td>2</td><td>1</td></tr><tr><td>Eye/Skin Wash</td><td>118 ml (total)</td><td>4 fl. oz total</td><td>1</td><td>2</td></tr><tr><td>First Aid Guide</td><td></td><td></td><td>1</td><td>1</td></tr><tr><td>Gloves, latex free</td><td>XL</td><td>XL</td><td>2 pair</td><td>1</td></tr><tr><td>Hand Sanitizer</td><td>0.9 g</td><td>1/32 oz.</td><td>6</td><td></td></tr><tr><td>Occlusive Dressing</td><td>10.2 x 10.2</td><td>4 x 4</td><td>1</td><td>2</td></tr><tr><td>Roller Bandage (2 in.)</td><td>5 x 366 cm</td><td>2 in. x 4 yd.</td><td>2</td><td>1</td></tr><tr><td>Roller Bandage (4 in.)</td><td>10 x 366 cm</td><td>4 in. x 4 yd.</td><td>1</td><td>1</td></tr><tr><td>Sterile pad</td><td>7.5 x 7.5 cm</td><td>3 x 3 in.</td><td>4</td><td>1</td></tr><tr><td>Triangular Bandage</td><td>101 x 101 x 14cm</td><td>40 x 40 x 50 in.</td><td>1</td><td>1</td></tr></table><p>* Required when power tools in use.</p></div>	Unit first aid item	Minimum Size or Volume (metric)	Minimum Size or Volume (US)	Item quantity per unit package	Unit package size	Absorbent Compress	208 cm ²	32 in ²	1	1	Adhesive Bandage	2.5 x 7.5 cm	1 x 3 in	16	1	Adhesive Tape	2.3 m	2.5 yd (total)	1 or 2	1 or 2	Antiseptic Wipe	2.5 x 2.5 cm	1 x 1 in.	10	1	Aspirin, Individually Wrapped	325 mg		2	2	Bandage Compress (2 in-4 in)	5 x 91 cm	2 x 36 in.	4	1	Burn Dressing	10 x 10 cm	4 x 4 in	1	1-2	Burn Treatment	0.9	1/32 fl. Oz.	6	1	Cold Pack	10 x 12.5 cm	4 x 5 in	1	1	*Combat style Tourniquet with Windlass	95.3 x 3.8	37.5 x 1.5 in. width	1	1	CPR Breathing Barrier			1	1	Eye Covering, with means of attachment	19 cm ²	2.9 in ²	2	1	Eye/Skin Wash	118 ml (total)	4 fl. oz total	1	2	First Aid Guide			1	1	Gloves, latex free	XL	XL	2 pair	1	Hand Sanitizer	0.9 g	1/32 oz.	6		Occlusive Dressing	10.2 x 10.2	4 x 4	1	2	Roller Bandage (2 in.)	5 x 366 cm	2 in. x 4 yd.	2	1	Roller Bandage (4 in.)	10 x 366 cm	4 in. x 4 yd.	1	1	Sterile pad	7.5 x 7.5 cm	3 x 3 in.	4	1	Triangular Bandage	101 x 101 x 14cm	40 x 40 x 50 in.	1	1
Unit first aid item	Minimum Size or Volume (metric)	Minimum Size or Volume (US)	Item quantity per unit package	Unit package size																																																																																																												
Absorbent Compress	208 cm ²	32 in ²	1	1																																																																																																												
Adhesive Bandage	2.5 x 7.5 cm	1 x 3 in	16	1																																																																																																												
Adhesive Tape	2.3 m	2.5 yd (total)	1 or 2	1 or 2																																																																																																												
Antiseptic Wipe	2.5 x 2.5 cm	1 x 1 in.	10	1																																																																																																												
Aspirin, Individually Wrapped	325 mg		2	2																																																																																																												
Bandage Compress (2 in-4 in)	5 x 91 cm	2 x 36 in.	4	1																																																																																																												
Burn Dressing	10 x 10 cm	4 x 4 in	1	1-2																																																																																																												
Burn Treatment	0.9	1/32 fl. Oz.	6	1																																																																																																												
Cold Pack	10 x 12.5 cm	4 x 5 in	1	1																																																																																																												
*Combat style Tourniquet with Windlass	95.3 x 3.8	37.5 x 1.5 in. width	1	1																																																																																																												
CPR Breathing Barrier			1	1																																																																																																												
Eye Covering, with means of attachment	19 cm ²	2.9 in ²	2	1																																																																																																												
Eye/Skin Wash	118 ml (total)	4 fl. oz total	1	2																																																																																																												
First Aid Guide			1	1																																																																																																												
Gloves, latex free	XL	XL	2 pair	1																																																																																																												
Hand Sanitizer	0.9 g	1/32 oz.	6																																																																																																													
Occlusive Dressing	10.2 x 10.2	4 x 4	1	2																																																																																																												
Roller Bandage (2 in.)	5 x 366 cm	2 in. x 4 yd.	2	1																																																																																																												
Roller Bandage (4 in.)	10 x 366 cm	4 in. x 4 yd.	1	1																																																																																																												
Sterile pad	7.5 x 7.5 cm	3 x 3 in.	4	1																																																																																																												
Triangular Bandage	101 x 101 x 14cm	40 x 40 x 50 in.	1	1																																																																																																												

ACTIVITY HAZARD ANALYSIS						
Activity/Work Task: Groundwater Sampling Project Name/Location: Avon Park AFR, Florida Contract number: W91278-21-D-0063 Date Prepared: September 9, 2021 Updated: October 2, 2023 Prepared By: Sarah Kwon Corporate Health and Safety reviewer: Nicole Easter, CSP, CDGP Notes: (Field Notes, Review Comments, etc.)	Overall Risk Assessment Code (RAC) (Use highest code)				M	
	Risk Assessment Code (RAC) Matrix					
	Severity	Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L
	Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above)					
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely. "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible				RAC Chart E = Extremely High Risk H = High Risk M = Moderate Risk L = Low Risk	
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.						

Job Steps	Hazards	Controls	RAC
Prepare for sampling event.	Failure to properly plan daily activities.	This AHA shall be reviewed by the crew prior to commencing daily activities, as a component of the morning Tailgate Safety Meeting to accommodate conditions encountered in the field and at any time throughout the workday when new tasks are initiated, unforeseen circumstances arise, or if working conditions change.	M
Obtain groundwater samples. Prepare samples for shipment to lab. Ship samples to lab.	Complacency.	All personnel shall attend the morning safety meetings to re-focus themselves to hazards, emergency procedures and equipment, operational aspects, and change(s) in site/work conditions. Recommended control measures for the hazards shall be part of the discussion.	M
	Heavy lifting, strains, and sprains.	Proper lifting techniques shall be used; this is especially true for sample coolers, ice bags, and emergency eyewash station. Lift with legs and straight back. Do not twist when carrying a load, move your feet. Multiple employees or the use of mechanical lifting devices are required for lifting objects over the 50-pound limit.	L
	Hand injuries.	Items to be handled shall be inspected for sharp edges, splinters, burrs, rough surfaces, etc. prior to being handled. Personnel shall wear leather gloves when handling materials with sharp edges, splinters, burrs, rough surfaces, etc. Personnel shall be aware of and avoid pinch point hazards.	L

Job Steps	Hazards	Controls	RAC
<p>Obtain groundwater samples.</p> <p>Prepare samples for shipment to lab. Ship samples to lab.</p>	Use of operational chemicals.	<p>Read and follow SDS for each chemical used.</p> <p>Provide emergency eyewash station for all areas where acid (sample preservative) and methanol are being used.</p> <p>Do not use any chemical that you have not been trained to safely use. Provide ventilation as necessary.</p> <p>Wear proper PPE.</p> <p>Properly label all containers.</p>	L
	Chemical hazards.	<p>Perform decontamination as specified in the SSHP.</p> <p>Avoid contact with contaminated materials. Wear PPE, as specified in the SSHP.</p> <p>The SSHO will perform chemical air monitoring, as specified in the SSHP and SSHP Addenda.</p> <p>Verify emergency eyewash stations have been inspected, cleaned, filled, and in service. Notify all personnel of the emergency eyewash station locations.</p> <p>Notify the SSHO if odors are detected.</p>	L
	<p>General site hazards: Insect bites and stings. Contact dermatitis from poisonous and irritating plants (poison ivy, poison oak, and poison sumac).</p> <p>Vehicle traffic</p> <p>Severe weather</p> <p>Heat stress</p> <p>Cold stress</p> <p>Noise.</p> <p>Lifting</p> <p>Slips, trips, falls</p> <p>UV hazards, etc.</p>	See AHA General Site Work Hazards	M

Job Steps	Hazards	Controls	RAC
<i>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</i>			

Equipment	Training	Inspection
<u>Personal Protective Equipment:</u> Safety Glasses with side shields Safety-Toed Boots Work Gloves Class 2 high visibility vests Hearing protection, as necessary Nitrile gloves to prevent contact with contaminated water <u>Other Equipment:</u> Smart phone apps for noise and temperature Fire Extinguishers First Aid Kit Drinking water Insect repellent with DEET (Deep Woods Off™ or equivalent) Repel Permanone™	Competent Person (CP) / Qualified Person (QP): CP/SSHO _____ QP/First Aid and CPR _____ QP/First Aid and CPR _____ Training Requirements (as determined by the SSHO): Site safety orientation Emergency procedures Hazard communication Applicable AHAs Fire extinguisher use Biological hazard identification and control Tornado shelter location Lightning safety procedures Heat stress prevention and heat stroke treatment	Daily site safety inspection (SSHO) _____ Daily site safety inspection (QCO) _____ Housekeeping (daily) Fire extinguisher (monthly) Vehicle inspection (daily) Equipment and tools inspection (daily and before use) Survey areas for poisonous plants, insects, and animals (each work area) Check body for ticks (each evening during tick season) Identify closest usable tornado shelter that is available (each work area)

ACTIVITY HAZARD ANALYSIS

Activity/Work Task: Mobilization/Demobilization (includes set-up, take down, and staging of equipment)

Project Name/Location: Avon Park AFR, Florida

Contract number: W91278-21-D-0063

Date Prepared: September 9, 2021

Updated: October 2, 2023

Prepared By: Sarah Kwon

Corporate Health and Safety reviewer: Nicole Easter, CSP, CDGP

Notes: (Field Notes, Review Comments, etc.)

Overall Risk Assessment Code (RAC) (Use highest code)

L

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.

RAC Chart

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

E = Extremely High Risk

H = High Risk

M = Moderate Risk

L = Low Risk

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each **"Hazard"** on AHA. Annotate the overall highest RAC at the top of AHA.

Job Steps	Hazards	Controls	RAC
1. Review-Health and Safety needs	Inadequate preparation which can lead to the pain and suffering of an accident or personal injury	<p>Confirm all field personnel understand the project hazards and hazard controls and are trained in the procedures corresponding to work assignments.</p> <p>Conduct pre-entry H&S briefing.</p> <p>Confirm all site hazards are recognized.</p> <p>Confirm all necessary equipment to evaluate and control site hazards is available, calibrated and in good working condition.</p> <p>Confirm applicable engineering, administrative and personal protective equipment (PPE) controls are ready to be implemented as needed.</p> <p>Confirm emergency safety and first aid supplies are available.</p> <p>Review emergency procedures and evacuation plans.</p>	L

Job Steps	Hazards	Controls	RAC
2. Mobilize Equipment, Tools and Safety Gear/Demob.	Strains, sprains, awkward bending/lifts and ergonomic hazards	<p>Move the load inside the truck as close to the edge of the bed as possible to be ready for unloading/ loading</p> <p>Test the load first by nudging the item or container to estimate its weight and to determine if it can be moved alone.</p> <p>Seek assistance in moving the object or load if it is heavier than 50 pounds.</p> <p>Slide the load across the truck bed, do not lift and move.</p> <p>Move obstructions inside the truck to allow the load to slide across the truck bed.</p> <p>Use a step stool or step ladder to gain access to bed.</p> <p>Use proper lifting techniques. Lift with legs and a straight back. Do not twist while carrying a load. Move feet to avoid twisting.</p> <p>Know your limitations</p> <p>Ensure walking pathway is clear</p> <p>Do not lift greater than 50 pounds without mechanical assistance or 2-man lift</p> <p>Limit repetitive awkward motions</p> <p>See General Site Hazards AHA</p>	L
3. Travel	Traffic (road and site traffic)	<p>Adjust seat and mirrors to ensure that you can reach controls and see behind you.</p> <p>Inspect vehicle to confirm it is in good working order and all cargo is secured and distractions are minimized. Familiarize yourself with the route and directions.</p>	L
4. Onsite Mobilization/Demob <ul style="list-style-type: none"> Determines location for set up/staging equipment. Determine strategy for demob. 	Traffic-Struck by hazards	<p>Select location away from traffic</p> <p>Place barricades for work site protection, if necessary</p> <p>Wear high visibility vest</p> <p>Stay clear of traffic and equipment. Have all necessary PPE (safety glasses, vest, etc)</p>	L
	Driving over soft ground Uneven and rough terrain	Choose location with level and firm soils	
	Site access control-unwanted entry	Use barricades or caution tape to mark the work area if there is a potential for intrusion by unauthorized personnel	
5. Removal and transport of equipment and supplies from the site	Take home toxics	<p>Decontaminate equipment and clothing as needed to minimize transfer of contaminants. Do not bring contaminated PPE or boots into truck.</p> <p>Use liners to prevent contamination of truck</p>	L
	Same hazards as in step 4 above	See action to eliminate or minimize hazards in step 4	

Job Steps	Hazards	Controls	RAC
6. General site work	<p>General site hazards: Insect bites and stings. Contact dermatitis from poisonous and irritating plants (poison ivy, poison oak, and poison sumac).</p> <p>Vehicle traffic</p> <p>Severe weather</p> <p>Heat stress</p> <p>Lifting</p> <p>Slips, trips, falls</p> <p>UV hazards, etc.</p>	<p>Refer to General Site Work AHA</p> <p>Pack what you will need for control of hazards</p>	L

Job Steps	Hazards	Controls	RAC
<i>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</i>			

Equipment	Training	Inspection
<u>Personal Protective Equipment:</u> Level D: Hard Hat Safety Glasses Safety-Toed Boots Work Gloves/ Chemical resistant gloves ANSI Class 2 reflective warning vests <u>Other Equipment:</u> Fire Extinguishers Emergency Eyewash First Aid Kit Insect repellent with DEET Repel Permanone™ Hand tools Spill containment supplies First aid supplies Containers as needed Drinking water Weather radio Heat stress monitoring Sampling equipment: including pumps, pump controllers, PID/OVM, water level probe, misc. hand tools	Competent Person (CP) / Qualified Person (QP): CP/SSHO _____ QP/First Aid and CPR _____ QP/First Aid and CPR _____ Training Requirements (as determined by the SSHO): HAZWOPER 40 hour Site safety orientation Tailgate meetings Emergency procedures Hazard communication Applicable AHAs Fire extinguisher use Biological hazard identification and control Tornado shelter location Lightning safety procedures Heat stress prevention and heat stroke treatment	Daily site safety inspection (SSHO) _____ Housekeeping (daily) Eye wash equipment (weekly) Fire extinguisher (monthly) Vehicle inspection daily Equipment and tools inspection daily and before use Survey areas for poisonous plants, insects, and animals (each work area) Check body for ticks (each evening during tick season) Identify closest usable tornado shelter that is available (each work area).

ACTIVITY HAZARD ANALYSIS

Activity/Work Task: Vehicle Operations Project Name/Location: Avon Park AFR, Florida Contract number: W91278-21-D-0063 Date Prepared: September 9, 2021 Prepared By: Sarah Kwon Corporate Health and Safety reviewer: Nicole Easter, CSP, CDGP Notes: (Field Notes, Review Comments, etc.)	Overall Risk Assessment Code (RAC) (Use highest code)				M	
	Risk Assessment Code (RAC) Matrix					
	Severity	Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L
	Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (See above)					
	“Probability” is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely.				RAC Chart	
	“Severity” is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible				E = Extremely High Risk	
					H = High Risk	
	Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each “Hazard” on AHA. Annotate the overall highest RAC at the top of AHA.				M = Moderate Risk	
L = Low Risk						

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
Project vehicle use on and off project site. Inspecting vehicles. Vehicle operations. Parking vehicles. Backing vehicles.	General	All company owned, leased, or rented vehicle operations shall comply with the requirements of Procedure No. 16 "Driving Safety." Subcontractors operating motor vehicles shall comply with all federal, state, and local traffic regulations. Subcontractors shall only use vehicles that are in good condition and safe to operate. All personnel shall drive defensively and wear seat belts while vehicles are in motion. Inspect vehicles before use – document inspection. Keep alert for pedestrians. Always yield to and give pedestrians the right of way. All drivers must be able to provide a valid drivers license and proof of insurance at any time.	M
	Failure to properly plan daily activities	This AHA shall be reviewed and a pre-task safety and health analysis completed by the crew prior to commencing daily activities, as a component of the morning Tailgate Safety Meeting to accommodate conditions encountered in the field and at any time throughout the workday when new tasks are initiated, unforeseen circumstances arise, or if working conditions change.	M

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
Project vehicle use on and off project site. Inspecting vehicles. Vehicle operations. Parking vehicles. Backing vehicles.	Accidents	In the event of an accident: stop; call for medical assistance; notify police; complete Vehicle Accident Report and submit to the SSHO. If a Tanaq employee is injured, contact Workcare 24-7 emergency number 888-4497-787, Workcare will provide information on the nearest health clinic or emergency room. Follow Procedure for "Incident Reporting Procedures." If a subcontractor employee is injured, the Supervisor's Employee Injury/Illness Report Form must be completed and submitted to the SSHO.	M
	Equipment failure	Perform daily inspections of your vehicle. Any vehicle with mechanical problems that may endanger the safety of the driver, passengers, or the public shall not be used.	L
	Not prepared for emergency	Ensure safety equipment is in the vehicle. Safety equipment should include a spare tire, jack, first-aid kit, fire extinguisher, and flashlight. Flares and/or reflective triangles shall be available in larger trucks. Verify that the proper documentation is in the vehicle - documentation includes an operations manual for the vehicle, insurance card, vehicle registration, and accident forms.	L
	Unfamiliar with the vehicle	Familiarize yourself with the vehicle before moving. Properly adjust mirrors and seat. Review the dashboard controls, steering radius, overhead, and side clearances. Locate controls for windshield wipers and lights.	M
	Vehicle loading	Do not overload the vehicle. Secure all equipment within the body of the vehicle. Do not block side view mirrors with load. Do not transport Department of Transportation manifested hazardous materials without a commercial driver's license. Dispatch all equipment and personnel with proper forms and identification.	M
	Cellular phones	Do not use handheld cellular phones while driving. Pull over to the side of the road when making or receiving a call.	M

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
Project vehicle use on and off project site. Inspecting vehicles. Vehicle operations. Parking vehicles. Backing vehicles.	Influenced by drug and alcohol	Never drive under the influence of drugs or alcohol. Disciplinary action, including termination, will be taken against anyone who is convicted of or who pleads no-contest to the charges of driving under the influence in accordance with the Substance Abuse Policy. It is recommended to not consume alcohol within 48 hours prior to field work, as it contributes to dehydration. Project-assigned hourly employees are not permitted to operate company owned, leased, or rented vehicles after 10:00 p.m. without written authorization from their supervisor.	M
	Driver attitude/fatigue	Do not operate any vehicle when abnormally tired or fatigued. Any employee may declare themselves unfit to drive without retribution. Keep an even temper when driving. Do not let the actions of others affect your attitude. Take breaks to avoid “highway-hypnosis” and “falling asleep at the wheel”. Take plenty of breaks when driving long distances or rotate driving responsibility with a passenger. Personnel, while on duty, shall not operate motor vehicles after being in a duty status (regardless of their role or function) for more than 12 hours during any 24-hour period without at least eight consecutive hours of rest. No employee may drive continuously for more than 10 hours in any single on- duty period (continuous period of more than 10 hours in any 24-hour period without at least eight consecutive hours of rest).	M
	Backing	Back into parking spaces upon arrival, whenever possible. When preparing to move or back vehicles, walk around the vehicle 360° before entering vehicle to identify any new conditions or obstructions. Use a spotter when backing whenever possible. Determine and agree upon hand signals (between spotter and driver) before attempting to back vehicle. Check the rear-view and side mirrors prior to backing (Note: All vehicles, other than automobiles, must have small convex mirrors attached to the side mirrors). Back slowly in areas of obstructed vision.	M

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
	Blind Spots	<p>Become familiar with any blind spots associated with your vehicle.</p> <p>Adjust mirrors properly.</p> <p>Make sure you use your directional signals.</p> <p>Always look over your shoulder to assure the lane is clear when changing lanes.</p> <p>Exercise caution when approaching other driver's blind spots.</p>	M
<p>Project vehicle use on and off project site.</p> <p>Inspecting vehicles.</p> <p>Vehicle operations.</p> <p>Parking vehicles.</p> <p>Backing vehicles.</p>	Spacing/distance	<p>Identify if your vehicle has Anti-Lock Brakes.</p> <p>Do not tailgate. Follow the 3-second rule. Increase the 3-second rule as necessary during hazardous travel conditions.</p> <p>Always leave yourself an "out" during travel – this applies to stoplights as well.</p> <p>When stopping, make sure that you leave enough distance between you and the car in front of you (you should be able to see the rear tires of the vehicle in front, when stopped).</p> <p>When at a red light, and it turns green, use the "delayed start" technique, by counting to three before you take your foot off the brake.</p> <p>Allow extra spacing and braking time for trucks and vehicles towing trailers.</p> <p>Trailers shall be equipped with brakes.</p>	M
	Skids.	<p>If the vehicle has begun to skid out of control, turn the steering wheel in the direction of the skid and re-adjust the wheel, as necessary.</p> <p>Slow down during hazardous travel conditions.</p> <p>Use 4-wheel drive, if available, when driving vehicles off road, on steep inclines, muddy conditions, etc.</p> <p>Do not take vehicles "off road" if they cannot be operated safely.</p>	M
	Speed.	<p>Obey all posted speed limits.</p> <p>Radar detectors are prohibited in all company owned, leased, or rented vehicles.</p> <p>Reduce travel speed during hazardous conditions (i.e., rain, fog, snow).</p>	M

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
	High profile vehicle/low clearances.	Determine actual height of vehicle during initial inspection - prior to moving vehicle. Maintain awareness of vehicle height while driving. Identify low clearance structures, such as motel overhangs, gas station canopies, bridges, tunnels, parking garages, fast-food drive-throughs, banks, etc. Determine the height of the low clearance structure prior to driving under it and verify that there is enough clearance to safely pass – use a spotter as necessary.	M
	Crossing railroad tracks.	Stop, look, and listen before crossing railroad tracks. Be aware that multiple tracks may have more than one train using them, and the trains may be traveling in opposite directions. Never drive around crossing gates.	M
	High water/drowning.	Never drive vehicles across flowing water on the road.	M

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
<i>Add Steps, Hazards, and Actions to Eliminate or Minimize Hazards based on conditions encountered in the field.</i>			

Equipment	Inspection	Training
<p><u>Equipment:</u></p> <p>Emergency phone list. Can be available on cell phone contacts.</p> <p>Map to medical care facilities</p> <p>Operator's manual Insurance card Vehicle registration Shaw accident forms Fire Extinguishers First Aid Kit</p> <p>Spare tire and jack</p> <p>Flashlight</p> <p>Flares and/or reflective triangles shall be available in larger trucks</p>	<p>Daily vehicle inspections</p> <p>Vehicle inspections (prior to trips greater than 50 miles for provided vehicles)</p> <p>Walk around the vehicle 360° before entering vehicle (each time)</p>	<p>Competent Person (CP) / Qualified Person (QP):</p> <p>CP/SSHO _____</p> <p>_____</p> <p>Training Requirements (as determined by the SSHO):</p> <p>Site safety orientation Qualified vehicle operators</p> <p>Defensive driving</p>

This page was intentionally left blank.

ATTACHMENT 2

**SAFETY PERSONNEL
PROOF OF TRAINING AND
COMPETENCY CERTIFICATIONS OF EMPLOYEE MEDICAL SURVEILLANCE PROGRAM
PARTICIPATION**

This page was intentionally left blank.

Certificate of Completion

This certifies that

Brantley C. Rudd

has successfully completed

8 Hour HAZWOPER Supervisor Training

This certificate does not in itself indicate initial 24 or 40 Hour HAZWOPER Training

In Accordance With Federal OSHA Regulation 29 CFR 1910.120(e)(4)

And all State OSHA/EPA Regulations as well including 29 CFR 1926.65 for Construction.

This course is approved for 8 Contact Hours (0.8 CEUs) of continuing education per the California Department of Public Health for Registered Environmental Health Specialist (REHS) (Accreditation # 044)

Safety Unlimited, Inc., Provider #5660170-2, is accredited by the International Association for Continuing Education and Training (IACET) and is accredited to issue the IACET CEU. As an IACET Accredited Provider, Safety Unlimited, Inc. offers CEUs for its programs that qualify under the ANSI/IACET Standard. Safety Unlimited, Inc. is authorized by IACET to offer 0.8 CEUs for this program.

Julius P. Griggs

Julius P. Griggs
Instructor #892

2309154436596

Certificate Number

9/15/2023

Issue Date



Scan this code or visit [safetyunlimited.com/v](https://www.safetyunlimited.com/v) to verify certificate.

Annual Refresher Training NOT Required



UNLIMITED, Inc.
OSHA Compliant Safety Training Since 1993

2139 Tapo St., Suite 228 Simi Valley, CA 93063
(855) 784-2677 or 805 306-8027
<https://www.safetyunlimited.com>

Certificate of Completion

This certifies that

Brantley C. Rudd

has successfully completed

8 Hour HAZWOPER Refresher Training

Refresher certification does NOT necessarily indicate initial 24 or 40 Hour HAZWOPER certification

In Accordance w/Federal OSHA Regulation 29 CFR 1910.120(e) & (p)

And all State OSHA/EPA Regulations as well including 29 CFR 1926.65 for Construction.

This course (Version 3) is approved for 8 Contact Hours (0.8 CEUs) of continuing education per the California Department of Public Health for Registered Environmental Health Specialist (REHS) (Accreditation # 044).

Safety Unlimited, Inc., Provider #5660170-2, is accredited by the International Association for Continuing Education and Training (IACET) and is accredited to issue the IACET CEU. As an IACET Accredited Provider, Safety Unlimited, Inc. offers CEUs for its programs that qualify under the ANSI/IACET Standard. Safety Unlimited, Inc. is authorized by IACET to offer 0.8 CEUs for this program.

Julius P. Griggs

Julius P. Griggs
Instructor #892

2304305436596

Certificate Number

4/30/2023

Issue Date



Scan this code or visit [safetyunlimited.com/v](https://www.safetyunlimited.com/v) to verify certificate.



UNLIMITED, Inc.
OSHA Compliant Safety Training Since 1993

2139 Tapo St., Suite 228 Simi Valley, CA 93063
(855) 784-2677 or 805 306-8027
<https://www.safetyunlimited.com>



Proof of initial certification and subsequent refresher training is NOT required to take refresher training

ALL-PRO

Occupational Trainers

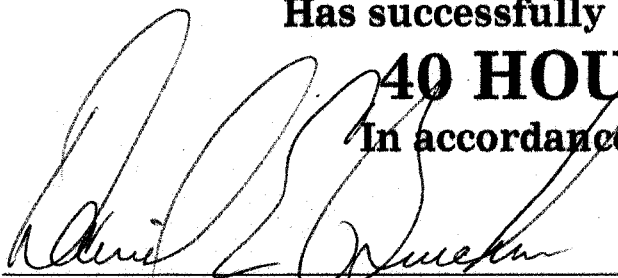
Certify to all that

Brantley Rudd

Has successfully completed the requirements of

40 HOUR HAZWOPER

In accordance with 29CFR1910.120(e)(3)



Instructor: Daniel E. Buechner

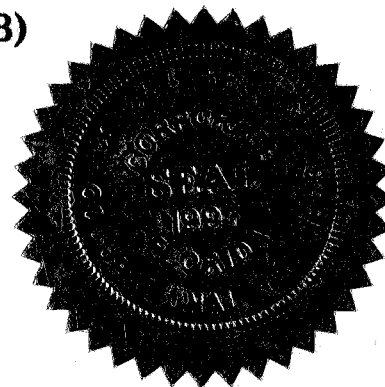
Date: August 16, 2002

City or Metropolitan Area of class attended: Norcross, GA

Certification Number: 020816446



President: ALL-PRO Occupational Trainers, Inc.





CERTIFICATE

Brantley Rudd
SWT-33-22-00244

has completed the Corps of Engineers and Naval Facility Engineering Command Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS - #784

<u>Tulsa, Ok</u>	<u>Aug 18, 2022</u>	<u>Tulsa District</u>	<u>Walter Dean</u>
Location	Training Date(s)	Instructional District/ NAVFAC	CQM-C Manager
<u>Walter Dean</u>	<u>walter.a.dean@usace.army.mil</u>	<u>918-669-7039</u>	<u>Walter Dean</u>
Facilitator/Instructor	Email	Telephone	Facilitator/Instructor Signature

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE
CQM-C Recertification online course: <https://www.myuln.net>

Jeffrey D. Dziedzic
Chief, USACE Learning Center
Jeffrey D. Dziedzic



American Red Cross
Training Services

Certificate of Completion

Brantley Rudd

has successfully completed requirements for

Adult, Child and Baby First Aid/CPR/AED Online (Eligible for Skills Session within 90 days)

Date Completed: 9/30/2022

Validity Period: 2 Years

Conducted by: American Red Cross



To verify certificate, scan code or visit redcross.org/digitalcertificate and enter ID.

Learn and be inspired at LifesavingAwards.org



011HE9B

WORK STATUS REPORT

Employer Copy

TYPE OF EXAMINATION: Baseline Exam
EXAM CLASSIFICATION: Baseline Examination

EMPLOYEE: Rudd, Brantley C.
ID:
DATE OF EXAM: 08/31/2022
EXPIRATION DATE: 08/31/2024

COMPANY: St. George Tanaq Corporation
POSITION: Site Superintendent
LOCATION: St. George Tanaq Corporation
SITE:

The following recommendations are based on a review of one or all of the following: a base history questionnaire, supporting diagnostic tests, physical examination, and the essential functions of the position applied for or occupied by the individual named above.

	Yes	No	Undecided
Has the employee any detected medical conditions that would increase his/her risk of material health impairment from occupational exposure in accordance with 29 CFR §1910.120 (Hazardous Materials)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Has the employee any contraindication for work in accordance with 29 CFR §1910.95(g)1926.52 (Hearing Conservation)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Has the employee any limitations in accordance with 29 CFR §1910.134 (Respirator)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

WORK STATUS

☒ **QUALIFIED**

The examination indicates no significant medical condition. Employee can be assigned any work consistent with skills and training.

☐ **QUALIFIED - WITH LIMITATIONS**

Pursuant to applicable OSHA regulations, the examination indicates that a medical condition currently exists which will require the following work assignment limitations:

☐ **NOT QUALIFIED**☐ **DEFERRED**

The examination indicated that additional information is necessary. The employee has been given the following instructions.

Comments:

I have reviewed the medical data of the above named employee, and informed the employee of the results of the medical examination and any medical conditions that require follow-up examination or treatment.

Name of Physician: Dr. Jeffrey Jacobs Date: 09/09/22

Signature: _____

AdvanceOnline Solutions Online Institute

Certificate of Completion

Brantley Rudd

has met the online course completion requirements for

OSHA 30-Hour Construction Safety

This student has completed the formal instruction for the 30-Hour Construction Outreach Program. Topics covered in this program were Introduction to OSHA, Managing Safety and Health, Struck-by and Caught-In or Between Hazards, Personal Protective Equipment, Hearing Conservation, Respiratory Protection, Lead and Crystalline Silica, Asbestos, GHS Hazard Communication, Electrical Safety, Hand and Power Tools, Fall Protection, Ladder Safety, Excavations, Scaffolds, Crane Safety, Heavy Equipment, Forklift Safety, Materials Handling, Permit-Required Confined Spaces, Fire Safety, Welding and Cutting, Concrete and Masonry, Steel Erection, and Ergonomics.

As an OSHA Outreach Training Program trainer, I affirm that I have conducted this OSHA Outreach Training Program training class in accordance with OSHA Outreach Training Program requirements. I will document this class to my OSHA Authorizing Training Organization. Upon successful review of my documentation, I will provide each student their course completion card within 90 calendar days of the end of the class. — Jason Cole

Instructor Jason Cole
Course ID A0310
Certificate ID 6745_1911987

Date 9/14/2022 8:58:00 AM
Time Online 30:12:58
AdvanceOnline Solutions, Inc.
1811 Bering Drive, Suite 430
Houston, Texas 77057
www.advanceonline.com
(713) 621-1100

AdvanceOnline
S O L U T I O N S



3980 Quebec St., 2nd Floor, Denver CO 80207-1633 800-711-2706

Student Affiliation
Tanaq Environmental
201900507

Certificate of Completion

Mark Lawrence
has successfully completed training and passed all testing requirements for
8-Hour HAZWOPER Annual Refresher
as per 29 CFR 1910.120(e) & Title 8CCR 5192(e)(3)(A)

Presented This
March 8, 2023

Compliance Solutions Occupational Trainers, Inc.

Certificate Number: REG27441

Jeffrey Kline
President/CEO

Anthony Camper
Instructor

202000174

Compliance Solutions Occupational Trainers, Inc.
Certificate of Completion

Student Name: Mark Lawrence

Company: Helios Resources, Ltd.

I Certify the above named student has been tested and trained for:

40-Hour HAZWOPER Initial Training

per 29 CFR 1910.120(e) & Title 8CCR 5192(e)(3)(A)

Date of Issue: 2/22/2021

By:  President/CEO

e Solutions

...Tomorrow's Solution™

Student Affiliation:

Helios Resources, Ltd.

202000174

3980 Quebec St., 2nd Floor, Denver CO 80207-1633 800-711-2706

Certificate of Completion

Mark Lawrence

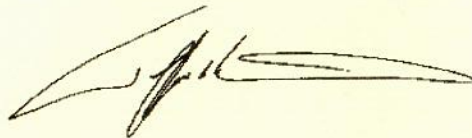
has successfully completed training and passed all testing requirements for

40-Hour HAZWOPER Initial Training
per 29 CFR 1910.120(e) & Title 8CCR 5192(e)(3)(A)

Presented this
Monday, February 22, 2021

Certificate Number: 754996132

Compliance Solutions Occupational Trainers, Inc.



Jeffrey E. Kline
President/CEO



14-602094630

This card acknowledges that the recipient has successfully completed:

30-hour Construction Safety and Health

This card issued to:

MARK ANDREW LAWRENCE

Jason L. Cole

Trainer Name

3/5/2021

Date of Issue



CERTIFICATE

Mark Lawrence
SWT-33-22-00184

has completed the Corps of Engineers and Naval Facility Engineering Command Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS - #784

<u>Tulsa, Ok</u>	<u>Aug 12, 2022</u>	<u>Tulsa District</u>	<u>Walter Dean</u>
Location	Training Date(s)	Instructional District/ NAVFAC	CQM-C Manager
<u>Walter Dean</u>	<u>walter.a.dean@usace.army.mil</u>	<u>918-669-7039</u>	<u>Walter Dean</u>
Facilitator/Instructor	Email	Telephone	Facilitator/Instructor Signature

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE
CQM-C Recertification online course: <https://www.myuln.net>

Jeffrey D. Dziedzic
Chief, USACE Learning Center
Jeffrey D. Dziedzic



American Red Cross
Training Services

Certificate of Completion

Mark Lawrence

has successfully completed requirements for

Adult First Aid/CPR/AED

Date Completed: 3/9/2023

Validity Period: 2 Years

Conducted by: American Red Cross



To verify certificate, scan code or visit redcross.org/digitalcertificate and enter ID.

Learn and be inspired at LifesavingAwards.org



0152132

WORK STATUS REPORT

Employer Copy

TYPE OF EXAMINATION: Periodic Exam
EXAM CLASSIFICATION: Periodic Examination

EMPLOYEE: Lawrence, Mark A.
ID:
DATE OF EXAM: 04/12/2023
EXPIRATION DATE: 04/12/2025

COMPANY: St. George Tanaq Corporation
POSITION: Geologist
LOCATION: St. George Tanaq Corporation
SITE:

The following recommendations are based on a review of one or all of the following: a base history questionnaire, supporting diagnostic tests, physical examination, and the essential functions of the position applied for or occupied by the individual named above.

	Yes	No	Undecided
Has the employee any detected medical conditions that would increase his/her risk of material health impairment from occupational exposure in accordance with 29 CFR §1910.120 (Hazardous Materials)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Has the employee any contraindication for work in accordance with 29 CFR §1910.95(g)1926.52 (Hearing Conservation)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Has the employee any limitations in accordance with 29 CFR §1910.134 (Respirator)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

WORK STATUS

☒ **QUALIFIED**

The examination indicates no significant medical condition. Employee can be assigned any work consistent with skills and training.

☐ **QUALIFIED - WITH LIMITATIONS**

Pursuant to applicable OSHA regulations, the examination indicates that a medical condition currently exists which will require the following work assignment limitations:

☐ **NOT QUALIFIED**☐ **DEFERRED**

The examination indicated that additional information is necessary. The employee has been given the following instructions.

Comments:

I have reviewed the medical data of the above named employee, and informed the employee of the results of the medical examination and any medical conditions that require follow-up examination or treatment.

Name of Physician: Dr. Jeffrey Jacobs Date: 04/19/23

Signature: _____



CERTIFICATE OF WEB BASED TRAINING

This is to certify that

MELAINA PIERCE

Has successfully completed

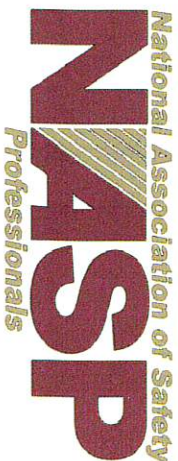
C4 Hazwoper Supervisor

The course was developed and presented by ClickSafety

Serial Number: 8758085

Completed: 5/20/2013

8758085

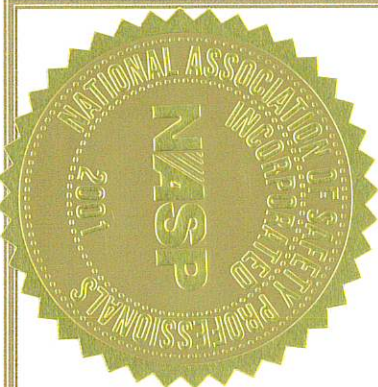


National Association of Safety Professionals

In recognition of the successful completion of the requisite course of study and by virtue of authority granted by The National Association of Safety Professionals hereby presents the
8-Hour HAZWOPER General Site Worker Refresher Meeting the Requirements of
29 CFR 1910.120(e)
Certificate Awarded to

Melaina Pierce

In witness whereof this Certificate, signed by the National Association of Safety Professionals Certified Trainer and sealed with the corporate seal of The National Association of Safety Professionals, is granted. The Signatory below is solely responsible for the quality and content of said training, and attests to attaining certification appropriate to provide training from The National Association of Safety Professionals.



<u><i>[Signature]</i></u>	<u>8</u>	<u>616582</u>
President, CEO	Course Hours	Trainer ID
<u><i>[Signature]</i></u>	<u>617487</u>	<u>2023-08-02</u>
Executive Director	Student ID	Completion Date
		<u>Certified Trainer Signature</u>



36-601554083

This card acknowledges that the recipient has successfully completed a
30-hour Occupational Safety and Health Training Course in
Construction Safety and Health

Melaina Pierce

RICK GLEASON, CIH, CSP

4/3/2020

(Trainer name – print or type)

(Course end date)



American Red Cross
Training Services

Certificate of Completion

Melaina Pierce

has successfully completed requirements for

Adult First Aid/CPR/AED Online Only

Date Completed: 7/12/2022

Validity Period: 2 - Years

Conducted by: American Red Cross



To verify certificate, scan code or visit redcross.org/digitalcertificate and enter ID.

Learn and be inspired at LifesavingAwards.org



00BFL3B

Compliance Solutions

"Today's Training... Tomorrow's Solution"

3980 Quebec St, 2nd Floor Denver, CO 80207-1633 800-711-2706

Student Affiliation:
MACTEC Engineering and Consulting Inc.
99002174

Certificate of Completion

This is to certify that

Melaina Pierce

has been tested and successfully meets the training requirements for

40-Hour HAZWOPER

29 CFR 1910.120(e)

Presented

Friday, April 29, 2011

Compliance Solutions Occupational Trainers, Inc.

Certificate Number:

75#824764

Neval Gupta
Vice President

William Niedzwiedz
Instructor

WORK STATUS REPORT

Employer Copy

TYPE OF EXAMINATION: Periodic Exam
EXAM CLASSIFICATION: Periodic Examination

EMPLOYEE: Pierce, Melaina
ID:

DATE OF EXAM: 02/16/2022
EXPIRATION DATE: 02/16/2024

COMPANY: St. George Tanaq Corporation
POSITION: Project Manager
LOCATION: St. George Tanaq Corporation - San Diego
SITE:

The following recommendations are based on a review of one or all of the following: a base history questionnaire, supporting diagnostic tests, physical examination, and the essential functions of the position applied for or occupied by the individual named above.

	Yes	No	Undecided
Has the employee any detected medical conditions that would increase his/her risk of material health impairment from occupational exposure in accordance with 29 CFR §1910.120 (Hazardous)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Has the employee any contraindication for work in accordance with 29 CFR §1910.95(g)1926.52 (Hearing Conservation)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Has the employee any limitations in accordance with 29 CFR §1910.134 (Respirator)?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

WORK STATUS

☒ **QUALIFIED**

The examination indicates no significant medical condition. Employee can be assigned any work consistent with skills and training.

☐ **QUALIFIED - WITH LIMITATIONS**

Pursuant to applicable OSHA regulations, the examination indicates that a medical condition currently exists which will require the following work assignment limitations:

☐ **NOT QUALIFIED**

☐ **DEFERRED**

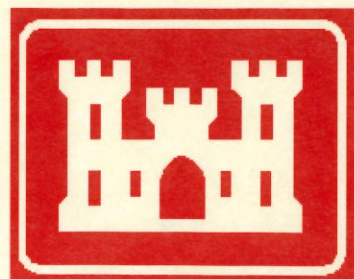
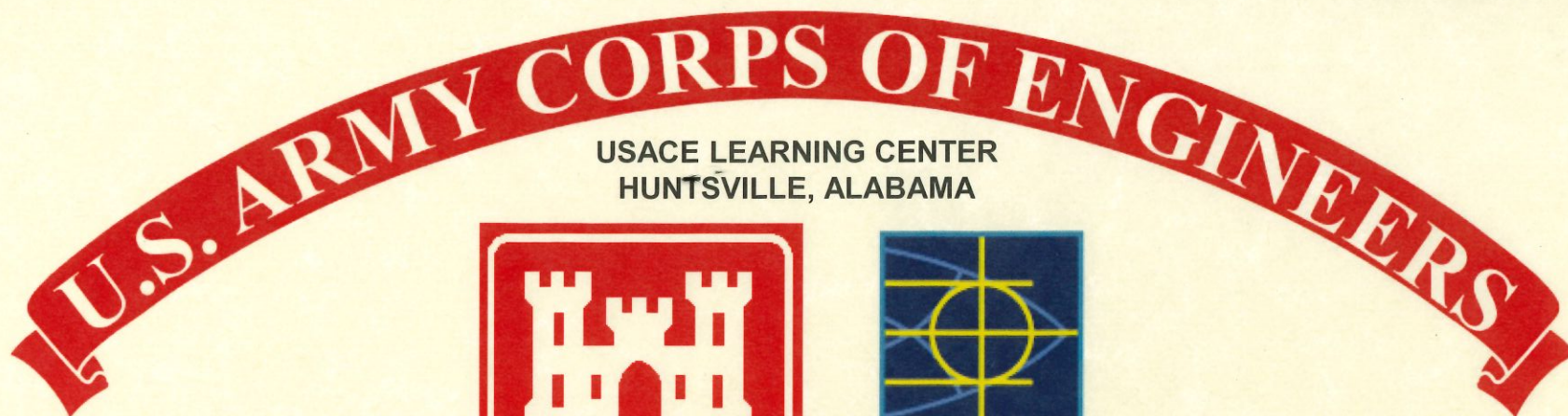
The examination indicated that additional information is necessary. The employee has been given the following instructions.

Comments:

I have reviewed the medical data of the above named employee, and informed the employee of the results of the medical examination and any medical conditions that require follow-up examination or treatment.

Name of Physician: Peter P. Greaney, M.D. Date: 02/25/22

Signature: 



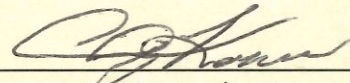
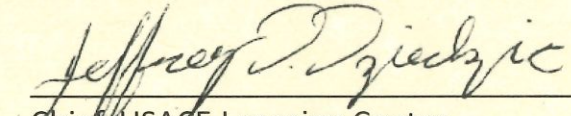
CERTIFICATE

Melania Pierce

NWO-71-19-00078

has completed the Corps of Engineers and Naval Facility Engineering Command Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS - #784

Colorado Springs, CO	Sep 9, 2020	NWO - Omaha District	Chris Horihan
Location	Training Date(s)	Instructional District/ NAVFAC	CQM-C Manager
Larisa Zdeb	chip.l.kossow@usace.army.mil	719-503-6982	
Facilitator/Instructor	Email	Telephone	Facilitator/Instructor Signature
			
			Chief, USACE Learning Center Jeffrey D. Dziedzic

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE

All-Pro Occupational Trainers, Inc.

Certify to all that

Sarah Kwon

Has successfully completed the requirements of

40 Hour Hazardous Waste Operations & Emergency Response (HAZWOPER)

In accordance with 29 CFR 1910.120 (e)(3)(i)



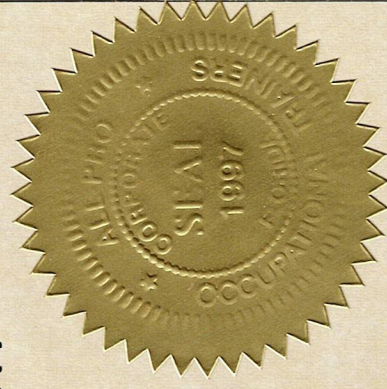
Instructor: Daniel E. Buechner

Date: June 9th, 2023

City or Metropolitan Area of class attended: Tampa, FL

Certification Number: 230609557

Company Information: www.allprotrainers.com 813.317.1186



Sarah Ruth Kwon
2127 Salem Ave n
St Petersburg, FL 33714



IMPORTANT

Your certificate of completion is your temporary card and is valid for 90 days - this is stated at the bottom of the certificate.
Your Department of Labor OSHA card will arrive approximately six to eight weeks from date of completion.

If it has been greater than 90 days, please contact our customer care team to check on the status of your Department of Labor OSHA card. If you're looking for a replacement, contact us by email at support@usfosha.com, by phone at 1-866-575-4310, or for the fastest response, try live chat. Live chat is accessible at <https://www.usfosha.com/contact-us.aspx>.

OSHA OUTREACH TRAINING

Completion Certificate

SARAH RUTH KWON

has successfully completed the following course:

OSHA 30-Hr Outreach Training for the Construction Industry

and is awarded 3.0 CEU credits

6/21/2023



David Couch

OSHA Authorized Trainer

Construction #: 20-0107970 General #: 20-0079854

*As an OSHA Outreach trainer, I verify that I have conducted this OSHA Outreach training class in accordance with OSHA Outreach Training Program requirements.
I will document this class to my OSHA Authorizing Training Organization. Upon successful review of my documentation,
I will provide each student their completion card within 90 days of the end of the class.*

OSHA Authorized Provider:



Certificate #: 06827322



CERTIFICATE

Sarah Kwon

SWT-33-23-00624

has completed the Corps of Engineers and Naval Facility Engineering Command Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS - #784

<u>Tulsa, Ok</u>	<u>Aug 8, 2023</u>	<u>Tulsa District</u>	<u>Walter Dean</u>
Location	Training Date(s)	Instructional District/ NAVFAC	CQM-C Manager
<u>Walter Dean</u>	<u>walter.a.dean@usace.army.mil</u>	<u>918-669-7039</u>	<u>Walter Dean</u>
Facilitator/Instructor	Email	Telephone	Facilitator/Instructor Signature

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE
CQM-C Recertification online course: <https://www.myuln.net>

Jeffrey D. Dziedzic
Chief, USACE Learning Center
Jeffrey D. Dziedzic



Certificate of Completion

Sarah Kwon

has successfully completed requirements for

Adult First Aid/CPR/AED

conducted by

American Red Cross

Date Completed: **05/24/2022**

Valid Period: **2 Years**

Instructors: **Manny Perez**



Certificate ID: 00U37PF

To verify, scan code or visit: <https://www.redcross.org/take-a-class/qrcode?certnumber=00U37PF>

ATTACHMENT 3

CONTAMINANTS OF INTEREST AND POTENTIAL ACUTE HEALTH EFFECTS

This page was intentionally left blank.

Contaminants of Interest, Peak Concentrations, OELs, and Health Hazards

Contaminant of Interest (CAS Number)	Highest Observed Concentration (sediment, water)	Published Exposure Limits for 2019			Ionization Potential (eV)	Health Hazards
		TLV/PEL	STEL/C	IDLH		
SVOCs						
Polyaromatic Hydrocarbons	NS	5mg/m ³	NA	NA	NA	Carcinogen (A2)
Coal Tar pitch volatiles as benzene soluble fraction/ PAHs (65996-93-2) e.g., pyrene, phenanthrene, chrysene, anthracene, benzo(a)pyrene)	NS	0.2 mg/m3 A1 Carcinogen	NA	80 mg/m3 Carcinogen	NA	Prevent skin contact and UV exposure. Dermatitis, bronchitis, skin cancer.
Dibenzo(a,h)anthracene (55-56-3)	NS	NA	NA	NA	NA	Carcinogen (A2)
Benzo(a)pyrene (50-32-8)	NS	NA	NA	NA	NA	Carcinogen (A2)
Metals						
Antimony (7440-36-0)	NS	0.5mg/m ³		50mg/m ³	NA	Irritant, headache, nausea, dizziness, vomiting, diarrhea, cramps
Lead and inorganic compounds as Lead (7439-92-1)	NS	0.05 mg/m ³ Action level 0.03 mg/m ³	0.03 mg/m ³	100 mg/m ³	NA	Central nervous system impairment; lower respiratory tract impairment; hematological effects

Notes:

C – Ceiling limit never to be exceeded
CAS – Chemical Abstract Service registry number
eV – electron volt
IDLH – immediately dangerous to life or health

mg/m³ – milligrams per cubic meter
NA – no exposure or no value
NS – not applicable, media has not been sampled
PAH – polynuclear aromatic hydrocarbon

PEL – permissible exposure limit (OSHA) over 8-hour work shift
STEL – short term exposure limit (15 minute)
SVOC – semivolatile organic compound
TLV – threshold limit value (ACGIH) over 8-hr work shift

A2—suspect human carcinogen, confirmed animal carcinogen





This page was intentionally left blank.

ATTACHMENT 4

EMERGENCY NOTIFICATION SIGNALS AND ACTIONS

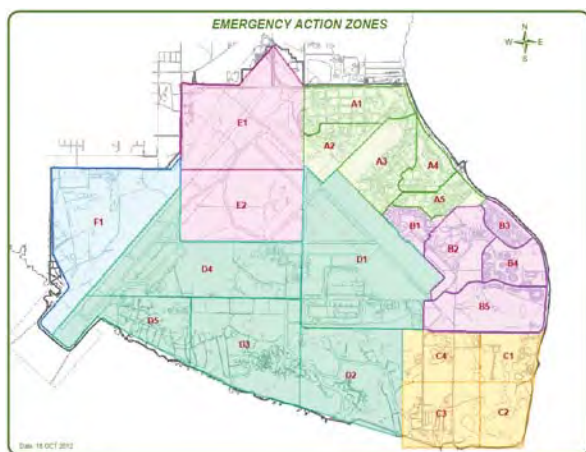
This page was intentionally left blank.

MACDILL AFB EMERGENCY NOTIFICATION SIGNALS AND ACTIONS

CONDITION	IF YOU HEAR	INDICATES	ACTIONS
ATTACK WARNING	<p>3-5 MINUTE WAVERING TONE OR SIREN</p> 	ATTACK IMMINENT OR IN PROGRESS	TAKE COVER & FOLLOW INSTRUCTIONS
ACTIVE SHOOTER	<p>3-5 MINUTE WAVERING TONE OR SIREN</p>  <p>AND VOICE- "LOCKDOWN, LOCKDOWN, LOCKDOWN"</p>	ACTIVE SHOOTER	<ul style="list-style-type: none"> • RUN • HIDE • FIGHT • STAY HIDDEN UNTIL "ALL CLEAR" GIVEN
DISASTER WARNING	<p>3-5 MINUTE STEADY TONE OR SIREN</p> 	DISASTER IMMINENT OR IN PROGRESS	<ul style="list-style-type: none"> • WARN OTHERS • FOLLOW INSTRUCTIONS TO TAKE COVER, EVACUATE, OR SHELTER • CONDUCT PERSONNEL ACCOUNTABILITY
	GIANT VOICE- "TORNADO WARNING"	TORNADO SPOTTED	<ul style="list-style-type: none"> • TAKE SHELTER INSIDE IMMEDIATELY
	<p>GIANT VOICE- "SHELTER IN PLACE"</p> 	HAZARDOUS ENVIRONMENT OUTSIDE	<ul style="list-style-type: none"> • TAKE SHELTER INSIDE IMMEDIATELY • LOOK FOR SIP ROOMS • USE SIP KITS • ACCOUNT FOR ALL PERSONNEL
	GIANT VOICE - "LIGHTNING WITHIN 5 MILES"	LIGHTNING WITHIN 5 NAUTICAL MILES	<ul style="list-style-type: none"> • TAKE SHELTER INSIDE IMMEDIATELY
ALL CLEAR	GIANT VOICE ANNOUNCEMENT- "ALL CLEAR"	ATTACK OVER/ IMMEDIATE DISASTER THREAT HAS ENDED	<ul style="list-style-type: none"> • REMAIN ALERT FOR SECONDARY HAZARDS • ACCOUNT FOR ALL PERSONNEL • REPORT FIRES, INJURIES, HAZARDS, DAMAGE AND SUSPICIOUS ACTIVITY

EMERGENCY ACTION ZONES

MacDill AFB has been divided into sectors and blocks to aid in evacuations and sheltering-in-place. These sectors and blocks are called Emergency Action Zones. Units may be directed to Shelter-in-place by Sectors and Blocks based upon the location and downwind hazard of the event.



TAKE SHELTER IMMEDIATELY



Used for most **natural disaster** situations i.e. **tornadoes**, heavy rains, strong winds, hail, etc.

Protective measures include going indoors, seeking protection on the lowest floor, in central-most part of the facility away from windows or glass doors. Interior hallways, bathrooms, or closets are your best measure.

SHELTER-IN-PLACE



Shelter-in-place is a protective action **used during a major accident** to provide limited protection for otherwise unprotected personnel for **short-term sheltering during a hazardous material release**. Use shelter in-place protection when evacuation may cause greater risk than remaining in place.

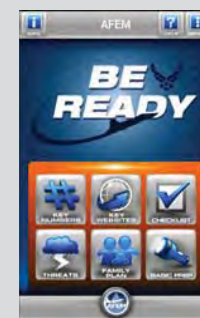
LOCK DOWN



Used when a hostile act such as a **terrorist attack** or **active shooter** incident is imminent or in progress. Personnel should be alert and ensure everyone in the area is warned of the danger. Security measures should be implemented immediately as appropriate. All personnel must quickly determine the most Reasonable way to protect themselves from the shooter and **escape, hide out, and/or take action against the shooter**.

MacDill AFB

Emergency Signals & Actions



ATTACHMENT 5

EMERGENCY CONTACT LIST AND HOSPITAL ROUTE MAP

This page was intentionally left blank.

EMERGENCY INFORMATION – AVON PARK AFR

To facilitate the quick retrieval of information in the event of an emergency, this summary has been placed in the front of this Accident Prevention Plan (APP). A copy must be posted in a conspicuous location onsite. In the event of any situation or unplanned occurrence requiring assistance, the appropriate contact(s) should be made from the list below. For emergency situations, telephone contact should be made with the site point of contact who will then contact the appropriate response teams. In the event of a serious, life-threatening emergency, emergency personnel should be contacted prior to contacting the site point of contact.

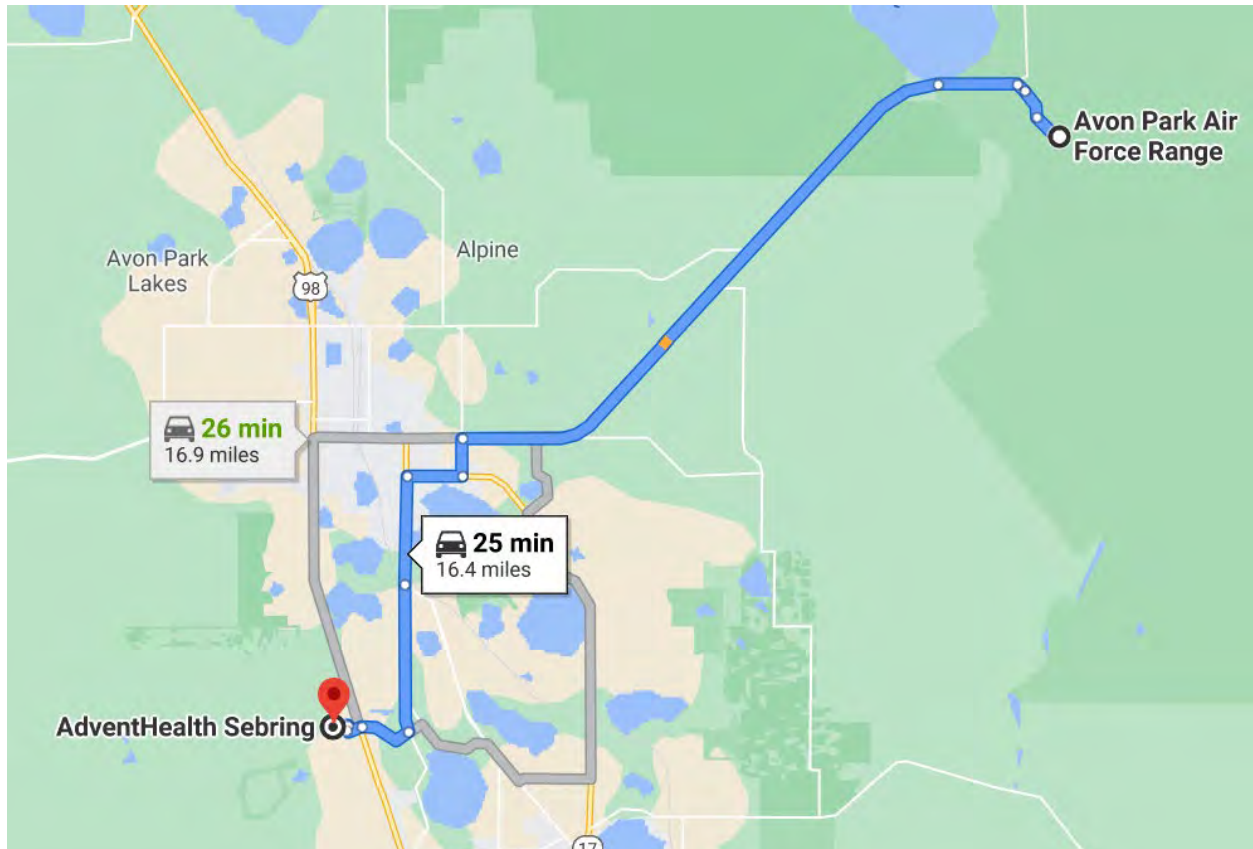
Emergency Telephone Numbers and Project Contacts

AGENCY	POC	PHONE
Fire, Police, Emergency Medical Services	Fire, Police, Ambulance	911 (tell them you are at Avon Park Air Force Range [APAFR])
Off-Base Emergency Medical Care	AdventHealth Sebring	(863) 314-4466
APAFR Remedial Project Manager	Kristy Snyder	(813) 716-4293
MacDill AFB Weather Service		(813) 828-4405
Florida Department of Environmental Protection Environmental Specialist III	Crystal Boutwell	(850) 245-7637
Client U.S. Army Corps of Engineers Project Manager	Bradley Jackson	(251) 376-8830
Tanaq Environmental, LLC Contacts		
24/7 Emergency number	Meriam Senoussi, P.G.	Cell: (773) 504-4406
Program Manager	Meriam Senoussi, P.G.	Cell: (303) 503-8496
Project Manager	Melaina Pierce	Cell: (860) 881-5292
Field Supervisor/Site Superintendent	Mark Lawrence	Cell: (325) 660-1738
Site Safety and Health Officer	Sarah Kwon	Cell: (727) 301-5865
Corporate Health and Safety Director/Safety and Health Manager	Nicole Easter	Cell: (303) 668-0589
WorkCare, Inc. 24/7 Incident Intervention Service (First aid and injury management guidance)	To be contacted for all work-related injuries and illnesses.	(888) 449-7787

DIRECTIONS TO NEAREST HOSPITAL FROM AVON PARK AIR FORCE RANGE

AdventHealth Sebring
4200 Sun N Lake Boulevard
Sebring, Florida 33872

16.4 miles, 25 minutes
(863) 314-4466



- Continue onto Wrainright Way – 0.1 miles
- Take County Rd 64 and Memorial Dr to Sun N Lake Blvd – 14.9 miles
- Continue on Sun N Lake Blvd to AdventHealth Sebring – 0.5 miles

Evacuation and rally points for severe weather: Tanaq Environmental, LLC will coordinate a safe place of refuge with APAFR personnel (Brent Bonner) to include rally points and evacuation methods to be identified onsite.

APPENDIX B – HEALTH AND SAFETY FIELD FORMS

- Daily Site Entry Log
- Daily Project Safety Inspection Report
- Safety and Occupational Health Deficiency Tracking Log
- Safety Meeting Training Log
- USACE Accident Investigation Report Form 3394
- Incident Report
- Automobile Accident Report

This page was intentionally left blank.

APPENDIX B – HEALTH AND SAFETY FIELD FORMS

- Daily Site Entry Log
- Daily Project Safety Inspection Report
- Safety and Occupational Health Deficiency Tracking Log
- Safety Meeting Training Log
- USACE Drilling Equipment Checklist
- USACE Accident Investigation Report Form 3394
- Incident Report
- Automobile Accident Report

This page was intentionally left blank.



DAILY SITE ENTRY LOG

SITE NAME: _____ **DATE:** _____

Name (print)	Company	Time	
		In	Out

Comments:



FIELD AUDIT CHECKLIST

Project Name: _____ **Project No.:** _____

Field Location: _____ **Completed by:** _____

Project Manager: _____ **Site Safety Officer:** _____

General Items		In Compliance?		
Health and Safety Plan Requirements		YES	NO	NA
1	Approved health and safety plan (HASP) on site or available			
2	Names of on-site personnel recorded in field logbook or daily log			
3	HASP compliance agreement form signed by all on-site personnel			
4	Material Safety Data Sheets on site or available			
5	Designated site safety coordinator present			
6	Daily tailgate safety meetings conducted and documented			
7	On-site personnel meet HASP requirements for medical examinations, fit testing, and training (including subcontractors)			
8	Compliance with specified safe work practices			
9	Documentation of training, medical examinations, and fit tests available from employer			
10	Exclusion, decontamination, and support zones delineated and enforced			
11	Windsock or ribbons in place to indicate wind direction			
12	Illness and injury prevention program reports completed (California only)			
Emergency Planning				
13	Emergency telephone numbers posted			
14	Emergency route to hospital posted			
15	Local emergency providers notified of site activities			
16	Adequate safety equipment inventory available			
17	First aid provider and supplies available			
18	Eyewash stations in place			
Air Monitoring				
19	Monitoring equipment specified in HASP available and in working order			
20	Monitoring equipment calibrated and calibration records available			
21	Personnel know how to operate monitoring equipment and equipment manuals available on site			
22	Environmental and personnel monitoring performed as specified in HASP			



FIELD AUDIT CHECKLIST (Continued)

Safety Items		In Compliance?		
Personal Protection		YES	NO	NA
1	Splash suit			
2	Chemical protective clothing			
3	Safety glasses or goggles			
4	Gloves			
5	Overboots			
6	Hard hat			
7	Dust mask			
8	Hearing protection			
9	Respirator			
Instrumentation				
10	Combustible gas meter			
11	Oxygen meter			
12	Organic vapor analyzer			
Supplies				
13	Decontamination equipment and supplies			
14	Fire extinguishers			
15	Spill cleanup supplies			
Corrective Action Taken During Audit:				
Corrective Action Still Needed:				

Note: NA = Not applicable

Auditor's Signature

Site Safety Officer's Signature

Date

SAFETY & OCCUPATIONAL HEALTH DEFICIENCY TRACKING LOG

[illegible]



Daily Safety Tailgate Meeting Form

Date: _____

Time: _____

Project: Luke AFB Phase I Remedial Investigation

Meeting Leader: _____

Current Weather: _____

Anticipated Weather: _____

Specific Work Area(s): _____

New/Short-Service/Visitors on Site: _____

Tanaq/Sundance Scope of Work: _____

Contractor Scope of Work: _____

Tools/Equipment to be used: _____

Chemical/Physical/ Biological Hazards: _____

Hazard Mitigation/Controls: _____

PPE to be worn: _____

Have all tools/equipment/PPE listed above been inspected and/or calibrated, and are in good working order?

Safety Topics Discussed: _____

Recent Safety Incidents/Near Misses/Lessons Learned: _____



Daily Safety Tailgate Meeting Acknowledgement

[illegible]

(For safety staff only)	REPORT NO.	EROC CODE	UNITED STATES ARMY CORPS OF ENGINEERS ACCIDENT INVESTIGATION REPORT For use of this form, see Help Menu and USACE Supplement to AR 385-40 The proponent agency is CESO		REQUIREMENT CONTROL SYMBOL: CEEC-S-8 (R2)
1. ACCIDENT CLASSIFICATION					
PERSONNEL CLASSIFICATION		INJURY/ILLNESS/FATAL		PROPERTY DAMAGE	
GOVERNMENT <input type="checkbox"/> CIVILIAN <input type="checkbox"/> MILITARY		<input type="checkbox"/> FIRE INVOLVED <input type="checkbox"/> OTHER		<input type="checkbox"/> MOTOR VEHICLE INVOLVED <input type="checkbox"/> DIVING	
<input type="checkbox"/> CONTRACTOR		<input type="checkbox"/> FIRE INVOLVED <input type="checkbox"/> OTHER		<input type="checkbox"/> MOTOR VEHICLE INVOLVED <input type="checkbox"/> DIVING	
<input type="checkbox"/> PUBLIC <input type="checkbox"/> FATAL <input type="checkbox"/> OTHER		X		X	
2. PERSONAL DATA					
a. NAME (Last, First MI.)		b. AGE	c. SEX <input type="checkbox"/> MALE <input type="checkbox"/> FEMALE		d. SOCIAL SECURITY NUMBER e. GRADE
f. JOB SERIES/TITLE		g. DUTY STATUS AT TIME OF ACCIDENT <input type="checkbox"/> ON DUTY <input type="checkbox"/> TDY <input type="checkbox"/> OFF DUTY		h. EMPLOYMENT STATUS AT TIME OF ACCIDENT <input type="checkbox"/> ARMY ACTIVE <input type="checkbox"/> ARMY RESERVE <input type="checkbox"/> VOLUNTEER <input type="checkbox"/> PERMANENT <input type="checkbox"/> FOREIGN NATIONAL <input type="checkbox"/> SEASONAL <input type="checkbox"/> TEMPORARY <input type="checkbox"/> STUDENT <input type="checkbox"/> OTHER (Specify) _____	
3. GENERAL INFORMATION					
a. DATE OF ACCIDENT (YYYYMMDD)	b. TIME OF ACCIDENT (Military Time) hrs.	c. EXACT LOCATION OF ACCIDENT			d. CONTRACTOR'S NAME
e. CONTRACT NUMBER <input type="checkbox"/> CIVIL WORKS <input type="checkbox"/> MILITARY <input type="checkbox"/> OTHER (Specify) _____		f. TYPE OF CONTRACT <input type="checkbox"/> CONSTRUCTION <input type="checkbox"/> SERVICE <input type="checkbox"/> A/E <input type="checkbox"/> DREDGE <input type="checkbox"/> OTHER (Specify) _____		g. HAZARDOUS/TOXIC WASTE ACTIVITY <input type="checkbox"/> SUPERFUND <input type="checkbox"/> DERP <input type="checkbox"/> IRP <input type="checkbox"/> OTHER (Specify) _____	
4. CONSTRUCTION ACTIVITIES ONLY (Fill in line and corresponding code number in box from list - see help menu)					
a. CONSTRUCTION ACTIVITY (CODE) # <input type="text"/>			b. TYPE OF CONSTRUCTION EQUIPMENT (CODE) # <input type="text"/>		
5. INJURY/ILLNESS INFORMATION (Include name on line and corresponding code number in box for items e, f & g - see help menu)					
a. SEVERITY OF ILLNESS/INJURY (CODE) # <input type="text"/>			b. ESTIMATED DAYS LOST	c. ESTIMATED DAYS HOSPITALIZED	d. ESTIMATED DAYS RESTRICTED DUTY
e. BODY PART AFFECTED (CODE) PRIMARY # <input type="text"/> (CODE) SECONDARY # <input type="text"/>			g. TYPE AND SOURCE OF INJURY/ILLNESS (CODE) TYPE # <input type="text"/> (CODE) SOURCE # <input type="text"/>		
f. NATURE OF ILLNESS / INJURY (CODE) # <input type="text"/>					
6. PUBLIC FATALITY (Fill in line and correspondence code number in box - see help menu)					
a. ACTIVITY AT TIME OF ACCIDENT (CODE) # <input type="text"/>			b. PERSONAL FLOTATION DEVICE USED? <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> N/A		

7. MOTOR VEHICLE ACCIDENT							
a. TYPE OF VEHICLE		b. TYPE OF COLLISION		c. SEAT BELTS	USED	NOT USED	NOT APPLICABLE
<input type="checkbox"/> <input type="checkbox"/> PICKUP/VAN <input type="checkbox"/> <input type="checkbox"/> AUTOMOBILE <input type="checkbox"/> <input type="checkbox"/> TRUCK <input type="checkbox"/> <input type="checkbox"/> OTHER (Specify) _____		<input type="checkbox"/> SIDE SWIPE <input type="checkbox"/> HEAD ON <input type="checkbox"/> REAR END <input type="checkbox"/> BROADSIDE <input type="checkbox"/> ROLL OVER <input type="checkbox"/> BACKING <input type="checkbox"/> OTHER (Specify) _____		(1) FRONT SEAT	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				(2) REAR SEAT	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. PROPERTY MATERIAL INVOLVED		
a. NAME OF ITEM	b. OWNERSHIP	c. AMOUNT OF DAMAGE
(1)		
(2)		
(3)		

9. VESSEL/FLOATING PLANT ACCIDENT (Fill in line and correspondence code number in box from list - see help menu)	
a. ACTIVITY AT TIME OF ACCIDENT	a. ACTIVITY AT TIME OF ACCIDENT
(CODE)	(CODE)
# <input style="width: 50px;" type="text"/>	# <input style="width: 50px;" type="text"/>

10. ACCIDENT DESCRIPTION (Use additional paper, if necessary, see attached page 4.)

11. CAUSAL FACTOR(s) (Read instructions before completing)		
a. (Explain YES answers in item 13)	YES	NO
DESIGN: Was design of facility, workplace or equipment a factor?	<input type="checkbox"/>	<input type="checkbox"/>
INSPECTION/MAINTENANCE: Were inspection & maintenance procedures a factor?	<input type="checkbox"/>	<input type="checkbox"/>
PERSON'S PHYSICAL CONDITION: In your opinion, was the physical condition of the person a factor?	<input type="checkbox"/>	<input type="checkbox"/>
OPERATING PROCEDURES: Were operating procedures a factor?	<input type="checkbox"/>	<input type="checkbox"/>
JOB PRACTICES: Were any job safety/health practices not followed when the accident occurred?	<input type="checkbox"/>	<input type="checkbox"/>
HUMAN FACTORS: Did any human factors such as, size or strength of person, etc., contribute to accident?	<input type="checkbox"/>	<input type="checkbox"/>
ENVIRONMENTAL FACTORS: Did heat, cold, dust, sun, glare, etc., contribute to the accident?	<input type="checkbox"/>	<input type="checkbox"/>
CHEMICAL AND PHYSICAL AGENT FACTORS: Did exposure to chemical agents, such as dust, fumes, mists, vapors or physical agents, such as, noise, radiation, etc., contribute to accident?	<input type="checkbox"/>	<input type="checkbox"/>
OFFICE FACTORS: Did office setting such as, lifting office furniture, carrying, stooping, etc., contribute to the accident?	<input type="checkbox"/>	<input type="checkbox"/>
SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?	<input type="checkbox"/>	<input type="checkbox"/>
PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?	<input type="checkbox"/>	<input type="checkbox"/>
DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident?	<input type="checkbox"/>	<input type="checkbox"/>
b. WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT? (If yes, attach a copy.)		
	<input type="checkbox"/>	<input type="checkbox"/>

12. TRAINING		
a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?	b. TYPE OF TRAINING	c. DATE OF MOST RECENT FORMAL TRAINING (YYYYMMDD)
<input type="checkbox"/> YES <input type="checkbox"/> NO	<input type="checkbox"/> CLASSROOM <input type="checkbox"/> ON JOB	

13. FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES (See instruction for definition of direct and indirect causes.) (Use additional paper, if necessary)

a. DIRECT CAUSE(s) (Attach additional sheets as needed, See page 4)
b. INDIRECT CAUSE(s) (Attach additional sheets as needed, See page 5)

14. ACTION(s) TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE(s)		
DESCRIBE FULLY <i>(Attach additional sheets as necessary, See page 5)</i>		
15. DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.		
a. BEGINNING (YYYYMMDD)		b. ANTICIPATED COMPLETION (YYYYMMDD)
c. DATE SIGNED (YYYYMMDD)	d. TITLE OF SUPERVISOR COMPLETING REPORT	e. CORPS SIGNATURE, SUPERVISOR COMPLETING REPORT
c. DATE SIGNED (YYYYMMDD)	d. TITLE OF SUPERVISOR COMPLETING REPORT	e. CONTRACTOR SIGNATURE, SUPERVISOR COMPLETING REPORT
f. ORGANIZATION IDENTIFIER <i>(Division, Branch, Section, etc.,)</i>		g. OFFICE SYMBOL
16. MANAGEMENT REVIEW <i>(1st)</i>		
a. <input type="checkbox"/> CONCUR b. <input type="checkbox"/> NONCONCUR c. COMMENTS		
DATE (YYYYMMDD)	TITLE	SIGNATURE
17. MANAGEMENT REVIEW <i>(2nd - Chief Operations, Construction, Engineering, etc.,)</i>		
a. <input type="checkbox"/> CONCUR b. <input type="checkbox"/> NONCONCUR c. COMMENTS		
DATE (YYYYMMDD)	TITLE	SIGNATURE
18. SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW		
a. <input type="checkbox"/> CONCUR b. <input type="checkbox"/> NONCONCUR c. ADDITIONAL ACTIONS/COMMENTS		
DATE (YYYYMMDD)	TITLE	SIGNATURE
19. COMMAND APPROVAL		
COMMENTS		
DATE (YYYYMMDD)	COMMANDER SIGNATURE	

10.

ACCIDENT DESCRIPTION *(Continuation)*

13a.

DIRECT CAUSE(s) *(Continuation)*

13b. INDIRECT CAUSE(s) (Continuation)

14. ACTION(s) TAKEN, ANTICIPATED, OR RECOMMENDED TO ELIMINATE CAUSE(s) (Continuation)

GENERAL. Complete a separate report for each person who was injured, caused, or contributed to the accident (*excluding uninjured personnel and witnesses*). Use of this form for reporting USACE employee first-aid type injuries not submitted to the Office of Workers' Compensation Programs (OWCP) shall be at the discretion of the FOA commander. Please type or print legibly. Appropriate items shall be marked with an "X" in box(es). If additional space is needed, provide the information on a separate sheet and attach to the completed form. Ensure that these instructions are forwarded with the completed report to the designated management reviewers indicated in sections 16 and 17.

INSTRUCTIONS FOR SECTION 1 - ACCIDENT CLASSIFICATION

(Mark All Boxes That Are Applicable)

a. GOVERNMENT. Mark "CIVILIAN" box if accident involved government civilian employee; mark "MILITARY" box if accident involved U.S. military personnel.

(1) INJURY/ILLNESS/FATALITY - Mark if accident resulted in any government civilian employee injury, illness, or fatality that requires the submission of OWCP Forms CA-1 (*injury*), CA-2 (*illness*) or CA-6 (*fatality*) to OWCP; mark if accident resulted in military personnel lost-time or fatal injury or illness.

(2) PROPERTY DAMAGE - Mark the appropriate box if accident resulted in any damage of \$1000 or more to government property (*including motor vehicles*).

(3) VEHICLE INVOLVED - Mark if accident involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY - Mark if the accident involved an in-house USACE diving activity.

b. CONTRACTOR.

(1) INJURY/ILLNESS/FATALITY - Mark if accident resulted in any contractor lost-time injury/illness or fatality.

(2) PROPERTY DAMAGE - Mark the appropriate box if accident resulted in any damage of \$1000 or more to contractor property (*including motor vehicles*).

(3) VEHICLE INVOLVED - Mark if accident involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY - Mark if the accident involved a USACE Contractor diving activity.

c. PUBLIC.

(1) INJURY/ILLNESS/FATALITY - Mark if accident resulted in public fatality or permanent total disability. (*The "OTHER" box will be marked when requested by the FOA to report an unusual non-fatal public accident that could result in claims against the government or as otherwise directed by the FOA Commander*).

(2) VOID SPACE - Make no entry.

(3) VEHICLE INVOLVED - Mark if accident resulted in a fatality to a member of the public and involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" is marked.

(4) VOID SPACE - Make no entry.

INSTRUCTIONS FOR SECTION 2 - PERSONAL DATA

a. NAME - (*MANDATORY FOR GOVERNMENT ACCIDENTS. OPTIONAL AT THE DISCRETION OF THE FOA COMMANDER FOR CONTRACTOR AND PUBLIC ACCIDENTS*). Enter last name, first name, middle initial of person involved.

b. AGE - Enter age.

c. SEX - Mark appropriate box.

d. SOCIAL SECURITY NUMBER - (*FOR GOVERNMENT PERSONNEL ONLY*) Enter the social security number (*or other personal identification number if no social security number issued*).

e. GRADE - (*FOR GOVERNMENT PERSONNEL ONLY*) Enter pay grade. Example: 0-6; E-7; WG-8; WS-12; GS-11; etc.

f. JOB SERIES/TITLE - For government civilian employees enter the pay plan, full series number, and job title, e.g., GS-O810/Civil Engineer. For military personnel enter the primary military occupational specialty (*PMOS*), e.g., 15A30 or 11G50. For contractor employees enter the job title assigned to the injured person, e.g., carpenter, laborer, surveyor, etc.

g. DUTY STATUS - Mark the appropriate box.

(1) ON DUTY - Person was at duty station during duty hours or person was away from duty station during duty hours but on official business at time of the accident.

(2) TDY - Person was on official business, away from the duty station and with travel orders at time of accident. Line-of-duty investigation required.

(3) OFF DUTY - Person was not on official business at time of accident.

h. EMPLOYMENT STATUS - (*FOR GOVERNMENT PERSONNEL ONLY*) Mark the most appropriate box. If "OTHER" is marked, specify the employment status of the person.

INSTRUCTION FOR SECTION 3 - GENERAL INFORMATION

- a. DATE OF ACCIDENT - Enter the month, day, and year of accident.
- b. TIME OF ACCIDENT - Enter the local time of accident in military time. Example: 1430 hrs (*not* 2:30 p.m.).
- c. EXACT LOCATION OF ACCIDENT - Enter facts needed to locate the accident scene, (*installation/project name, building number, street, direction and distance from closest landmark, etc.*).
- d. CONTRACTOR NAME
- (1) PRIME - Enter the exact name (*title of firm*) of the prime contractor.
- (2) SUBCONTRACTOR - Enter the name of any subcontractor involved in the accident.
- e. CONTRACT NUMBER - Mark the appropriate box to identify if contract is civil works, military, or other: if "OTHER" is marked, specify contract appropriation on line provided. Enter complete contract number of prime contract, e.g., DACW 09-85-C-0100.
- f. TYPE OF CONTRACT - Mark appropriate box. A/E means architect/engineer. If "OTHER" is marked, specify type of contract on line provided.
- g. HAZARDOUS/TOXIC WASTE ACTIVITY (*HTW*) - Mark the box to identify the HTW activity being performed at the time of the accident. For Superfund, DERP, and Installation Restoration Program (*IRP*) HTW activities include accidents that occurred during inventory, predesign, design, and construction. For the purpose of accident reporting, DERP Formerly Used DoD Site (*FUDS*) activities and IRP activities will be treated separately. For Civil Works O&M HTW activities mark the "OTHER" box.

INSTRUCTIONS FOR SECTION 4 - CONSTRUCTION ACTIVITIES

- a. CONSTRUCTION ACTIVITY - Select the most appropriate construction activity being performed at time of accident from the list below. Enter the activity name and place the corresponding code number identified in the box.

CONSTRUCTION ACTIVITY LIST

- | | |
|-------------------------|----------------------------|
| 1. MOBILIZATION | 13. CARPENTRY |
| 2. SITE PREPARATION | 14. ELECTRICAL |
| 3. EXCAVATION/TRENCHING | 15. SCAFFOLDING/ACCESS |
| 4. GRADING (EARTHWORK) | 16. MECHANICAL |
| 5. PIPING/UTILITIES | 17. PAINTING |
| 6. FOUNDATION | 18. EQUIPMENT/MAINTENANCE |
| 7. FORMING | 19. TUNNELING |
| 8. CONCRETE PLACEMENT | 20. WAREHOUSING/STORAGE |
| 9. STEEL ERECTION | 21. PAVING |
| 10. ROOFING | 22. FENCING |
| 11. FRAMING | 23. SIGNING |
| 12. MASONRY | 24. LANDSCAPING/IRRIGATION |
| | 25. INSULATION |
| | 26. DEMOLITION |

- b. TYPE OF CONSTRUCTION EQUIPMENT - Select the equipment involved in the accident from the list below. Enter the name and place the corresponding code number identified in the box. If equipment is not included below, use code 24, "OTHER", and write in specific type of equipment.

CONSTRUCTION EQUIPMENT

- | | |
|---|---------------------------------------|
| 1. GRADER | 12. DUMP TRUCK (<i>HIGHWAY</i>) |
| 2. DRAGLINE | 13. DUMP TRUCK (<i>OFF HIGHWAY</i>) |
| 3. CRANE (<i>ON VESSEL/BARGE</i>) | 14. TRUCK (<i>OTHER</i>) |
| 4. CRANE (<i>TRACKED</i>) | 15. FORKLIFT |
| 5. CRANE (<i>RUBBER TIRE</i>) | 16. BACKHOE |
| 6. CRANE (<i>VEHICLE MOUNTED</i>) | 17. FRONT-END LOADER |
| 7. CRANE (<i>TOWER</i>) | 18. PILE DRIVER |
| 8. SHOVEL | 19. TRACTOR (<i>UTILITY</i>) |
| 9. SCRAPER | 20. MANLIFT |
| 10. PUMP TRUCK (<i>CONCRETE</i>) | 21. DOZER |
| 11. TRUCK (<i>CONCRETE/TRANSIT MIXER</i>) | 22. DRILL RIG |
| | 23. COMPACTOR/VIBRATORY ROLLER |
| | 24. OTHER |

INSTRUCTIONS FOR SECTION 5 - INJURY/ILLNESS INFORMATION

- a. SEVERITY OF INJURY/ILLNESS - Reference paragraph 2-10 of USACE Supplement 1 to AR 385-40 and enter code and description from list below.

- | | |
|-----|---|
| NOI | NO INJURY |
| FAT | FATALITY |
| PTL | PERMANENT TOTAL DISABILITY |
| PPR | PERMANENT PARTIAL DISABILITY |
| LWD | LOST WORKDAY CASE INVOLVING DAYS AWAY FROM WORK |
| NLW | RECORDABLE CASE WITHOUT LOST WORKDAYS |
| RFA | RECORDABLE FIRST AID CASE |
| NRI | NON-RECORDABLE INJURY |

- b. ESTIMATED DAYS LOST - Enter the estimated number of workdays the person will lose from work.

c. ESTIMATED DAYS HOSPITALIZED - Enter the estimated number of workdays the person will be hospitalized.

d. ESTIMATED DAYS RESTRICTED DUTY - Enter the estimated number of workdays the person, as a result of the accident, will not be able to perform all of their regular duties.

e. BODY PART AFFECTED - Select the most appropriate primary and when applicable, secondary body part affected from the list below. Enter body part name on line and place the corresponding code letters identifying that body part in the box.

GENERAL BODY AREA	CODE	BODY PART NAME	HEAD, EXTERNAL	H1	EYE EXTERNAL
ARM/WRIST	AB	ARM AND WRIST		H2	BOTH EYES EXTERNAL
	AS	ARM OR WRIST		H3	EAR EXTERNAL
TRUNK, EXTERNAL MUSCULATURE				H4	BOTH EARS EXTERNAL
				HC	CHIN
				HF	FACE
				HK	NECK/THROAT
				HM	MOUTH/LIPS
				HN	NOSE
				HS	SCALP
			KNEE	KB	BOTH KNEES
				KS	KNEE
			LEG, HIP, ANKLE, BUTTOCKS	LB	BOTH LEGS/HIPS/ ANKLES/
			BUTTOCK	LS	SINGLE LEG/HIP/ ANKLE/BUTTOCK
HEAD, INTERNAL			HAND	MB	BOTH HANDS
				MS	SINGLE HAND
			FOOT	PB	BOTH FEET
				PS	SINGLE FOOT
			TRUNK, BONES	R1	SINGLE COLLAR BONE
				R2	BOTH COLLAR BONES
				R3	SHOULDER BLADE
				R4	BOTH SHOULDER BLADES
				RB	RIB
				RS	STERNUM (BREAST BONE)
				RV	VERTEBRAE (SPINE; DISC)
				RZ	TRUNK BONES OTHER
			SHOULDER	SB	BOTH SHOULDERS
ELBOW	EB	BOTH ELBOWS		SS	SINGLE SHOULDER
	ES	SINGLE ELBOW			
FINGER			THUMB	TB	BOTH THUMBS
				TS	SINGLE THUMB
			TRUNK, INTERNAL ORGANS	V1	LUNG, SINGLE
				V2	LUNGS, BOTH
				V3	KIDNEY, SINGLE
				V4	KIDNEYS, BOTH
				VH	HEART
TOE				VL	LIVER
				VR	REPRODUCTIVE ORGANS
				VS	STOMACH
				VV	INTESTINES
				VZ	TRUNK, INTERNAL; OTHER

f. NATURE OF INJURY/ILLNESS - Select the most appropriate nature of injury/illness from the list below. This nature of injury/illness shall correspond to the primary body part selected in 5e, above. Enter the nature of injury/illness name on the line and place the corresponding CODE letters in the box provided.

* The injury or condition selected below must be caused by a specific incident or event which occurred during a single work day or shift.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME	TU	BURN, SCALD, SUNBURN
*TRAUMATIC INJURY OR DISABILITY	TA	AMPUTATION	TI	TRAUMATIC SKIN DISEASES/ CONDITIONS INCLUDING DERMATITIS
	TB	BACK STRAIN	TR	TRAUMATIC RESPIRATORY DISEASE
	TC	CONTUSION; BRUISE; ABRASION	TQ	TRAUMATIC FOOD POISONING
	TD	DISLOCATION	TW	TRAUMATIC TUBERCULOSIS
	TF	FRACTURE	TX	TRAUMATIC VIROLOGICAL/INFECTIVE/
	TH	HERNIA		
GENERAL NATURE CATEGORY			T1	TRAUMATIC CEREBRAL VASCULAR
			T2	TRAUMATIC HEARING LOSS
			T3	TRAUMATIC HEART CONDITION
			T4	TRAUMATIC MENTAL DISORDER, STRESS; NERVOUS CONDITION
			T8	TRAUMATIC INJURY - OTHER (EXCEPT DISEASE, ILLNESS)
	TK	CONCUSSION		
	TL	LACERATION, CUT		
	TP	PUNCTURE		
	TS	STRAIN, MULTIPLE		

**** A nontraumatic physiological harm or loss of capacity produced by systemic infection; continued or repeated stress or strain; exposure to toxins, poisons, fumes, etc.; or other continued and repeated exposures to conditions of the work environment over a long period of time. For practical purposes, an occupational illness/disease or disability is any reported condition which does not meet the definition of traumatic injury or disability as described above.**

**GENERAL NATURE
CATEGORY**

CODE NATURE OF INJURY NAME

****NON-TRAUMATIC ILLNESS/DISEASE OR DISABILITY**

RESPIRATORY DISEASE	RA	ASBESTOSIS	DD	ENDEMIC DISEASE (<i>OTHER THAN CODE TYPES R&S</i>)
	RB	BRONCHITIS		
	RE	EMPHYSEMA	DE	EFFECT OF ENVIRONMENTAL
	RP	PNEUMOCONIOSIS		
	RS	SILICOSIS	DH	HEARING LOSS
VIROLOGICAL, INFECTIVE & PARASITIC DISEASES	R9	RESPIRATORY DISEASE, OTHER	DK	HEART CONDITION
			DM	MENTAL DISORDER, EMOTIONAL STRESS, NERVOUS CONDITION
	VB	BRUCELLOSIS	DR	RADIATION
	VC	COCCIDIOMYCOSIS	DS	STRAIN, MULTIPLE
	VF	FOOD POISONING	DU	ULCER
	VH	HEPATITIS	DV	OTHER VASCULAR CONDITIONS
	VM	MALARIA	D9	DISABILITY, OTHER
	VS	STAPHYLOCOCCUS		
	VT	TUBERCULOSIS		
	V9	VIROLOGICAL/INFECTIVE/ PARASITIC - OTHER	SB	BIOLOGICAL
DISABILITY, OCCUPATIONAL	DA	ARTHRITIS, BURSITIS	SC	CHEMICAL
	DB	BACK STRAIN, BACK SPRAIN	S9	DERMATITIS, UNCLASSIFIED
	DC	CEREBRAL VASCULAR CONDITION; STROKE		

g. TYPE AND SOURCE OF INJURY/ILLNESS (*CAUSE*) - Type and Source Codes are used to describe what caused the incident. The Type Code stands for an ACTION and the Source Code for an OBJECT or SUBSTANCE. Together, they form a brief description of how the incident occurred. Where there are two different sources, code the initiating source of the incident (*see example 1, below*). Examples:

(1) An employee tripped on carpet and struck his head on a desk. TYPE: 210 (*fell on same level*) SOURCE: 0110 (*walking/working surface*).

NOTE: This example would NOT be coded 120 (*struck against*) and 0140 (*furniture*).

(2) A Park Ranger contracted dermatitis from contact with poison ivy/oak.

TYPE: 510 (*contact*) SOURCE: 0920 (*plant*)

(3) A lock and dam mechanic punctured his finger with a metal sliver while grinding a turbine blade.

TYPE: 410 (*punctured by*) SOURCE: 0830 (*metal*)

(4) An employee was driving a government vehicle when it was struck by another vehicle.

TYPE: 800 (*traveling in*) SOURCE: 0421 (*government-owned vehicle, as driver*)

NOTE: The Type Code 800, "Traveling In" is different from the other type codes in that its function is not to identify factors contributing to the injury or fatality, but rather to collect data on the type of vehicle the employee was operating or traveling in at the time of the incident.

Select the most appropriate TYPE and SOURCE identifier from the list below and enter the name on the line and the corresponding code in the appropriate box.

CODE	TYPE OF INJURY NAME	CODE	SOURCE OF INJURY NAME
		0610	EXERTED
	STRUCK	0620	LIFTED, STRAINED BY (<i>SINGLE ACTION</i>)
0110	STRUCK BY		STRESSED BY (<i>REPEATED ACTION</i>)
0111	STRUCK BY FALLING OBJECT	0710	EXPOSED
0120	STRUCK AGAINST	0720	INHALED
	FELL, SLIPPED, TRIPPED	0730	INGESTED
0210	FELL ON SAME LEVEL	0740	ABSORBED
0220	FELL ON DIFFERENT LEVEL	0800	EXPOSED TO
0230	SLIPPED, TRIPPED (<i>NO FALL</i>)		TRAVELING IN
	CAUGHT		
0310	CAUGHT ON		
0320	CAUGHT IN	0100	BUILDING OR WORKING AREA
0330	CAUGHT BETWEEN	0110	WALKING/WORKING SURFACE (<i>FLOOR, STREET, SIDEWALKS, ETC.</i>)
	PUNCTURED, LACERATED		
0410	PUNCTURED BY	0120	STAIRS, STEPS
0420	CUT BY	0130	LADDER
0430	STUNG BY	0140	FURNITURE, FURNISHINGS, OFFICE EQUIPMENT
0440	BITTEN BY	0150	BOILER, PRESSURE VESSEL
	CONTACTED	0160	EQUIPMENT LAYOUT (<i>ERGONOMIC</i>)
0510	CONTACTED WITH (<i>INJURED PERSON MOVING</i>)	0170	WINDOWS, DOORS
0520	CONTACTED BY (<i>OBJECT WAS MOVING</i>)	0180	ELECTRICITY

0200	ENVIRONMENTAL CONDITION	0631	CARBON MONOXIDE
0210	TEMPERATURE EXTREME (<i>INDOOR</i>)	0640	MIST, STEAM, VAPOR, FUME
0220	WEATHER (<i>ICE, RAIN, HEAT, ETC.</i>)	0641	WELDING FUMES
0230	FIRE, FLAME, SMOKE (<i>NOT TOBACCO</i>)	0650	PARTICLES (<i>UNIDENTIFIED</i>)
0240	NOISE	0700	CHEMICAL, PLASTIC, ETC.
0250	RADIATION	0711	DRY CHEMICAL - CORROSIVE
0260	LIGHT	0712	DRY CHEMICAL - TOXIC
0270	VENTILATION	0713	DRY CHEMICAL - EXPLOSIVE
0271	TOBACCO SMOKE	0714	DRY CHEMICAL FLAMMABLE
0280	STRESS (<i>EMOTIONAL</i>)	0721	LIQUID CHEMICAL - CORROSIVE
0290	CONFINED SPACE	0722	LIQUID CHEMICAL - TOXIC
0300	MACHINE OR TOOL	0723	LIQUID CHEMICAL - EXPLOSIVE
0310	HAND TOOL (<i>POWERED; SAW, GRINDER, ETC.</i>)	0724	LIQUID CHEMICAL - FLAMMABLE
0320	HAND TOOL (<i>NONPOWERED</i>)	0730	PLASTIC
0330	MECHANICAL POWER TRANSMISSION APPARATUS	0740	WATER
0340	GUARD, SHIELD (<i>FIXED, MOVEABLE, INTERLOCK</i>)	0750	MEDICINE
0350	VIDEO DISPLAY TERMINAL	0800	INAMINATE OBJECT
0360	PUMP, COMPRESSOR, AIR PRESSURE TOOL	0810	BOX, BARREL, ETC.
0370	HEATING EQUIPMENT	0820	PAPER
0380	WELDING EQUIPMENT	0830	METAL ITEM, MINERAL
0400	VEHICLE	0831	NEEDLE
0411	AS DRIVER OF PRIVATELY OWNED/RENTAL VEHICLE	0840	GLASS
0412	AS PASSENGER OF PRIVATELY OWNED/RENTAL VEHICLE	0850	SCRAP, TRASH
0421	DRIVER OF GOVERNMENT VEHICLE	0860	WOOD
0422	PASSENGER OF GOVERNMENT VEHICLE	0870	FOOD
0430	COMMON CARRIER (<i>AIRLINE, BUS, ETC.</i>)	0880	CLOTHING, APPAREL, SHOES
0440	AIRCRAFT (<i>NOT COMMERCIAL</i>)	0900	ANIMATE OBJECT
0450	BOAT, SHIP, BARGE	0911	DOG
0500	MATERIAL HANDLING EQUIPMENT	0912	OTHER ANIMAL
0510	EARTHMOVER (<i>TRACTOR, BACKHOE, ETC.</i>)	0920	PLANT
0520	CONVEYOR (<i>FOR MATERIAL AND EQUIPMENT</i>)	0930	INSECT
0530	ELEVATOR, ESCALATOR, PERSONNEL HOIST	0940	HUMAN (<i>VIOLENCE</i>)
0540	HOIST, SLING CHAIN, JACK	0950	HUMAN (<i>COMMUNICABLE DISEASE</i>)
0550	CRANE	0960	BACTERIA, VIRUS (<i>NOT HUMAN CONTACT</i>)
0551	FORKLIFT	1000	PERSONAL PROTECTIVE EQUIPMENT
0560	HANDTRUCK, DOLLY	1010	PROTECTIVE CLOTHING, SHOES, GLASSES,
0600	DUST, VAPOR, ETC.		GOGGLES
0610	DUST (<i>SILICA, COAL, ETC.</i>)	1020	RESPIRATOR, MASK
0620	FIBERS	1021	DIVING EQUIPMENT
0621	ASBESTOS	1030	SAFETY BELT, HARNESS
0630	GASES	1040	PARACHUTE

INSTRUCTIONS FOR SECTION 6 - PUBLIC FATALITY

a. **ACTIVITY AT TIME OF ACCIDENT** - Select the activity being performed at the time of the accident from the list below. Enter the activity name on the line and the corresponding number in the box. If the activity performed is not identified on the list, select from the most appropriate primary activity area (*water related, non-water related or other activity*), the code number for "Other", and write in the activity being performed at the time of the accident.

WATER RELATED RECREATION

1. Sailing
2. Boating-powered
3. Boating-unpowered
4. Water skiing
5. Fishing from boat
6. Fishing from bank dock or pier
7. Fishing while wading
8. Swimming/supervised area
9. Swimming/designated area
10. Swimming/other area
11. Underwater activities (*skin diving, scuba, etc.*)
12. Wading
13. Attempted rescue
14. Hunting from boat
15. Other

NON-WATER RELATED RECREATION

16. Hiking and walking
17. Climbing (*general*)
18. Camping/picnicking authorized area

19. Camping/picnicking unauthorized area
20. Guided tours
21. Hunting
22. Playground equipment
23. Sports/summer (*baseball, football, etc.*)
24. Sports/winter (*skiing, sledding, snowmobiling etc.*)
25. Cycling (*bicycle, motorcycle, scooter*)
26. Gliding
27. Parachuting
28. Other non-water related

OTHER ACTIVITIES

29. Unlawful acts (*fight, riots, vandalism, etc.*)
30. Food preparation/serving
31. Food consumption
32. Housekeeping
33. Sleeping
34. Pedestrian struck by vehicle
35. Pedestrian other acts
36. Suicide
37. "Other" activities

b. **PERSONAL FLOTATION DEVICE USED** - If fatality was water-related was the victim wearing a person flotation device? Mark the appropriate box.

INSTRUCTIONS FOR SECTION 7 - MOTOR VEHICLE ACCIDENT

a. **TYPE OF VEHICLE** - Mark appropriate box for each vehicle involved. If more than one vehicle of the same type is involved, mark both halves of the appropriate box. USACE vehicle(s) involved shall be marked in left half of appropriate box.

b. TYPE OF COLLISION - Mark appropriate box.

c. SEAT BELT - Mark appropriate box.

INSTRUCTIONS FOR SECTION 8 - PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM - Describe all property involved in accident. Property/material involved means material which is damaged or whose use or misuse contributed to the accident. Include the name, type, model; also include the National Stock Number (NSN) whenever applicable.

b. OWNERSHIP - Enter ownership for each item listed. (*Enter one of the following: USACE; OTHER GOVERNMENT; CONTRACTOR; PRIVATE*)

c. \$ AMOUNT OF DAMAGE - Enter the total estimated dollar amount of damage (*parts and labor*), if any.

INSTRUCTIONS FOR SECTION 9 - VESSEL/FLOATING PLANT ACCIDENT

a. TYPE OF VESSEL/FLOATING PLANT - Select the most appropriate vessel/floating plant from list below. Enter name and place corresponding number in box. If item is not listed below, enter item number for "OTHER" and write in specific type of vessel floating plant.

VESSEL/FLOATING PLANTS

1. ROW BOAT
2. SAIL BOAT
3. MOTOR BOAT
4. BARGE
5. DREDGE/HOPPER
6. DREDGE/SIDE CASTING
7. DREDGE/DIPPER
8. DREDGE/CLAMSHELL, BUCKET
9. DREDGE/PIPE LINE
10. DREDGE/DUST PAN
11. TUG BOAT
12. OTHER

b. COLLISION/MISHAP - Select from the list below the object(s) that contributed to the accident or were damaged in the accident.

COLLISION/MISHAP

1. COLLISION W/OTHER VESSEL
2. UPPER GUIDE WALL
3. UPPER LOCK GATES
4. LOCK WALL
5. LOWER LOCK GATES
6. LOWER GUIDE WALL
7. HAULAGE UNIT
8. BREAKING TOW
9. TOW BREAKING UP
10. SWEEP DOWN ON DAM
11. BUOY/DOLPHIN/CELL
12. WHARF OR DOCK
13. OTHER

INSTRUCTIONS FOR SECTION 10 - ACCIDENT DESCRIPTION

DESCRIBE ACCIDENT - Fully describe the accident. Give the sequence of events that describe what happened leading up to and including the accident. Fully identify personnel and equipment involved and their role(s) in the accident. Ensure that relationships between personnel and equipment are clearly specified. Continue on blank sheets if necessary and attach to this report.

INSTRUCTIONS FOR SECTION 11 - CAUSAL FACTORS

a. Review thoroughly. Answer each question by marking the appropriate block. If any answer is yes, explain in item 13 below. Consider, as a minimum, the following:

- (1) **DESIGN** - Did inadequacies associated with the building or work site play a role? Would an improved design or layout of the equipment or facilities reduce the likelihood of similar accidents? Were the tools or other equipment designed and intended for the task at hand?
- (2) **INSPECTION/MAINTENANCE** - Did inadequately or improperly maintained equipment, tools, workplace, etc. create or worsen any hazards that contributed to the accident? Would better equipment, facility, work site or work activity inspections have helped avoid the accident?
- (3) **PERSON'S PHYSICAL CONDITION** - Do you feel that the accident would probably not have occurred if the employee was in "good" physical condition? If the person involved in the accident had been in better physical condition, would the accident have been less severe or avoided altogether? Was over exertion a factor?
- (4) **OPERATING PROCEDURES** - Did a lack of or inadequacy within established operating procedures contribute to the accident? Did any aspect of the procedures introduce any hazard to, or increase the risk associated with the work process? Would establishment or improvement of operating procedures reduce the likelihood of similar accidents?
- (5) **JOB PRACTICES** - Were any of the provisions of the Safety and Health Requirements Manual (*EM 385-1-1*) violated? Was the task being accomplished in a manner which was not in compliance with an established job hazard analysis or activity hazard analysis? Did any established job practice (*including EM 385-1-1*) fail to adequately address the task or work process? Would better job practices improve the safety of the task?
- (6) **HUMAN FACTORS** - Was the person under undue stress (*either internal or external to the job*)? Did the task tend toward overloading the capabilities of the person; i.e., did the job require tracking and reacting to many external inputs such as displays, alarms, or signals? Did the arrangement of the workplace tend to interfere with efficient task performance? Did the task require reach, strength, endurance, agility, etc., at or beyond the capabilities of the employee? Was the work environment ill-adapted to the person? Did the person need more training, experience, or practice in doing the task? Was the person inadequately rested to perform safely?
- (7) **ENVIRONMENTAL FACTORS** - Did any factors such as moisture, humidity, rain, snow, sleet, hail, ice, fog, cold, heat, sun, temperature changes, wind, tides, floods, currents, dust, mud, glare, pressure changes, lightning, etc., play a part in the accident?

- (8) **CHEMICAL AND PHYSICAL AGENT FACTORS** - Did exposure to chemical agents (*either single shift exposure or long-term exposure*) such as dusts, fibers (*asbestos, etc.*), silica, gases (*carbon monoxide, chlorine, etc.*), mists, steam, vapors, fumes, smoke, other particulates, liquid or dry chemicals that are corrosive, toxic, explosive or flammable, by products of combustion or physical agents such as noise, ionizing radiation, non-ionizing radiation (*UV radiation created during welding, etc.*) contribute to the accident/incident?
- (9) **OFFICE FACTORS** - Did the fact that the accident occurred in an office setting or to an office worker have a bearing on its cause? For example, office workers tend to have less experience and training in performing tasks such as lifting office furniture. Did physical hazards within the office environment contribute to the hazard?
- (10) **SUPPORT FACTORS** - Was the person using an improper tool for the job? Was inadequate time available or utilized to safely accomplish the task? Were less than adequate personnel resources (*in terms of employee skills, number of workers, and adequate supervision*) available to get the job done properly? Was funding available, utilized, and adequate to provide proper tools, equipment, personnel, site preparation, etc.?
- (11) **PERSONAL PROTECTIVE EQUIPMENT** - Did the person fail to use appropriate personal protective equipment (*gloves, eye protection, hard-toed shoes, respirator, etc.*) for the task or environment? Did protective equipment provided or worn fail to provide adequate protection from the hazard(s)? Did lack of or inadequate maintenance of protective gear contribute to the accident?
- (12) **DRUGS/ALCOHOL** - Is there any reason to believe the person's mental or physical capabilities, judgment, etc., were impaired or altered by the use of drugs or alcohol? Consider the effects of prescription medicine and over the counter medications as well as illicit drug use. Consider the effect of drug or alcohol induced "hangovers".
- b. **WRITTEN JOB/ACTIVITY HAZARD ANALYSIS** - Was a written Job/Activity Hazard Analysis completed for the task being performed at the time of the accident? Mark the appropriate box. If one was performed, attach a copy of the analysis to the report.

INSTRUCTIONS FOR SECTION 12 - TRAINING

- a. **WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?** - For the purpose of this section "trained" means the person has been provided the necessary information (*either formal and/or on-the-job (OJT) training*) to competently perform the activity/task in a safe and healthful manner.
- b. **TYPE OF TRAINING** - Mark the appropriate box that best indicates the type of training; (*classroom or on-the-job*) that the injured person received, before the accident happened.
- c. **DATE OF MOST RECENT TRAINING** - Enter YYYYMMDD of the last formal training completed that covered the activity task being performed at the time of the accident.

INSTRUCTIONS FOR SECTION 13 - CAUSES

- a. **DIRECT CAUSES** - The direct cause is that single factor, which most directly lead to the accident. See examples below.
- b. **INDIRECT CAUSES** - Indirect causes are those factors which contributed to but did not directly initiate the occurrence of the accident.

Examples for section 13:

- a. Employee was dismantling scaffold and fell 12 feet from unguarded opening.

Direct cause: failure to provide fall protection at elevation. Indirect causes: failure to enforce USACE safety requirements; improper training/motivation of employee (*possibility that employee was not knowledgeable of USACE fall protection requirements or was lax in his attitude towards safety*); failure to ensure provision of positive fall protection whenever elevated; failure to address fall protection during scaffold dismantling in phase hazard analysis.

- b. Private citizen had stopped his vehicle at intersection for red light when vehicle was struck in rear by USACE vehicle. (*Note: USACE vehicle was in proper/safe working condition*).

Direct cause: failure of USACE driver to maintain control of and stop USACE vehicle within safe distance.

Indirect cause: failure of employee to pay attention to driving (*defensive driving*).

INSTRUCTIONS FOR SECTION 14 - ACTION TO ELIMINATE CAUSE(s)

DESCRIPTION - Fully describe all the actions taken, anticipated, and recommended to eliminate the cause(s) and prevent reoccurrence of similar accidents/illnesses. Continue on blank sheets of paper if necessary to fully explain and attach to the completed report form.

INSTRUCTIONS FOR SECTION 15 - DATES FOR ACTION

- a. **BEGIN DATE** - Enter the date YYYYMMDD when the corrective action(s) identified in section 14 will begin.
- b. **COMPLETE DATE** - Enter the date YYYYMMDD when the corrective action(s) identified in section 14 will be completed.
- c. **DATE SIGNED** - Enter YYYYMMDD that the report was signed by the responsible supervisor.
- d.e.. **TITLE AND SIGNATURE** - Enter the title and signature of supervisor completing the accident report. For a GOVERNMENT employee accident/illness the immediate supervisor will complete and sign the report. For PUBLIC accidents the USACE Project Manager/Area Engineer responsible for the USACE property where the accident happened shall complete and sign the report. For CONTRACTOR accidents the Contractor's project manager shall complete and sign the report and provide to the USACE supervisor responsible for oversight of that contractor activity. This USACE supervisor shall also sign the report. Upon entering the information required in 15c., 15d., 15e., 15f. and 15g. below, the responsible USACE supervisor shall forward the report for management review as indicated in section 16.

f. **ORGANIZATION NAME** - For GOVERNMENT employee accidents enter the USACE organization name (*Division, Branch, Section, etc.*) of the injured employee. For PUBLIC accidents enter the USACE organization name for the person identified in block 15d. For CONTRACTOR accidents enter the USACE organization name for the USACE office responsible for providing contract administration oversight.

g. **OFFICE SYMBOL** - Enter the latest complete USACE Office Symbol for the USACE organization identified in block 15f.

INSTRUCTIONS FOR SECTION 16 - MANAGEMENT REVIEW (1st)

1ST REVIEW - Each USACE FOA shall determine who will provide 1st management review. The responsible USACE supervisor in section 15d. shall forward the completed report to the USACE office designated as the 1st Reviewer by the FOA. Upon receipt, the Chief of the Office shall review the completed report, mark the appropriate box, provide substantive comments, sign, date, and forward to the FOA Staff Chief (*2nd review*) for review and comment.

INSTRUCTIONS FOR SECTION 17 - MANAGEMENT REVIEW (2nd)

2ND REVIEW - The FOA Staff Chief (*i.e., FOA Chief of Construction, Operations, Engineering, Planning, etc.*) shall mark the appropriate box, review the completed report, provide substantive comments, sign, date, and return to the FOA Safety and Occupational Health Office.

INSTRUCTIONS FOR SECTION 18 - SAFETY AND OCCUPATIONAL HEALTH REVIEW

3RD REVIEW - The FOA Safety and Occupational Health Office shall review the completed report, mark the appropriate box, ensure that any inadequacies, discrepancies, etc. are rectified by the responsible supervisor and management reviewers, provide substantive comments, sign, date and forward to the FOA Commander for review, comment, and signature.

INSTRUCTION FOR SECTION 19 - COMMAND APPROVAL

4TH REVIEW - The FOA Commander shall (*to include the person designated Acting Commander in his absence*) review the completed report, comment if required, sign, date, and forward the report to the FOA Safety and Occupational Health Office. Signature authority shall not be delegated.



INCIDENT REPORT

Report Date	Report Prepared By	Incident Report Number
<p align="center"><u>INSTRUCTIONS:</u></p> <p align="center">All incidents (including those involving subcontractors under direct supervision of Tetra Tech personnel) must be documented on the IR Form.</p> <p align="center">Complete any additional parts to this form as indicated below for the type of incident selected.</p>		
TYPE OF INCIDENT (Check all that apply)	Additional Form(s) Required for this type of incident	
Near Miss (No losses, but could have resulted in injury, illness, or damage)	<input type="checkbox"/> Complete IR Form Only	
Injury or Illness	<input type="checkbox"/> Complete Form IR-A; Injury or Illness	
Property or Equipment Damage, Fire, Spill or Release	<input type="checkbox"/> Complete Form IR-B; Damage, Fire, Spill or Release	
Motor Vehicle	<input type="checkbox"/> Complete Form IR-C; Motor Vehicle	
INFORMATION ABOUT THE INCIDENT		
Name of Affected Employee		
Description of Incident (be sure to include human, technological, and/or organizational errors, if any)		
<hr/> <hr/> <hr/> <hr/> <hr/>		
<p>Note: If no employee was directly affected, enter the employee that witnessed the event or who would have been impacted. If the individual involved is a subcontractor directly supervised by a Tetra Tech employee, check below and enter the supervisor or project manager above.</p>		
Subcontractor <input type="checkbox"/>		
Date of Incident	Time of Incident	
	<div> <div>AM <input type="checkbox"/></div> <div>PM <input type="checkbox"/></div> <div>OR Cannot be determined <input type="checkbox"/></div> </div>	
Weather conditions at the time of the incident	Was there adequate lighting?	
	<div> <div>Yes <input type="checkbox"/></div> <div>No <input type="checkbox"/></div> </div>	
Location of Incident		
<div> <div></div> <div>Was location of incident within the employer's work environment? Yes <input type="checkbox"/> No <input type="checkbox"/></div> </div>		
Street Address	City, State, Zip Code and Country	
Operating Unit	Office Location	
Project Name / Project#	Client	
Tt Supervisor or Project Manager	Was supervisor on the scene?	
	<div> <div>Yes <input type="checkbox"/></div> <div>No <input type="checkbox"/></div> </div>	

INCIDENT REPORT

WITNESS INFORMATION (attach additional sheets if necessary)				
Name		Company		
Street Address		City, State and Zip Code		
Telephone Number(s)				
RESPONSE ACTIONS				
Response action(s) immediately taken by unit reporting the incident:				
<hr/> <hr/> <hr/> <hr/> <hr/>				
NOTIFICATIONS				
Title				
Project Manager or Supervisor	Printed Name	Signature	Telephone Number	Date
Site Safety Coordinator or Office H&S Representative				
Operating Unit H&S Representative				
Other: _____				

The signatures provided above indicate that appropriate personnel have been notified of the incident.

INCIDENT FORM IR-A

INSTRUCTIONS:

Complete all sections below for incidents involving injury or illness.

Do NOT leave any blanks.

Attach this form to the IR FORM completed for this incident.

Incident Report Number: (From the IR Form)			
EMPLOYEE INFORMATION			
Company Affiliation			
Tetra Tech Employee? <input type="checkbox"/>		TetraTech subcontractor employee (directly supervised by Tt personnel)? <input type="checkbox"/>	
Full Name		Company (if not Tt employee)	
Street Address, City, State and Zip Code		Address Type	
_____		Home address (for Tt employees) <input type="checkbox"/>	
_____		Business address (for subcontractors) <input type="checkbox"/>	
Telephone Numbers			
Work: _____	Home: _____	Cell: _____	
Occupation (regular job title)		Department	
Was the individual performing regular job duties?		Time individual began work	
Yes <input type="checkbox"/> No <input type="checkbox"/>		_____ AM <input type="checkbox"/> PM <input type="checkbox"/> OR Cannot be determined <input type="checkbox"/>	
Safety equipment			
Provided? Yes <input type="checkbox"/> No <input type="checkbox"/> Used? Yes <input type="checkbox"/> No <input type="checkbox"/> If no, explain why _____ _____ _____		Type(s) provided: <input type="checkbox"/> Hard hat <input type="checkbox"/> Protective clothing <input type="checkbox"/> Gloves <input type="checkbox"/> High visibility vest <input type="checkbox"/> Eye protection <input type="checkbox"/> Fall protection <input type="checkbox"/> Safety shoes <input type="checkbox"/> Machine guarding <input type="checkbox"/> Respirator <input type="checkbox"/> Other (list) _____	
NOTIFICATIONS			
Name of Tt employee to whom the injury or illness was first reported		Was H&S notified within one hour of injury or illness?	
		Yes <input type="checkbox"/> No <input type="checkbox"/>	
Date of report		H&S Personnel Notified	
Time of report		Time of Report	
If subcontractor injury, did subcontractor's firm perform their own incident investigation?			
Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, request a copy of their completed investigation form/report and attach it to this report.			

INCIDENT FORM IR-A

INJURY / ILLNESS DETAILS

What was the individual doing just before the incident occurred? Describe the activity as well as the tools, equipment, or material the individual was using. Be specific. Examples: "Climbing a ladder while carrying roofing materials"; "Spraying chlorine from a hand sprayer"; "Daily computer key-entry"

What Happened? Describe how the injury occurred. Examples: "When ladder slipped on wet floor and worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; Worker developed soreness in wrist over time"

Describe the object or substance that directly harmed the individual: Examples: "Concrete floor"; "Chlorine"; "Radial Arm Saw". If this question does not apply to the incident, write "Not Applicable".

MEDICAL CARE PROVIDED

Was first aid provided at the site: Yes ☐ No ☐ If yes, describe the type of first aid administered and by whom?

Was treatment provided away from the site: Yes ☐ No ☐ If yes, provide the information below.

Name of physician or health care professional	Facility Name
<hr/>	<hr/>
Street Address, City State and Zip Code	Type of Care?
<hr/>	Was individual treated in emergency room? Yes <input type="checkbox"/> No <input type="checkbox"/>
<hr/>	Was individual hospitalized overnight as an in-patient? Yes <input type="checkbox"/> No <input type="checkbox"/>
<hr/>	Did the individual die? Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, date: <hr/>
Telephone Number	Did Ambulance respond? Yes <input type="checkbox"/> No <input type="checkbox"/>
<hr/>	Will a worker's compensation claim be filed? Yes <input type="checkbox"/> No <input type="checkbox"/>

NOTE: Attach any police reports or related diagrams to this report.

SIGNATURES

I have reviewed this report and agree that all the supplied information is accurate

Affected individual (print)	Affected individual (signature)	Telephone Number	Date
<hr/>	<hr/>	<hr/>	<hr/>

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

INCIDENT FORM IR-B

INSTRUCTIONS:

Complete all sections below for incidents involving property/equipment damage, fire, spill or release.

Do NOT leave any blanks.

Attach this form to the IR FORM completed for this incident.

Incident Report Number: (From the IR Form)							
TYPE OF INCIDENT (Check all that apply)							
Property Damage <input type="checkbox"/>		Equipment Damage <input type="checkbox"/>		Fire or Explosion <input type="checkbox"/>		Spill or Release <input type="checkbox"/>	
INCIDENT DETAILS							
Results of Incident: Fully describe damages, losses, etc.							
<div></div> <div></div> <div></div>							
Response Actions Taken:							
<div></div> <div></div> <div></div>							
Responding Agency(s) (i.e. police, fire department, etc.)				Agency(s) Contact Name(s)			
DAMAGED ITEMS (List all damaged items, extent of damage and estimated repair cost)							
Item:		Extent of damage:			Estimated repair cost		
SPILLS / RELEASES (Provide information for spilled/released materials)							
Substance		Estimated quantity and duration		Specify Reportable Quantity (RQ)			
				<div></div> Exceeded? Yes <input type="checkbox"/> No <input type="checkbox"/> NA <input type="checkbox"/>			
FIRES / EXPLOSIONS (Provide information related to fires/explosions)							
Fire fighting equipment used? Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, type of equipment: <div></div>							
NOTIFICATIONS							
Required notifications		Name of person notified		By whom		Date / Time	
Client: <div></div> Yes <input type="checkbox"/> No <input type="checkbox"/>							
Agency: <div></div> Yes <input type="checkbox"/> No <input type="checkbox"/>							
Other: <div></div> Yes <input type="checkbox"/> No <input type="checkbox"/>							
Who is responsible for reporting incident to outside agency(s)? Tt <input type="checkbox"/> Client <input type="checkbox"/> Other <input type="checkbox"/> Name: <div></div>							
Was an additional written report on this incident generated? Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, place in project file.							

INCIDENT FORM IR-C

INSTRUCTIONS:

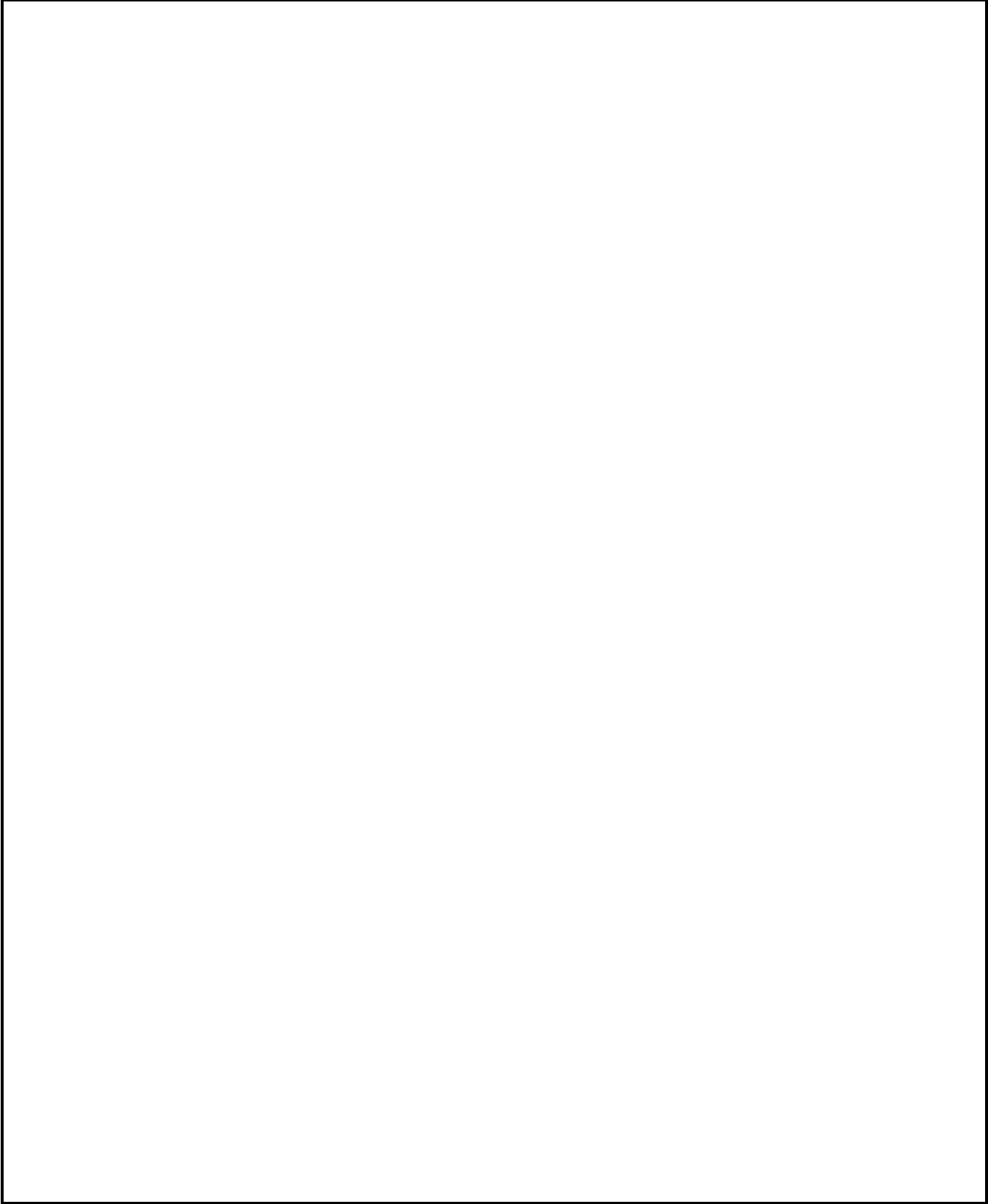
Complete all sections below for incidents involving motor vehicle accidents. Do NOT leave any blanks.
Attach this form to the IR FORM completed for this incident.

Incident Report Number: (From the IR Form)							
INCIDENT DETAILS							
Name of road, street, highway or location where accident occurred				Name of intersecting road, street or highway if applicable			
County		City			State		
Did police respond to the accident?				Did ambulance respond to the accident?			
Yes <input type="checkbox"/> No <input type="checkbox"/>				Yes <input type="checkbox"/> No <input type="checkbox"/>			
Name and location of responding police department				Ambulance company name and location			
Officer's name/badge #							
Did police complete an incident report? Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, police report number: _____ Request a copy of completed investigation report and attach to this form.							
VEHICLE INFORMATION							
How many vehicles were involved in the accident? _____ (Attach additional sheets as applicable for accidents involving more than 2 vehicles.)							
Vehicle Number 1 – Tetra Tech Vehicle				Vehicle Number 2 – Other Vehicle			
Vehicle Owner / Contact Information				Vehicle Owner / Contact Information			
Color				Color			
Make				Make			
Model				Model			
Year				Year			
License Plate #				License Plate #			
Identification #				Identification #			
Describe damage to vehicle number 1				Describe damage to vehicle number 2			
Insurance Company Name and Address				Insurance Company Name and Address			
Agent Name				Agent Name			
Agent Phone No.				Agent Phone No.			
Policy Number				Policy Number			

INCIDENT FORM IR-C

DRIVER INFORMATION									
Vehicle Number 1 – Tetra Tech Vehicle					Vehicle Number 2 – Other Vehicle				
Driver's Name					Driver's Name				
Driver's Address					Driver's Address				
Phone Number					Phone Number				
Date of Birth					Date of Birth				
Driver's License #					Driver's License #				
Licensing State					Licensing State				
Gender		Male <input type="checkbox"/> Female <input type="checkbox"/>			Gender		Male <input type="checkbox"/> Female <input type="checkbox"/>		
Was traffic citation issued to Tetra Tech driver? Yes <input type="checkbox"/> No <input type="checkbox"/>					Was traffic citation issued to driver of other vehicle? Yes <input type="checkbox"/> No <input type="checkbox"/>				
Citation #					Citation #				
Citation Description					Citation Description				
PASSENGERS IN VEHICLES (NON-INJURED)									
<p align="center">List all non-injured passengers (excluding driver) in each vehicle. Driver information is captured in the preceding section. Information related to persons injured in the accident (non-Tt employees) is captured in the section below on this form. Injured Tt employee information is captured on FORM IR-A</p>									
Vehicle Number 1 – Tetra Tech Vehicle					Vehicle Number 2 – Other Vehicle				
How many passengers (excluding driver) in the vehicle? _____					How many passengers (excluding driver) in the vehicle? _____				
Non-Injured Passenger Name and Address					Non-Injured Passenger Name and Address				
Non-Injured Passenger Name and Address					Non-Injured Passenger Name and Address				
Non-Injured Passenger Name and Address					Non-Injured Passenger Name and Address				
INJURIES TO NON-TETRATECH EMPLOYEES									
Name of injured person 1					Address of injured person 1				
Age	Gender	Car No.	Location in Car	Seat Belt Used?	Ejected from car?	Injury or Fatality?			
	Male <input type="checkbox"/> Female <input type="checkbox"/>			Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>	Injured <input type="checkbox"/> Died <input type="checkbox"/>			
Name of injured person 2					Address of injured person 2				
Age	Gender	Car No.	Location in Car	Seat Belt Used?	Ejected from car?	Injury or Fatality?			
	Male <input type="checkbox"/> Female <input type="checkbox"/>			Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>	Injured <input type="checkbox"/> Died <input type="checkbox"/>			
OTHER PROPERTY DAMAGE									
Describe damage to property other than motor vehicles									
Property Owner's Name					Property Owner's Address				

COMPLETE AND SUBMIT DIAGRAM DEPICTING WHAT HAPPENED

A large, empty rectangular box with a black border, intended for a diagram. It occupies the majority of the page below the header.

USACE PRIME CONTRACTOR
Monthly Record of Work-Related Injuries/Illnesses & Exposure

US Army Corps of Engineers



Month _____
Year _____

In accordance with the provisions of EM 385-1-1, Section 01 Program Management, Paragraph 01.D Accident Reporting and Recording, sub-paragraphs 01.D.05, you (the Prime Contractor) shall provide a monthly record of all exposure and accident experience incidental to the work (this includes exposure and accident experience of the Prime Contractor and its sub-contractor(s)). As a minimum , these records shall include exposure work hours and a record of occupational injuries and illnesses that include the data elements listed below. Definitional criteria for each data element is found in 29 CFR Part 1904. If the maintenance of OSHA 300 Logs are required by OSHA, most of this information can be obtained from those logs. If data on log provided below is revised after it is submitted to USACE, Contractor shall provide a revised report to the GDA. You must complete the USACE ENG Form 3394, Report of Accident Investigation Report for all recordable accidents. If you're not sure whether a case is recordable, call your local Safety and Occupational Health Office for help.

USACE Command	
Contractor Name	
Contract Number	
Project Title	
City	State
USACE Office Overseeing Work	

Identify the person						Describe The Case		Classify the case																					
(A)	(B1)	(B2)	(B3)	(C)	(D)	(E)	(F)	Using these categories, check ONLY the most serious result for each case:				Enter the number of days the injured or ill worker was:		Check the "injury" column or choose one type of illness:															
Company Name	Prime or Sub (P or S)	Age	Gender	Date Employee Began Work on Job Covered by Contract	Job Title (e.g., Welder)	Date of injury or onset of illness (mo./day)	Where the event occurred (e.g. Loading dock north end)													Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g. Second degree burns on right forearm from acetylene torch)									
								Death		Days away from work		Remained at work		On job transfer or restriction (days)		Away from work (days)		(M)											
										Job transfer or restriction		Other recordable cases						Injury		Skin Disorder		Respiratory Condition		Poisoning		Hearing Loss		All other illnesses	
								(G)	(H)	(I)		(J)		(K)		(L)		(1)	(2)	(3)		(4)	(5)	(6)					

USACE Summary of Contractor Work-Related Injuries and Illnesses



Month Submitted _____

Year _____

US Army Corps of Engineers

Review the Record to verify that the entries are complete & accurate before completing this summary. Using the Record, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the record. If you had no cases write "0". This summary is a cumulative record of the injury/illness experience for the year.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
------------------------	--	--	--

0

(G)

0

(H)

0

(I)

0

(J)

Number of Days

Total days of job transfer or restriction

Total days away from work

0

(K)

0

(L)

Injury and Illness Types

Total number of...

(M)

(1) Injury

0

(4) Poisoning

0

(2) Skin Disorder

0

(5) Hearing Loss

0

(3) Respiratory Condition

0

(6) All other illnesses

0

Establishment information

Establishment name

Street

City

State

Zip

Industry description (e.g., Manufacture of motor truck trailers)

Standard Industrial Classification (SIC), if known (e.g., SIC 3715)

or

North American Industrial Classification (NAICS) if known (e.g. 336212)

Employment information

Annual average number of employees

Total hours worked by all employees last year

This page was intentionally left blank.

APPENDIX C – TANAQ ENVIRONMENTAL HEALTH AND SAFETY PROGRAM

This page was intentionally left blank

**HELIOS RESOURCES, LTD (HEL)
TANAQ ENVIRONMENTAL, LLC (TEL)**

**ENVIRONMENT, HEALTH, AND SAFETY
PROGRAM**

May 2020

REVISION 00



TABLE OF CONTENTS

1.0	<i>Philosophy and Policy</i>	<i>1</i>
2.0	<i>Roles and Responsibilities</i>	<i>1</i>
3.0	<i>Training and Qualifications.....</i>	<i>2</i>
4.0	<i>Hazard Communications.....</i>	<i>2</i>
5.0	<i>Personal Protective Equipment.....</i>	<i>3</i>
6.0	<i>Respiratory Protection</i>	<i>5</i>
7.0	<i>Noise Protection and Hearing Conservation.....</i>	<i>9</i>
8.0	<i>Emergency Response Plan.....</i>	<i>9</i>
9.0	<i>Hazardous Waste Site Operations</i>	<i>16</i>
10.0	<i>Review and Approval</i>	<i>18</i>

1.0 Philosophy and Policy

This environment, health, and safety (EHS) program provides the framework for the environmental business lines of Chadux Management Services, consisting of Helios Resources, Ltd. (HEL) and Tanaq Environmental, LLC (TEL), together henceforth known as HEL/TEL, for the work performed by HEL/TEL employees and subcontractors to be performed safely and in full compliance with applicable regulations and standards.

It is HEL/TEL's EHS policy to perform our work safely, and in an environmentally conscientious manner regardless of the importance or urgency of the project. HEL/TEL implements health and safety practices and creates work environments that enable our personnel to work injury and illness free. We continuously:

- Assure managers and employees are trained and accountable for preventing work-related injuries and illnesses.
- Provide a safe and healthy work environment for all employees in all aspects of their work.
- Develop safety awareness among employees engaged in work so that accidents (personal injuries and property damage) and occupational illnesses will be reduced to a minimum, and take an active role in improving the program.
- Comply with all applicable regulatory requirements, and implement programs and processes to achieve greater worker protection.

Where applicable, HEL/TEL personnel and subcontractors will comply with Occupational Safety and Health Act of 1970, Public Law 91-596, and the Environmental, Safety, and Occupational Health (ESOH) (DODD 4715.1E).

2.0 Roles and Responsibilities

The HEL/TEL safety and health manager (SHM) is responsible for verifying that the EHS program is implemented during all work activities. Each project shall have a site safety and health officer (SSHO) who will be responsible for safe work practices on specific projects. Each employee is responsible for administering and adhering to the EHS program.

Personnel shall work together to ensure consistent safe work practices are followed on all projects. Project team members will follow the safe work practices established for each project and as administered by the on-site safety coordinator.

All subcontractors conducting work for HEL/TEL shall adhere to recognized health and safety practices for their industry or trade and take safety precautions consistent with work in industrial, chemical, or manufacturing facilities where hazardous substances may be encountered.

3.0 Training and Qualifications

HEL/TEL new hires who will participate in field activities, will be required to meet and maintain training requirements outlined in Title 29 of the Code of Federal Regulations (CFR) Part 1910.120, “Hazardous Waste Operations and Emergency Response.” Training requirements, at a minimum, include the following:

- 40-hour HAZWOPER Certification Course
- 8-hour HAZWOPER Refresher Course, if applicable
- First Aid and cardiopulmonary resuscitation (CPR)/ automated external defibrillator (AED) training
- Blood-borne pathogens
- Activity Hazard Analysis AHA Training
- Training in proper use of personal protective equipment (PPE)
- Fire extinguisher awareness
- Hazard Communication

All personnel involved with field personnel must satisfy any specialized training requirements that are required in the project-specific planning and safety documents. HEL/TEL personnel are required to update training, if necessary, via classes held at individual office locations or on-line training. All on-line classes shall be Occupational Safety and Health Administration (OSHA) approved. HEL/TEL will reimburse the personnel for all required and pre-approved trainings.

4.0 Hazard Communications

This section discusses the elements of the hazard communication program, which includes hazard determination, hazardous chemical inventory, labeling and containers, Material Safety Data Sheets (MSDS) and/or Safety Data Sheets (SDS), and employee training. The hazard communication program defines the measures to communicate these hazards and ensure that employees and subcontractors are informed of chemical and physical hazards of materials they use in their work in accordance with the requirements outlined in 29 CFR 1910.1200. The OSHA standard applies to all work places where personnel are occupationally exposed to hazardous chemicals. The hazard communication program does not apply to hazardous wastes but does apply to all hazardous materials, such as acids and caustics, used in sample preparation and to cleaning solvents brought onto and used at a work site.

In most cases, the determination of chemical hazards will be based on information provided by the chemical’s manufacturer. When any material or chemical is brought onto a job site, a MSDS/SDS will be provided to the SSHO. The SSHO will review the MSDS/SDS with the workers using the material and will be documented and placed in project-specific files. All workers will have general hazard communication training that

specifically requires workers to notify the SSHO when any new material is brought on to the job site, and how the hazard communication program is managed on the site. All containers brought on to the job site will be labeled as to content and hazards of the material in the container. For those cases where further determination of the chemical hazard is warranted, area and/or personal air monitoring will be performed per the local project- or site-specific safety and health plan (SSHP).

The SSHO or project manager will develop and maintain a current list of hazardous materials brought onto each job site. The list will typically be kept within the SSHP. Before a chemical is brought on to the site, the SSHO or site manager shall verify that the container is properly labeled with the product identifier, name, address, and telephone number of the manufacturer, signal word, hazard statement(s), pictogram(s), and precautionary statement(s) (as listed on the MSDS/SDS), per Appendix C of 29 CFR 1910.1200. The manufacturer, importer, or distributor is required to label each container of hazardous chemicals. All original labels, warnings, and other printed information must be maintained intact and plainly visible at all times. If a hazardous chemical is transferred into an unmarked container, the container must be labeled with the required information. However, container labeling is not required if the container into which the chemical is transferred is intended for the immediate use by the employee who performed the transfer.

Employees will be trained upon assignment to a job involving the use of hazardous materials and when a new material that poses new physical or health hazards is introduced. The project manager or SSHO will provide information and training to each project personnel. Training will be conducted by categories of hazard (such as carcinogens, sensitizers, acutely toxic agents) that are or may be encountered by an employee during the project tasks.

The site manager or SSHP will inform subcontractors of the hazardous materials labeling system used on the job site. Copies of MSDS/SDS for chemicals they may be exposed to while working on site will be available for subcontractors. Subcontractors will be informed of any precautionary measures that need to be taken to protect them if they are using hazardous materials brought on site.

5.0 Personal Protective Equipment

The levels of personal protection to be used for work tasks will be selected based on known or anticipated physical or health hazards; types and concentrations of chemical contaminants that may be encountered on site; and contaminant properties, toxicity, exposure routes, and matrices. The SSHO will maintain PPE in the site support zone and ensure that all field personnel have the appropriate PPE to complete project tasks.

At a minimum, it is HEL/TEL EHS policy that all CSM personnel and their contractors on any project site shall wear the following at all times:

- Long pants of a durable material (denim or similar) that are free of holes or other wear and tear
- Shirt with sleeves of a minimum of 3 inches in length that is free of holes or other wear and tear
- High-visibility shirt or vest
- Sturdy, ankle-height (or higher) boots with steel or safety-toe protection

Personnel will wear additional PPE when (1) site activities involve known or suspected atmospheric contamination; (2) site activities may generate vapors, gases, or particulates; (3) direct contact with hazardous materials may occur, or (4) physical hazards such as noise, flying projectiles, dropped objects, or others may be encountered. Based on the anticipated hazard level, personnel will initially perform field tasks in Level D protection. The SSHO is responsible for deciding which PPE are necessary to complete the project-specific tasks. If site conditions or the results of air monitoring performed during on-site activities warrant a higher level of protection, all field personnel will withdraw from the site, immediately notify the SSHO, and wait for further instructions. Examples of PPE that may be required for Level D protection include the following:

- Coveralls or other durable work clothes
- Hard hats, when working around overhead hazards
- Hearing protection (e.g., plugs or muffs), with a minimum Noise Reduction Rating of 29 decibels
- Reflective vest
- Disposal and/or chemical-resistant coveralls
- Disposable chemical-protectant gloves (e.g. nitrile)
- Splash-protection goggles or faceshields
- Disposable boot covers or chemical-resistant outer boots
- Impact-resistant safety glasses with side shields with ANSI rating of Z87.1 or better

For each field project, PPE will be initially selected based on the nature of planned activities and in recognition of potential hazards that may be encountered while performing those planned activities (i.e., for hazards which cannot be prevented or controlled through engineering or administrative controls) and will be documented in the SSHP. Once the project and tasks have been initiated, PPE levels may be upgraded or downgraded based on a change in site conditions or on investigation findings that could influence types or degrees of hazards, in compliance with the requirements of the SSHP.

When a significant change in site conditions occurs, hazards will be reassessed by the SSHO and the project manager. Reassessment may be required if (1) a new work phase

is started, (2) there is a change in weather (temperature extremes can effect PPE selections), (3) contaminants or hazards are discovered that were not previously identified, (4) a change in ambient levels of airborne contaminants or hazards are identified, or (5) a change in work scope affects the degree of contact with contaminated media.

If any worker in the exclusion zone experiences a failure of protective equipment that affects their personal protection, the worker and all coworkers will immediately Stop Work and leave the exclusion zone. Re-entry to the exclusion zone, which can only be approved by the SSHO, will not be permitted until (1) the protective equipment has been repaired or replaced, (2) the cause of the equipment failure has been determined, and (3) the equipment failure is no longer considered to be a threat.

No protective garment, glove, or boot is entirely chemical-resistant, nor does any protective clothing provide protection against all types of chemicals. Permeation of a given chemical through PPE depends on the physical properties of the contaminant, contaminant concentration, environmental conditions, physical condition of the protective garment, and resistance of the garment to the specific contaminant. Chemical permeation may continue even after the source of contamination has been removed from the garment.

Field personnel will be required to perform PPE inspections prior to, during, and after use. When chemical-protective coveralls become contaminated, field personnel will don a new, clean garment after each rest break or at the beginning of each shift. They will inspect reusable garments, boots, and gloves for visible signs of chemical permeation. Reusable gloves, boots, or coveralls exhibiting any of the characteristics ineffectiveness will be discarded. Reusable PPE will be decontaminated in accordance with the decontamination procedures that are set forth in the SSHP.

6.0 Respiratory Protection

Respirators and face masks are used to protect employees from inhaling hazardous chemicals or biological hazards in the air or to provide breathing air (such as in low oxygen atmospheres). Respirable hazards can include the presence of airborne chemicals in the form of gases, vapors, mists or dust, or oxygen-deficient atmospheres. Respirable hazards also include airborne bacteria or viruses. Respirators or face masks are typically used in three different situations: (1) routine or regular exposure to environments, processes or activities involving respiratory hazards, (2) infrequent, but predictable occasions where there is a respiratory hazard, or (3) emergencies.

It is HEL/TEL's intent to provide a safe and healthy work environment. Exposure to hazardous atmospheres will be reduced using engineering controls and appropriate work

practices whenever possible. If such controls are not possible, employees will wear appropriate respiratory protection. Respiratory protection is important because inhalation is the major route of exposure to hazardous materials.

If respiratory protection is required in the SSHP, the SSHO shall be responsible for ensuring that (1) only medically cleared employees wear respiratory protection, (2) all employees potentially exposed to hazardous materials wear National Institute for Occupational Safety and Health (NIOSH)-certified respirators and follow OSHA regulations for respiratory protection, and (3) the required respirator maintenance, storage, and inspection procedures are followed.

During the planning stages of the project, potential respiratory hazards in the workplace will be thoroughly identified, evaluated and assessed. Respiratory protection will be selected based on this evaluation and assessment of the nature and extent of hazardous conditions anticipated during field activities. This assessment shall include a reasonable estimate of employee exposure to respiratory hazards and an identification of the chemical state and physical form of contaminants or hazards potentially encountered.

The following parameters will be considered for the selection of proper respiratory protection:

- A task-specific hazard assessment, that includes an appropriate evaluation of potential worker exposures via inhalation;
- Nature of the hazardous materials or atmospheres that may be encountered;
- Characteristics of the hazardous operation, process, or work area, including temperature extremes;
- Location of the hazardous area in relation to an area with respirable air;
- Employee conditioning and workload;
- Period of time respiratory protection may be required;
- Worker activities in the hazardous area;
- Other PPE in use;
- Physical characteristics, capabilities, and limitations of the various types of respirators;
- Respiratory protection factors to determine the maximum use limit of a particular respirator.

If a contaminant or exposure estimate cannot be reasonably identified after the initial hazard assessment, the atmosphere shall be considered immediately dangerous to life and health (IDLH). Respirators used in IDLH environments will be supplied air respirators (SAR). If a self-contained breathing apparatus (SCBA) is used, it will be provided with a minimum 30-minute service life. If an airline system is used, it will have an auxiliary self-contained 5-minute air supply.

When potential contaminants to be encountered are identifiable gases or vapors and the concentrations are known or can be reasonably estimated, respiratory protection shall include a SAR or an air purifying respirator. The air purifying respirator will be equipped with a NIOSH-certified end of service life indicator for the identified contaminant. Alternately, a change schedule for cartridges and canisters must be developed.

For protection against particulate contaminants, approved respirators include (1) a SAR, (2) a respirator equipped with a filter certified by NIOSH under 42 CFR Part 84 as a high-efficiency particulate air (HEPA) filter designated by N100, R100, or P100; or (3) an air purifying respirator equipped with any certified NIOSH filter for particles with mass median aerodynamic diameter of at least 2 micrometers.

The SSHP will determine the filter selection and respirator cartridge change out schedule. Prior to respirator use in the workplace, all personnel required to wear respirators will receive effective respirator training as a single-subject course or included during the initial 40-hour or 8-hour refresher training. Training will be conducted prior to project work where site-specific respiratory requirements were not included in the original training. If changes in the workplace or type of respirator render previous training obsolete, respirator retraining shall be conducted.

HEL/TEL provides respirators to employees requiring respiratory protection. Respirators are provided based on the successful completion of a medical evaluation and qualitative or quantitative fit test, as appropriate. Each respirator user will be qualitatively or quantitatively fit-tested in accordance with procedures specified in 29 CFR Part 1910.134, Appendix A. Fit testing of field personnel will be conducted prior to field work requiring respiratory protection, and the respirator fit test record shall be maintained by the SHM.

Respirators will be inspected by employees before and after each use by checking the tightness of connections and condition of the facepiece, headbands, valves, connecting tubes, and canisters and by checking all rubber and elastomeric parts for pliability and signs of deterioration. Respirators will be cleaned and sanitized per the manufacturer's instructions after each use to ensure that the respirators are maintained at their original level of effectiveness. Cleaning and sanitizing agents will be specified by the respirator manufacturer. Respirator cleaning procedures will be conducted in accordance with 29 CFR Part 1910.134, Appendix B-2.

Inspected and cleaned respirators will be stored in areas free of dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. The respirators shall be stored in a manner to prevent deformation of the facepiece and exhalation valve. All manufacturer storage instructions will be followed.

Breathing air and supply systems, if selected, shall provide Type 1 Grade D breathing air described in ANSI/Compressed Gas Association Commodity Specification for Air, G- 7.1-

1989. The project manager or SSHO shall retain a certificate of analysis from the supplier of purchased cylinders of supplied breathing air that indicates the breathing air has been tested within the previous 6 months and meets the ANSI specifications. The compressor for supplied breathing air shall be equipped with the necessary safety and standby devices. Compressors shall be constructed and situated to prevent entry of contaminated air into the system, and suitable in-line air purifying sorbent beds and filters must be installed to further ensure breathing air quality. The compressor shall have a tag containing information including the most recent filter and sorbent change date and signature of the person performing the service.

7.0 Noise Protection and Hearing Conservation

Noise levels in excess of 85 dBA (decibels on the A-weighted scale) for extended periods can result in temporary and permanent hearing. The permissible exposure limit (PEL) for noise is 90 dBA, while the 8-hour, TWA sound level of 85 dBA is the OSHA Action Level. Historical noise monitoring data collected during work using heavy equipment have shown noise levels can exceed these regulatory limits. As a result, hearing protection devices will be used, as appropriate, for field activities conducted in the field.

Noise monitoring in the field will be conducted using either a sound level meter or the general rule of “employees should be able to speak to someone at arm’s length distance without having to raise their voice”. Noise hazards, such as heavy equipment, drilling rig, or truck traffic are considered a physical hazard, and hearing protection, with a minimum noise reduction rating of 29 decibels, will be required by personnel when working around a rotary drill rig or other loud noises.

8.0 Emergency Response Plan

HEL/TEL personnel will conduct a practice exercise for the elements of the emergency response plan prior to beginning the site field activities. During the pre-work briefing and daily tailgate safety meetings, all on-site personnel will be trained in and reminded of the provisions of personal protection requirements, site communication systems, site evacuation routes and biological hazards. The emergency response provisions shall be revised, if necessary, to ensure they are adequate and consistent with prevailing site conditions.

Successful communication between field teams and personnel in the support zone is essential. A communication system will be available on all job sites and will be used to alert personnel of emergencies when hand signals are not practical. Cellular telephones are the acceptable mode of communications, unless otherwise specified in SSHPs. In addition, a project information board may be setup for all necessary project information for all field activities. The emergency contact information, which provides names and telephone numbers of emergency contact personnel, shall be posted on the project information board and readily available at all times. For small projects, the project information board may be contained to a clipboard, which is then placed on the dashboard of every vehicle used by the workers. The SSHO will be responsible for maintaining the project information board and will use professional judgment to determine the size and location of the project information board.

Lines of Authority

The SSHO has primary responsibility for responding to and correcting emergency situations and for taking appropriate measures to ensure the safety of site personnel and the public. The SSHO is also responsible for ensuring that corrective measures have been implemented, appropriate authorities have been notified, and follow-up reports have been completed. As a courtesy to the local fire or emergency response department, and prior to site work, the SSHO shall contact the agencies to brief them on the type and duration of the activities that will be conducted. Individual subcontractors are required to cooperate with the SSHO, within the parameters of their scopes of work.

The SSHO will be notified of any on-site emergencies and is responsible for ensuring that the appropriate emergency procedures described in this section are followed. Personnel are required to report all injuries, illnesses, spills, fires, and property damage to the SSHO.

Pre-Emergency Planning

Before performing any site activities, HEL/TEL personnel shall conduct a pre-emergency hospital run to familiarize themselves with the route to the local hospital. A map showing the hospital route shall be posted on the project information board and available at all times.

In addition, the SSHO will establish safe egress routes from the job site to the evacuation assembly area and hold an emergency evacuation drill prior to the start of activities at each job site. The drill requires an evacuation of the site to an assembly area located upwind of the job site. At the assembly area, the SSHO will brief the crew on the route for the project and the route to the hospital. The project personnel shall evaluate and provide any recommendations during the briefing. If the project involves multiple job site locations, a separate drill shall be conducted for each site location.

Vehicle Safety

Hand-held cellular telephone usage and texting are not authorized while driving at any time during field activities. Vehicle operators and passengers are required to wear seat belts at all times while driving.

Evacuation Procedures

In the event of an emergency that necessitates evacuation of a work area or the site, the SSHO shall contact all nearby personnel using the on-site communications as discussed above to advise the personnel of the emergency. The personnel will proceed along site roads to a safe distance upwind from the hazard source. The personnel will remain in that area until the SSHO or an authorized individual provides further instructions. After all personnel have been located and evacuated, the SSHO shall contact the project manager, SHM, and client to inform them of the emergency and that personnel are leaving the site.

Emergency Medical Treatment Procedures

In the event of an emergency, site personnel will immediately notify 9-1-1 emergency services (call direct number if using a cell phone). First aid and CPR will be administered when necessary until an ambulance or paramedics arrive. All injuries and illnesses must be reported immediately to the project manager and SHM. As required by USACE Safety Manual EM 385-1-1 ([USACE 2008](#)), HEL/TEL will ensure that at least two site personnel are on-site at all times that have current certifications in First Aid, CPR/AED, and blood-borne pathogen training. Any person transported to a clinic or hospital for chemical exposure treatment will be accompanied by information on the chemical they have been exposed to at the site, if possible.

A person who becomes ill or injured during work tasks may require decontamination. If the illness or injury is minor, any decontamination necessary will be completed and first aid should be administered prior to patient transport. If the patient's condition is serious, partial decontamination will be completed (such as complete disrobing of the person and redressing in the person in clean coveralls or wrapping in a blanket). In the event of an emergency, personnel decontamination may be postponed but not bypassed.

Fire or Explosion

In the event of a fire or explosion on-site, the local fire department will be immediately summoned. The contact information of the local fire department should be provided in the SSHP. The SSHO or site manager will advise the fire department of the location and nature of any hazardous materials involved. Appropriate personal protection requirements will be implemented by site personnel.

Workers will not fight any fires other than incipient stage fires. At least one 20-pound dry chemical fire extinguisher shall be available at each job site where work is being performed. Fire extinguishers shall also be located in each piece of heavy equipment and in the crew vehicle. The fire extinguishers are intended only to fight fires that have recently occurred and can be extinguished immediately; in no case will workers attempt to fight any fire that cannot be extinguished within 30 to 60 seconds. The fire extinguishers contain only enough chemical for small fires.

If the fire is too large for employees and the fire department is called, all personnel in both the restricted and non-restricted areas will evacuate and assemble near the support zone, or other safe area, as identified by the SSHO. For efficient and safe site evacuation and assessment of the emergency situation, the SSHO will have the authority to initiate proper action if outside services are required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been given. The SSHO will ensure that access for emergency equipment is provided and that all equipment that may cause combustion has been shut down once the alarm has been

sounded. As soon as possible, and while the safety of all personnel is being confirmed, emergency agency notification will commence. The SSHO will brief site personnel each day as to the location of the evacuation assembly area.

Weather-Related Emergencies

Site work shall not be conducted during severe weather conditions, including high- speed winds or lightning. In the event of severe weather, field personnel will stop work, secure and lower all equipment (for example, drilling masts), and leave the site. Thermal stress caused by excessive heat or cold may occur as a result of extreme temperatures, workload, or the PPE used.

Heat Stress

There is a potential for heat stress and related injuries during work activities. Potential heat stress hazards include heat rash, heat cramps, fainting, heat exhaustion, heat stroke, and hyperthermia.

Sweating does not cool the body unless the sweat evaporates. Heat rash occurs because sweat is not evaporating, causing irritation and vesicular inflammation. Standing erect and immobile in the heat allows blood to pool in the lower extremities. As a result, blood does not return to the heart to be pumped back to the brain and fainting may occur. Heat cramps are painful spasms of the muscles due to excessive water and salt loss from profuse sweating. Similarly, heat exhaustion occurs due to the large fluid and salt loss from profuse sweating. Heat exhaustion is characterized by clammy and moist skin, nausea, dizziness, headaches, and low blood pressure.

Hyperthermia occurs when there is a rise in body core temperature above 99.6 degrees Fahrenheit (°F); heat stroke occurs when the body's temperature regulatory system has failed. Skin is hot, dry, red, and spotted. The affected person may be mentally confused, delirious, and convulsions may occur. A person exhibiting signs of heat stroke should be removed from the work area and moved to a shaded area immediately, soaked with water and fanned to promote evaporation. Medical attention must be obtained immediately.

Early symptoms of heat stress related problems include the following:

- Decline in task performance
- Lack of coordination
- Decline in alertness
- Unsteady walk
- Excessive fatigue
- Muscle cramps
- Dizziness

To avoid heat stress, the following steps, as necessary, will be implemented at the site:

- Adjust work schedules.
 - Modify work/rest schedules according to monitoring requirements.
 - Mandate work slowdowns as needed.
 - Perform work during cooler hours of the day, if possible, or at night if adequate lighting can be provided.
- Perform physiological monitoring.
- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.

Steps to maintain worker's body fluids at normal levels will be implemented. This is necessary to ensure the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat, e.g. 8 fluid ounces (0.23 liters) of water must be ingested for approximately every 8 ounces (0.23 kilograms) of weight loss. The normal thirst mechanism is not sensitive enough to ensure that enough water will be consumed to replace lost sweat. When heavy sweating occurs, workers will be encouraged to drink more. Cooling vests will be utilized when impermeable clothing is worn. The following strategies may be implemented when excessive temperatures are anticipated:

- Maintain water temperature at 50° to 60°F (10 to 16.6 degrees Celsius [°C])
- Provide small disposable cups that hold about 4 ounces (0.1 liter)
 - Have workers drink 16 ounces (0.5 liter) of fluid, preferably water or dilute drinks, before beginning work
 - Urge workers to drink a cup or two every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day are recommended, but more may be necessary based on body weight
- Train workers to recognize the symptoms of heat-related illnesses
- Rotate personnel and alternate job functions

Cold Stress

Cold stress may be of concern when field activities are scheduled to occur during the winter months. The most likely contributor to cold stress during the course of a project might be rain and wind. Exposure to low temperatures for extended periods presents a risk to employee safety and health. Wind increases the rate at which the body loses heat. Systemic cold exposure is referred to as hypothermia, and localized tissue damage from cold exposure is generally labeled frostbite. Recognition of the symptoms of cold-related illnesses will be discussed during the health and safety briefing conducted prior to the onset of site activities.

Hypothermia is a life-threatening condition in which the core body temperature falls below the Threshold Limit Value of 96.8°F. Hypothermia can occur at temperatures above freezing particularly when the skin or clothing becomes wet. During exposure to cold, maximum shivering occurs when the core temperature falls to 95°F. As hypothermia progresses, depression of the central nervous system becomes increasingly more severe. This accounts for the progressive signs and symptoms ranging from sluggishness

discharge, and the hazardous area will be isolated. Personnel shall stay on the upwind side of the spill or discharge. Entry into a confined space or low area where liquids or vapors may accumulate shall be avoided. Sources of ignition shall be eliminated if the spill or discharge involves combustible materials. Drains, manholes, waterways, sewers, and the like shall be identified and covered or protected. The spill shall be controlled or absorbed using appropriate media or devices. When the spill or discharge is fully contained and under control, spill or discharge material shall be collected and disposed of properly. Following cleanup, the spill area shall be evaluated by collecting soil samples and screening the area with air monitoring instruments.

Medical Surveillance

All HEL/TEL personnel involved in on-site activities participate in a health monitoring program as required by 29 CFR §1910.120(f). HEL/TEL uses a network of clinics and hospitals that are arranged by its Workers Compensation Insurance and medical provider, Workcare®, to provide timely and proper medical care for its employees. All personnel that participate in field activities will have a current medical certification to indicate fitness for duty and for wearing all required PPE; the SHM will maintain this certificate in the training records file. The exam must have been performed annually or biennially, depending on the decision of the corporate medical provider of the respective employers.

Medical surveillance shall occur annually and at the end of employment for all employees exposed to any particular hazardous substance at or above established exposure levels. In addition, medical surveillance shall occur for those who wear approved respirators for 30 days or more on site. Such surveillance also will be conducted if a worker is exposed by unexpected or emergency releases.

All subcontractors must have health monitoring programs conducted by their own clinics in compliance with 29 CFR §1910.120(f). Any visitor or observer at the site will be required to provide records in compliance with 29 CFR §1910.120(f) before entering the site.

Emergency Equipment and Facilities

The following emergency equipment will be available on all job sites where intrusive activities will occur:

- First aid kit
- Fire extinguisher
- Eye wash (portable) (ANSI-Z358.1-2009 compliant)

9.0 Hazardous Waste Site Operations

The requirements of this section apply to personnel and operations involved in investigation and remediation efforts associated with improperly disposed of hazardous, toxic, and/or radioactive wastes. Clean-up operations and corrective actions involving clean-up operations required by local, state, or federal agencies will be conducted according to these procedures. Voluntary (nonemergency) clean-up operations associated with classified hazardous wastes, which may have environmental impact or public exposure, fall within the scope of this standard. This section does not apply to activities involving the generation and collection of hazardous wastes which are being temporarily stored prior to proper disposal.

Each project shall have a site-specific work plan prepared that reflects the current status of site characterization/analysis and the proposed objectives and tasks to be conducted. The work plan shall designate a program manager who will have the responsibility and authority to direct all hazardous waste operations. The work plan shall identify the methods to accomplish the identified tasks and objectives, and will include characteristics such as location, size, boundaries, topography, accessibility, contaminant concentrations, and contaminant dispersion pathways for uncontrolled hazardous waste sites.

An SSHP, which is designed to identify, evaluate, and control safety and health hazards, and provide for emergency response, shall be prepared and available to all employees at the job site. The SSHP will include a risk assessment for each identified hazard and associated task in the work plan and specify the requirements and procedures necessary to protect personnel according to all applicable standards. The SSHP will indicate specific expectations for meeting the standards, including programs for inspection, training, medical evaluation, contaminant/exposure monitoring, site control, decontamination, PPE, emergency response, confined space entry, and spill containment requirements associated with site operations.

The SSHP shall include a hazard evaluation and control plan and a hazard communication plan. Hazard evaluation of the site and operations shall be conducted to identify the specific hazards and determine procedures appropriate for controlling exposure to those hazards. At a minimum, the site control plan will have a site map, site work zones, site communications, safe work practices and identification of the nearest medical assistance. Use of a "buddy system" as a protective measure is also required in particularly hazardous situations so that employees can keep watch on one another to provide quick aid if needed. Controls will be implemented prior to initiating site activities. In addition, personnel must be informed of all identified risks and work requirements before entry into a contaminated area and before starting hazardous activities. Safety briefings will be conducted at intervals necessary to ensure personnel are knowledgeable of the most current information and requirements of the SSHP.

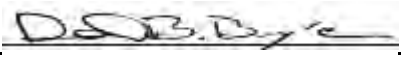
The work plan and SSHP shall identify engineering controls, work practices and PPE, or a combination of these methods that will be implemented to reduce exposure below established exposure levels for the hazardous substance involved. Decontamination procedures shall be implemented and performed before any employee or equipment may leave an area of potential hazardous exposure.

Training of employees will be required before they are allowed to engage in hazardous waste operations or emergency response that could expose them to safety and health hazards. Training requirements will vary with the type of operation involved.


Work at uncontrolled hazardous waste operations, as mandated by various levels of government, requires that workers have 40 hours of initial training before entering a site and at least three days of actual field experience under a trained, experienced supervisor. Employees visiting the site occasionally need only 24 hours of prior training and one day of supervised field experience. Managers and supervisors directly responsible for clean-up operations must have an additional 8 hours of specialized training in waste management. Annual refresher training of 8 hours is required for regular site workers and the managers.

10.0 Review and Approval

This document was developed to set and implement a standard for employee protection. The Health and Safety Plan was reviewed and approved of by the following:

Approved By: 
Donald Boyle, HEL/TEL General
Manager

Date: 5/11/2020

Approved By: 
Melaina Pierce
HEL/TEL Safety and Health Manager

Date: 5/11/2020

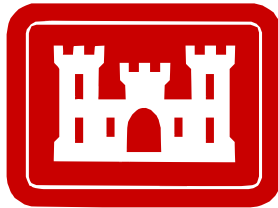
APPENDIX F: WASTE MANAGEMENT PLAN

This page was intentionally left blank.

WASTE MANAGEMENT PLAN, UPDATE 1
Florida Central Optimized Remediation Contract
at
Avon Park Air Force Range, Florida

December 2023 - Revision 0

Prepared for:



**U.S. Army Corps of Engineers
Mobile District
109 St. Joseph St. Mobile,
AL 36602-0001**

In Accordance With:

Contract No: W91278-21-D-0063
Delivery Order No: W9127821F0305

Prepared by:



**Tanaq Environmental, LLC
2480 West 26th Avenue, Suite B-26
Denver, CO 80211**

This page was intentionally left blank.

TABLE OF CONTENTS

Table of Contents.....	F-i
List of Attachments.....	F-iii
List of Acronyms.....	F-v
1.0 Purpose	F-1-1
2.0 General Requirements	F-2-1
3.0 Waste Sources.....	F-3-1
3.1 Water Level Gauging.....	F-3-1
3.2 Groundwater Sampling.....	F-3-1
3.3 Decontamination	F-3-1
4.0 Liquid Waste Containerization, Storage and Treatment	F-4-1
5.0 Labeling and Tracking	F-5-1
6.0 Waste Characterization, Management, Transport, and Disposal.....	F-6-1
7.0 Disposable Materials.....	F-7-1

This page was intentionally left blank.

LIST OF ATTACHMENTS

Attachment F.1 DoD Fact Sheet and the 11 July 2023 Memorandum: *Interim Guidance on Destruction or Disposal of Materials Containing Per- and Polyfluoroalkyl Substances in the United States*

Attachment F.2 Waste Management and Tracking Log

This page was intentionally left blank.

LIST OF ACRONYMS

AFFF	Aqueous Film Forming Foam
APAFR	Avon Park Air Force Range
CFR	Code of Federal Regulations
IDW	Investigation-Derived Waste
LTM	Long Term Management
ORC	Optimized Remediation Contract
PFAS	Per and Polyfluoroalkyl Substance
POC	Point of Contact
PPE	Personal Protective Equipment
ppt	Parts per trillion
RCRA	Resource Conservation and Recovery Act
SOP	Standard Operating Procedure
Tanaq	Tanaq Environmental, LLC
TSDF	Treatment, Storage, and Disposal Facility
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WMP	Waste Management Plan

This page was intentionally left blank.

1.0 PURPOSE

This Waste Management Plan (WMP) describes the procedures for the storage, management, and disposal of investigation-derived wastes (IDW) generated from the Florida Central Optimized Remediation Contract (ORC) at the Avon Park Air Force Range (APAFR) in Florida. Tanaq Environmental, LLC (Tanaq), is executing comprehensive environmental remediation fieldwork, including Long Term Management (LTM), for the U.S. Army Corps of Engineers (USACE), Mobile District under Contract Number: W91278-21-D-0063, Delivery Order Number: W9127821F0305.

The fieldwork consists of the following components that will generate IDW:

1. Water level gauging – Decontamination fluids from equipment used during groundwater gauging prior to each groundwater sampling event.
2. Groundwater sampling – Groundwater samples will be collected from existing wells and from newly installed wells during comprehensive LTM field activities.

The ORC fieldwork may generate a variety of wastes including, but not limited to, the following:

- Liquid wastes, which may contain either hazardous or nonhazardous wastes (for example, development water, purge water, and decontamination fluids).
- Disposable materials (for example, disposable personal protective equipment [PPE], disposable sampling equipment, general refuse, and trash generated by on-site personnel).

This WMP was prepared in accordance with applicable federal, state, and local regulations and is required reading for all site workers, whether employed by Tanaq, or subcontractors. The policies within this document are to be considered mandatory unless overridden by instruction from USACE Mobile District.

This page was intentionally left blank.

2.0 GENERAL REQUIREMENTS

All work will be performed in accordance with the approved Accident Prevention Plan/Site Safety and Health Plan for relevant health and safety requirements and the UFP-QAPP. Any deviations from requirements specified in this WMP will be justified to and authorized by the Tanaq Project Manager, the Tanaq Project Quality Assurance/Quality Control Officer, and the USACE Mobile District Project Manager. Deviations from requirements will be documented through written (electronic mail transmission or within a letter on letterhead) and within the Contractor's Progress, Status, and Management Reports.

Ongoing environmental investigation work being conducted at APAFR under a separate contract includes a study of groundwater contamination for Per- and Polyfluoroalkyl Substances (PFAS) at potential Aqueous Film Forming Foam (AFFF) release areas. Therefore, all waste management associated with this ORC will be performed in accordance with the National Defense Authorization Act (NDAA, 2022) Section 343 Moratorium on PFAS Incineration. IDW disposal will be conducted in accordance with the 11 July 2023 DoD Memorandum *"Interim Guidance on Destruction or Disposal of Materials Containing Per- and Polyfluoroalkyl Substances in the United States"* (Attachment F.1). No PFAS-containing IDW will be incinerated.

This page was intentionally left blank.

3.0 WASTE SOURCES

The ORC field activities include groundwater gauging and sampling. All field activities will be conducted in accordance with the Standard Operating Procedures (SOPs) provided in the UFP-QAPP. Several components of the ORC fieldwork will generate IDW as described below.

3.1 Water Level Gauging

Water levels will be measured in existing monitoring wells during the ORC fieldwork. The IDW generated during this activity will include liquid IDW from the decontamination of equipment, discarded PPE, and trash.

3.2 Groundwater Sampling

Annual groundwater sampling events will be conducted as part of the ORC field activities. The IDW generated during these activities will include purge water, disposable sampling equipment, equipment decontamination water, discarded PPE, and trash.

3.3 Decontamination

Decontamination for ORC activities will be limited to decontaminating hand-held equipment such as water level meters, flow-through cells, multimeters, and submersible pumps. Decontamination will consist of cleaning the hand-held equipment within five-gallon buckets with an Alconox/water solution and a final water rinse. Decontamination SOPs are included in the UFP-QAPP. Decontamination will generate liquid IDW, discarded PPE, and trash for management.

This page was intentionally left blank.

4.0 LIQUID WASTE CONTAINERIZATION, STORAGE AND TREATMENT

Liquid IDW will be containerized in a polymer 500-gallon tank or 55-gallon drums at APAFR and at the Civil Engineering yard at APAFR. All drums containing liquid IDW will be staged on polymer sheeting and/or pallets in an easily accessible area designated by the APAFR point of contact (POC). Sufficient space will be left between drums or other storage containers to allow labels to be clearly visible for identification and inspection. After staging, composite waste characterization samples will be collected for profiling and manifesting the liquid IDW as either non-hazardous or hazardous.

- Liquid IDW found to contain measurable concentrations of PFAS will be profiled, manifested, and disposed of at a Resource Conservation and Recovery Act (RCRA) Subtitle C Treatment, Storage and Disposal Facility (TSDF).
- Liquid IDW found to contain no measurable concentrations of PFAS will be further characterized for disposal, profiled, manifested, and transported off-site for disposal as non-hazardous waste.

Tanks or drums containing liquid IDW characterized as hazardous waste based on disposal characterization analysis will be stored at the designated staging location for no more than 90 days. Liquid IDW characterized as hazardous waste is not anticipated based on a review of historical contaminant concentrations. Non-hazardous IDW will be disposed of as soon as feasible based on the field schedule.

This page was intentionally left blank.

5.0 LABELING AND TRACKING

Containers used to store IDW must be properly labeled. Two general conditions exist as follows:

1. The IDW characteristics are unknown, and the waste is awaiting analytical results for characterization.
2. The IDW characteristics are known, and the waste is classified as either hazardous or non-hazardous based on analytical data. This is typically the case for the ORC sites at APAFR.

When characterization of IDW is unknown, a “pending analysis” label will be affixed to the containers and the following information will be included on the label:

- Site;
- Unique drum identification number;
- Description of IDW (decontamination liquids, purge water);
- Generator information (USACE POC name, address, and telephone number); and
- Date of generation.

Once the final waste characteristics are known, a label reading “Non-hazardous Waste” or “Hazardous Waste” will be placed on the waste container.

The following information shall be placed on all “Non-hazardous Waste” labels:

- Site;
- Unique drum identification number;
- Description of IDW (decontamination liquid, purge water);
- Generator information (USACE POC name, address, and telephone number); and
- Date of generation.

The following information shall be placed on all “Hazardous Waste” labels:

- Site;
- Unique drum identification number;
- Description of IDW (decontamination liquid, purge water);
- Generator information (USACE POC name, address, and telephone number);
- United States Environmental Protection Agency (USEPA) generator identification number (supplied by USACE POC); and
- Date of generation.

The IDW labels will be constructed of weatherproof material and filled out with a permanent marker to prevent being washed off or becoming faded by sunlight. The IDW labels will be placed on the side of the container since the top is more subject to weathering. However, the top of each drum shall be marked

with the unique drum identification number in the event the labels become compromised. Paint pens may also be used to supplement labels.

During field activities, a Waste Inventory Tracking Form will be maintained (Attachment F.2) to ensure IDW can be systematically tracked.

6.0 WASTE CHARACTERIZATION, MANAGEMENT, TRANSPORT, AND DISPOSAL

Liquid IDW will be characterized to determine if it is a RCRA hazardous waste. The waste may be characterized through knowledge of the process generating the waste, the analytical results of samples collected during the investigation, or laboratory analytical results from waste characterization sampling.

If IDW is determined to be a hazardous waste, the waste will be managed on site in accordance with the requirements of 40 Code of Federal Regulations (CFR) § 260/262, and equivalent state hazardous waste regulations. All IDW determined to be hazardous waste will be removed from the site within 90 days of generation for off-Base disposal.

Each off-Base shipment of IDW will be accompanied by a completed non-hazardous or hazardous waste manifest. Hazardous waste may only be shipped using a USEPA Uniform Hazardous Waste Manifest. An authorized USACE POC will sign all manifests as the generator. Tanaq will coordinate with USACE and USAF to arrange hazardous waste manifests to be signed at the time the hazardous waste is transported off-Base. Original manifests will be maintained at APAFR by USAF and copies of the manifests will be distributed to the project delivery team.

All wastes will be transported in accordance with 49 CFR § 172, 173, 178, and 179, and including all other applicable state and local regulations. Non-hazardous and hazardous waste will be shipped and transported only by properly licensed haulers in accordance with applicable state, local, and federal regulations. If IDW is characterized as non-hazardous waste, it will be disposed of off-site at a permitted RCRA Subtitle D TSDF. If IDW is characterized as hazardous waste or if the IDW contains measurable concentrations of PFAS, it will be disposed of at a permitted RCRA Subtitle C TSDF. No PFAS-containing IDW will be incinerated.

This page was intentionally left blank.

7.0 DISPOSABLE MATERIALS

Non-investigative waste, such as general refuse, will be collected on an as-needed basis to maintain the site in a clean and orderly manner. This waste will be containerized and transported to the designated sanitary landfill or collection bin. Acceptable containers will be sealed boxes or plastic garbage bags. Disposable materials such as PPE, disposable sampling equipment, aluminum foil, and paper towels will be placed and sealed in plastic trash bags for disposal with sanitary waste from the site.

This page was intentionally left blank.

ATTACHMENT F.1:
DOD FACT SHEET AND THE 11 JULY 2023 MEMORANDUM: INTERIM GUIDANCE
ON DESTRUCTION OR DISPOSAL OF MATERIALS CONTAINING PER- AND
POLYFLUOROALKYL SUBSTANCES IN THE UNITED STATES

This page was intentionally left blank.



DoD PFAS Disposal, Cleanup, and Environmental Justice



Why is DoD issuing interim Per- and Polyfluoroalkyl Substances (PFAS) Disposal Guidance?

DoD is issuing this PFAS interim guidance to help DoD make informed decisions in the evaluation of existing PFAS destruction and disposal options. This DoD guidance applies only to DoD and identifies the considerations the DoD Components will follow before disposing of PFAS-containing materials. It directs the DoD Components to dispose of, or destroy PFAS in the safest, most effective, and technologically sound manner. DoD worked closely with the U.S. Environmental Protection Agency (EPA) to incorporate the best currently available safeguards on disposal to ensure PFAS cleanup advances the Administration's priorities on the environment, public health, and environmental justice. This guidance is interim because it will be updated annually based on developing PFAS destruction and disposal technologies, monitoring the effectiveness and potential environmental effects of

all technologies, and collaborating Administration-wide on best practices.

DoD needs a comprehensive destruction and disposal PFAS strategy because of the large volumes of PFAS-containing materials it generates from its cleanup program, its replacement of certain firefighting foam that contains PFAS, and its current emergency use and spill response to releases of this PFAS-containing firefighting foam. This strategy needs to be comprehensive and include all available technologies that address PFAS destruction and disposal, to include incineration.

This guidance fulfills section 343 of the FY 2022 National Defense Authorization Act (NDAA), which prohibits the incineration of DoD PFAS materials until DoD issues guidance implementing 1) the December 2020 EPA Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances (hereinafter referred to as the EPA guidance), and 2) section 330 of the FY 2020 NDAA.



What does the DoD PFAS Disposal Guidance say?

The guidance directs the DoD Components to dispose of or destroy PFAS in the most protective, effective, and technologically-sound manner. The guidance complies with section 343 of the FY 2022 NDAA and is consistent with the EPA guidance.¹ DoD is committed to using and advancing the best available science and treatment technologies to treat, destroy, and dispose of PFAS and has identified disposal options with the most stringent controls where an environmental regulator has issued a permit for the facility.

In addition to these four DoD-wide options, the DoD Components will consider onsite hazardous waste storage on a site-specific basis, and may consider underground injection control, consistent with the DoD guidance. The DoD Components, upon notification to the Office of the Assistant Secretary of Defense for Energy, Installations, and Environment, may also consider, on a site-specific basis, other existing and developing PFAS treatment or destruction technologies that are approved/permitted by the appropriate State or Federal regulator, instead of utilizing hazardous waste incinerators.

DoD has identified the following four commercially available options to destroy or dispose of DoD PFAS-containing materials, in the order of consideration:

- Carbon reactivation units with environmental permits (for used granular activated carbon only).
- Hazardous waste landfills with environmental permits.
- Solid waste landfills with environmental permits that have composite liners, and gas and leachate collection and treatment systems.
- Hazardous waste incinerators with environmental permits.

¹Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances, Environmental Protection Agency, (Dec. 18, 2020, <https://www.epa.gov/pfas/interim-guidance-destroying-and-disposing-certain-pfas-and-pfas-containing-materials-are-not>).



How is DoD incorporating environmental justice principles when addressing PFAS?

DoD acknowledges that many of the communities surrounding our military installations are communities with environmental justice concerns and shares the Administration's commitment to addressing PFAS, safeguarding public health, and advancing environmental justice. Through this guidance, we address exposures to communities with environmental justice concerns (e.g., drinking water) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund). In addition, DoD actively seeks public participation in the CERCLA cleanup process, and additional public outreach and engagement (e.g., Restoration Advisory Boards) to ensure that the voices and lived experiences of communities with environmental justice concerns inform DoD's work. We also address impacts of PFAS releases and cleanup on communities with environmental justice concerns by supporting the Superfund Community Involvement Toolkit referenced in the EPA guidance.

We considered the potential impacts to communities that exist near landfills and hazardous waste incinerators where PFAS disposal and destruction could take place. Through this work, we found that a disproportionate number of landfills and other hazardous waste facilities,

such as incinerators, are located in communities with environmental justice concerns. DoD used EPA's Environmental Justice Screening and Mapping Tool ("EJScreen", <https://www.epa.gov/ejscreen>) to identify potential impact to communities living near PFAS destruction or disposal sites identified in this guidance, as well as communities surrounding our military installations where PFAS cleanups are ongoing and firefighting foam that contains PFAS will be replaced. DoD considered the relative risk between its top priority of addressing elevated levels of PFAS in drinking water from DoD activities versus indirect potential PFAS exposures from destruction and disposal facilities. In choosing among disposal options, DoD paid particular attention to the additional oversight and controls provided at disposal and destruction facilities with environmental permits to ensure the least exposure to communities.

DoD will explore new partnership opportunities with EPA and other Federal agencies to advance environmental justice in accordance with Executive Order 14096. DoD is committed to early and meaningful engagement with communities and will also continue to identify opportunities for engagement and provide updates on its PFAS cleanup progress. For additional information regarding OSD's current PFAS-related outreach efforts, see DoD's PFAS website and the "Public Outreach" page at <https://www.acq.osd.mil/eie/eer/ecc/pfas/po/index.html>.



What are the potential health effects from PFAS?

PFAS is found in everyday consumer items – from nonstick cookware to water-resistant clothing. PFAS is also found in essential use applications such as in microelectronics, batteries, and medical equipment. Reports indicate most people in the United States have been exposed to PFAS and have PFAS in their blood. Health monitoring studies show PFAS is most prominently detected in workers associated with manufacturing activities and in communities with elevated levels of PFAS in their drinking water. Current scientific research suggests that exposure

to high levels of certain PFAS may lead to adverse health outcomes such as reproductive effects (e.g., decreased fertility), immune effects, and increased risk of some cancers. The science on PFAS is evolving.² There is extensive research being done to determine where PFAS exist and what impact they have on human health and the environment.

Additional information regarding PFAS exposure can be found on the EPA website (<https://www.epa.gov/pfas>) and on the Centers for Disease Control and Prevention's Agency for Toxic Substances and Disease Registry website (<https://www.atsdr.cdc.gov/pfas/>).

²White House Office of Science and Technology Policy (OSTP), National Science and Technology Council, *Per- and Polyfluoroalkyl Substances (PFAS) Report*, https://www.whitehouse.gov/ostp/news-updates/2023/03/14/nstc_pfas_report/, March 2023.



For more information regarding DoD's PFAS efforts visit: www.defense.gov/pfas



ASSISTANT SECRETARY OF DEFENSE

3400 DEFENSE PENTAGON
WASHINGTON, DC 20301-3400

ENERGY, INSTALLATIONS,
AND ENVIRONMENT

7/11/23

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS,
ENERGY AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE NAVY (ENERGY,
INSTALLATIONS AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE AIR FORCE
(INSTALLATIONS, ENVIRONMENT AND ENERGY)
DIRECTOR, DEFENSE LOGISTICS AGENCY (LOGISTICS
OPERATIONS)

SUBJECT: Interim Guidance on Destruction or Disposal of Materials Containing Per- and Polyfluoroalkyl Substances in the United States

The DoD Per- and Polyfluoroalkyl Substances (PFAS) Task Force issues this interim guidance to help DoD make informed decisions in the evaluation of existing destruction and disposal options, and to comply with section 343 of the FY 2022 National Defense Authorization Act (NDAA). Section 343 requires DoD to prohibit the incineration of covered DoD PFAS-containing materials¹ until DoD issues guidance implementing the U.S. Environmental Protection Agency (EPA) “Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances,” December 18, 2020 (hereinafter referred to as the EPA guidance), and section 330 of the FY 2020 NDAA.

Concurrent with its compliance with these requirements on PFAS destruction and disposal, DoD is transitioning to a PFAS-free firefighting agent for land-based applications over the next few years. DoD has determined that this transition, which requires the removal of PFAS-containing firefighting foam (i.e., Aqueous Film Forming Foam (AFFF)) from installation fire protection inventories, will generate large quantities of PFAS-containing concentrate and rinsate for which DoD must find a safe disposal solution. In addition, quantities of PFAS-containing material are generated from DoD’s nationwide cleanup program, and recovery of emergency use discharges or spills of AFFF. Given these combined quantities, DoD’s long-term storage capabilities will be exceeded and thus DoD requires a comprehensive destruction and disposal strategy.

In choosing among disposal options, one of the most significant factors for DoD was the additional oversight and controls provided at disposal and destruction facilities with

¹ PFAS-containing materials covered under this guidance includes all “covered material” under Section 343 of the FY 2022 NDAA, which means “any [Aqueous Film Forming Foam] AFFF formulation containing PFAS, material contaminated by AFFF release, or spent filter or other PFAS-contaminated material resulting from site remediation or water filtration that—

- (A) has been used by the Department of Defense or a military department;
- (B) is being discarded for disposal by the Department of Defense or a military department; or
- (C) is being removed from sites or facilities owned or operated by the Department of Defense.”

environmental permits. In issuing this guidance to comply with section 343 of the FY 2022 NDAA, DoD continues to recognize the statutory authority and responsibility of the EPA and State environmental regulatory agencies to regulate the disposal of wastes that may threaten human health or the environment.

Based on the analysis contained in Attachment 1 and consistent with the EPA guidance, DoD has identified the following four commercially available options to destroy or dispose of DoD PFAS-containing materials, in the order of consideration:

- Carbon reactivation units with environmental permits (for used granular activated carbon only).
- Hazardous waste landfills with environmental permits.
- Solid waste landfills with environmental permits that have composite liners, and gas and leachate collection and treatment systems.
- Hazardous waste incinerators with environmental permits.

In addition to these four DoD-wide options, the DoD Components are directed to consider onsite hazardous waste storage on a site-specific basis, for storage over ninety days. The DoD Components may also consider underground injection control on a site-specific basis. Third, the DoD Components, upon notification to the Office of the Assistant Secretary of Defense for Energy, Installations, and Environment (OASD(EI&E)), may also consider other existing and developing PFAS treatment or destruction technologies that are accepted/permitted by the appropriate State or Federal regulator, instead of utilizing hazardous waste incinerators, on a site-specific basis. The DoD Components, when selecting one of the options above for the destruction or disposal of PFAS-containing materials, including AFFF, must continue to make informed, fact-based decisions to mitigate the risk of PFAS releases to the environment for the protection of human health, consistent with the attached guidance and decision tree.

DoD continues to evaluate existing and developing PFAS destruction and disposal technologies, monitor studies on those technologies' effectiveness and potential environmental effects, and collaborate Administration-wide on best practices. For example, DoD's Strategic Environmental Research and Development Program has ongoing projects to develop an improved understanding of the effectiveness and sustainability of thermal destruction technologies for treatment of PFAS-containing materials. Of particular interest is the assessment of the fate and behavior of PFAS throughout the thermal treatment process. DoD also anticipates that EPA will be updating its guidance by December 2023. OASD(EI&E) will update this guidance annually to reflect changes as technologies mature, EPA updates its guidance, and additional data becomes available. The point of contact for this guidance is Ms. Alexandria Long, OASD(EI&E), at 703-571-9061 or alexandria.d.long.civ@mail.mil.

OWENS.BRENDA
N.M.1030451844

Digitally signed by
OWENS.BRENDAN.M.10304518
44
Date: 2023.07.11 18:11:14 -04'00'

Brendan M. Owens

Attachments:
As stated

Attachment 1 — DoD Guidance on Options for the Destruction and Disposal of PFAS-Containing Materials and Implementation of Section 343 of the FY 2022 NDAA

1. DoD Implementation of the EPA’s “Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances,” December 18, 2020

The EPA issued the “Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances,” on December 18, 2020, (referred to as “the EPA guidance” in this document).² In the EPA guidance, EPA evaluated destruction and disposal technologies that are commercially available and have the potential to control the migration of PFAS to the environment and identified three destruction or disposal options: landfilling, thermal treatment, and underground injection. DoD reviewed the EPA guidance and is implementing that guidance through this interim policy. Specifically, DoD is using the EPA guidance to help DoD make informed decisions in the evaluation of existing destruction and disposal options, including the relative uncertainty associated with each technology’s capability to control releases to the environment for the protection of human health. DoD is also implementing EPA’s guidance on environmental justice considerations in disposal and destruction of PFAS-containing materials.

A. EPA Interim Guidance on Destruction and Disposal of PFAS and Materials Containing PFAS

EPA’s guidance recognizes that interim storage is not a destruction or disposal method, but asserts that storage “may be an option” if the immediate destruction or disposal of PFAS-containing materials is “not imperative.”³ EPA defines “interim storage” as storage “estimated to be anywhere from 2 to 5 years.”⁴ EPA does not define the term “imperative.” DoD finds that multi-year storage of large quantities of PFAS-containing materials is not a viable option, from either a safety, environmental, logistical, or economic perspective.⁵ Thus, in general, DoD assesses that, due to the volume of PFAS-containing materials at issue, DoD will need to implement actual destruction or disposal solutions for those materials.

DoD is currently conducting cleanup investigations and response actions at over 700 military installations and State Guard facilities. These investigations and response actions generate PFAS-containing materials (e.g., granular activated carbon, soils, investigation-derived wastes). If DoD had to plan for, locate, and secure storage of all PFAS-containing materials at

² “Interim PFAS Destruction and Disposal Guidance (Notice of Availability for Public Comment).” 85 Federal Register 83554 (Dec. 22, 2020).

³ “Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances,” pp. 5. Environmental Protection Agency, 18 Dec. 2020, <https://www.epa.gov/pfas/interim-guidance-destroying-and-disposing-certain-pfas-and-pfas-containing-materials-are-not>. Referred to as “EPA Interim PFAS Disposal Guidance (Dec. 2020)” in later footnotes.

⁴ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 5.

⁵ EPA’s proposed PFAS National Primary Drinking Water Regulation similarly states: “As part of this rulemaking, EPA considered that in drinking water treatment, large volumes of spent [granular activated carbon] and ion exchange resin must be removed which does not lend itself to on-site storage over time. The disposal options identified in the Interim Guidance (US EPA, 2020b) are landfill disposal and thermal treatment.” 88 Federal Register at 18686 (Mar. 29, 2023).

applicable DoD/Guard facilities, these storage requirements would affect the pace of this necessary cleanup. In addition, the storage would generate its own risks of release to the environment.

DoD is also required to transition to a new firefighting agent for land-based applications and remove existing AFFF. The volume of AFFF that requires disposal is estimated to be over 2 million gallons. DoD does not have the warehouse capacity to properly and safely store this AFFF and associated rinsate at individual bases. DoD also is concerned with the risks of release to the environment from storage and believes that secondary containment would be needed to contain releases of PFAS. Storage areas at individual military installations or Guard facilities, where these PFAS-containing materials could potentially be stored if space was available, are not likely to have secondary containment. Building additional storage capacity, to include the necessary contracting actions, would negatively affect the pace of these required cleanup and AFFF replacement activities. While DoD believes it does not have the capacity to properly store all PFAS-containing materials at its facilities, and thus disposal or destruction of those materials is imperative, the DoD Components are directed to consider if onsite hazardous waste storage capacity exists for storage over ninety days at an individual military installation.

DoD next considered all the existing destruction and disposal options identified in the EPA guidance to identify options that are protective of human health and the environment. EPA identified several factors to consider in determining how to destroy or dispose of PFAS-containing materials:

- The relative uncertainty associated with the technologies' capabilities to control migration of PFAS,
- Whether it is imperative to destroy or dispose of these materials versus storing it and waiting for uncertainties to be reduced,
- The cost and availability of destruction and disposal options,
- The type of waste materials,
- The concentrations of PFAS in the waste, and
- Health risks from PFAS releases, especially for potentially vulnerable populations ⁶

The first option DoD considered was deep well injection. EPA acknowledged deep well injection has the capability to control migration of PFAS to the environment, and the limited number of these wells currently receiving PFAS “may significantly limit the practicability of this disposal option.”⁷ Because of the limited availability of deep well injection locations, use for only liquid materials, and the volume of disposal required for DoD PFAS-containing materials, DoD believes this disposal option will rarely be an available option for DoD. DoD, however, has identified deep well injection as a disposal option that maximizes reduction of PFAS releases or emissions to the environment and human health exposures, and the DoD Components may consider whether deep well injection is an available and cost-effective option at an individual military installation.

⁶ EPA Interim PFAS Disposal Guidance (Dec. 2020), pages 5 and 83.

⁷ EPA Interim PFAS Disposal Guidance (Dec. 2020), pages 5-6.

Consistent with the EPA guidance, DoD next considered permitted hazardous waste landfills. Hazardous waste landfills “have the most stringent environmental controls in place and higher potential capacity to manage the migration of PFAS into the environment.”⁸ Hazardous waste landfills are “more effective at minimizing PFAS migration into the environment than other landfill types.”⁹ Because “permitted hazardous waste landfills employ the most extensive set of environmental controls (e.g., double liner systems with leachate collection and leak detection) and practices (e.g., extensive record keeping) that are currently available for the containment of PFAS waste,” DoD has identified these landfills as an available disposal option that maximizes reduction of PFAS releases or emissions to the environment and human health exposures.¹⁰

DoD next considered solid waste landfills. The EPA guidance identifies a variety of solid waste landfills: municipal solid waste, ash monofill, industrial, and construction and demolition landfills.¹¹ Because environmental controls can vary at landfills, EPA evaluated the viability of landfilling as a means of containing PFAS. Modern solid waste landfills “when constructed with appropriate controls (e.g., liner system and leachate and gas collection and management systems), can also control the migration of PFAS into the environment.”¹² DoD has identified solid waste landfills with these controls in place (composite liner and gas and leachate collection and management) as an available disposal option that maximizes reduction of PFAS releases or emissions to the environment and human health exposures. Any solid waste landfill DoD uses for PFAS-containing materials must have a composite liner, gas and leachate collection and management systems, and an environmental permit.

The DoD Components, consistent with the Decision Tree in Attachment 2, will need to consider the type of PFAS-containing materials when considering the use of both hazardous waste and solid waste landfills. For example, liquids must be solidified to remove any free liquids before disposal in a landfill, which may increase the volume significantly (e.g., threefold).¹³ The cost and availability of all destruction and disposal options are additional considerations that need evaluation.

DoD next considered thermal treatment technologies, recognizing that these options have higher levels of uncertainties regarding their capacity to control the migration of PFAS into the environment. Thermal treatment technologies include a wide-variety of technologies and controls, including hazardous waste combustors (e.g., incinerators, cement kilns, lightweight aggregate kilns), as well as other thermal treatment (e.g., carbon reactivation units, sewage sludge incinerators, municipal waste combustors, thermal oxidizers).¹⁴ EPA, notwithstanding its acknowledgment of uncertainties with PFAS thermal treatment technologies, recognized that the subset of permitted hazardous waste combustors “may operate under conditions more conducive to destroying PFAS and controlling related [products of incomplete combustion] PICs relative to

⁸ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 5.

⁹ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 6.

¹⁰ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 6.

¹¹ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 56.

¹² EPA Interim PFAS Disposal Guidance (Dec. 2020), page 55.

¹³ <https://www.geoengineer.org/education/web-class-projects/cee-549-geoenvironmental-engineering-winter-2013/assignments/stabilization-solidification> (“Volume of the treated wastes usually increases significantly”)

¹⁴ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 6.

thermal treatment units that do not have both [Resource Conservation and Recovery Act] RCRA and [Clean Air Act] CAA permits.”¹⁵ EPA also recognized that permitted hazardous waste incinerators “are designed to optimize temperatures, residence times, turbulence, and other parameters” to “maximize organic destruction and minimize the formation of PICs.”¹⁶ These controls include pollution control devices which can remove hydrogen fluoride and other products of combustion.¹⁷ After considering the latest studies and additional information¹⁸ presented in the next section of this guidance on implementation of section 330 of the FY 2020 NDAA, DoD has identified hazardous waste incinerators as an available destruction option that maximizes reduction of PFAS releases or emissions to the environment and human health exposures.

Because DoD, and others, have widely utilized granular activated carbon (GAC) to remove PFAS from drinking water and groundwater, and “GAC reactivation is economically favored over replacement with virgin carbon,”¹⁹ DoD also considered carbon reactivation units.²⁰ While carbon reactivation units “use high temperatures to thermally desorb contaminants from GAC, which allows for the carbon to be used again,”²¹ they are not “incinerators” and instead are a form of recycling/preserving virgin materials. While there are about seventeen commercial carbon reactivation units across the country, currently only four “operate under RCRA permits and applicable air permits” which “provide additional regulatory oversight and include operating requirements and emission limitations to safely and effectively treat the hazardous contaminants.”²² Due to these additional safeguards, RCRA-permitted carbon reactivation units “may operate under conditions more conducive to destroying PFAS and controlling related PICs.”²³ Therefore, DoD has identified RCRA permitted carbon reactivation units as an available destruction option to address PFAS-containing GAC that maximizes reduction of PFAS releases or emissions to the environment and human health exposures.

B. EPA Guidance on Environmental Justice

DoD also considered section 4 of the EPA guidance, which addresses environmental justice and impacts on vulnerable communities. The recent April 2023 Executive Order on “Revitalizing Our Nation’s Commitment to Environmental Justice for All”,²⁴ emphasizes that every person has a right to breathe clean air, drink clean water, and live in a healthy community. Under Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations”, Federal agencies are directed to identify and address,

¹⁵ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 35.

¹⁶ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 35.

¹⁷ EPA Interim PFAS Disposal Guidance (Dec. 2020), pages 33-35.

¹⁸ Several of those studies post-date EPA’s December 2020 Guidance and its findings on relative uncertainty.

¹⁹ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 95.

²⁰ EPA’s proposed PFAS National Primary Drinking Water Regulation similarly states: “At present, the most likely management option for spent materials containing PFAS is reactivation for GAC and incineration for spent IX resin.” 88 Federal Register at 18686 (Mar. 29, 2023).

²¹ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 36.

²² EPA Interim PFAS Disposal Guidance (Dec. 2020), page 36.

²³ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 36.

²⁴ “Executive Order 14096 of April 21, 2023, Revitalizing Our Nation’s Commitment to Environmental Justice for All,” *Federal Register* 88, no. 80 (April 26, 2023): 25251-25261. <https://www.govinfo.gov/content/pkg/FR-2023-04-26/pdf/2023-08955.pdf>.

as appropriate, “disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations.”²⁵ In Executive Order 14008, “Tackling the Climate Crisis at Home and Abroad,” Federal agencies shall “develop programs, policies, and activities to address the disproportionately high and adverse human health, environmental, climate-related and other cumulative impacts on disadvantaged communities, as well as the accompanying economic challenges of such impacts.”²⁶ DoD is also a signatory to a Memorandum of Understanding on Environmental Justice, and a member of the Environmental Justice Interagency Council under these Executive Orders. DoD considered these White House documents, as well as the EPA guidance, in determining what currently available disposal and destruction options should be included in this interim guidance.

As the EPA guidance notes, certain communities “may be highly exposed to environmental contaminants because they live or work near the sources of release or presence in the environment.”²⁷ This includes “those living near and using PFAS-contaminated environments (e.g., drinking water, fishing, hunting, and recreation).”²⁸ DoD acknowledges that many of the communities surrounding our military installations are communities with environmental justice concerns. We have prioritized our cleanup program to address the highest risks first, regardless of the community demographics, and address exposures (e.g., drinking water) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund). Environmental justice principles are incorporated into CERCLA through public participation in the cleanup process, as well as the additional public outreach and engagement that DoD conducts (e.g., Restoration Advisory Boards). It is this cleanup program that addresses high exposures to PFAS that generates a large volume of PFAS-containing materials for disposal. Impact on vulnerable communities is thus addressed primarily in our cleanup program, and we support the Superfund Community Involvement Toolkit referenced in the EPA guidance. DoD is working on improving its public outreach and community dialogue for our PFAS cleanups through expanded public outreach at both senior leadership and local levels, a more user-friendly DoD PFAS website, and updating our Restoration Advisory Board guidance. We also note that EPA’s Office of Land and Emergency Management is working with DoD and State representatives to develop “approaches to characterizing communities adjacent to three federal facility [National Priority List] NPL sites, to identify those with [Environmental Justice] EJ concerns.”²⁹ When completed, these projects will inform EPA’s understanding of best practices and be publicly shared. DoD supports this approach.

We also considered the vulnerable communities that exist near landfills and hazardous waste incinerators. We found this to be more complex in helping to choose among existing

²⁵ “Executive Order 12898 of February 11, 1994, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” *Code of Federal Regulations*, title 3 (1994): 1-101, <https://www.archives.gov/files/federal-register/executive-orders/pdf/12898.pdf>.

²⁶ “Executive Order 14008 of January 27, 2021, Tackling the Climate Crisis at Home and Abroad,” *Federal Register* 86, no. 19 (February 1, 2021): 7619-7633, <https://www.govinfo.gov/content/pkg/FR-2021-02-01/pdf/2021-02177.pdf>.

²⁷ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 87.

²⁸ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 87.

²⁹ EPA Office of Land and Emergency Management, “EJ Action Plan. Building Up Environmental Justice in EPA’s Land Protection and Cleanup Programs (Sept. 2022), page 25.

disposal and destruction options. For example, studies have identified that a disproportionate number of landfills and other hazardous waste facilities, such as incinerators, are located in communities with environmental justice concerns. DoD also used EPA's Environmental Justice Screening and Mapping Tool ("EJScreen")³⁰ to identify potentially impacted communities living near PFAS destruction or disposal sites identified in this guidance, as well as communities surrounding our military installations where PFAS cleanups are ongoing and AFFF will be replaced. DoD also considered the relative risk between its top priority of addressing elevated levels of PFAS in drinking water from DoD activities versus indirect potential PFAS exposures from destruction and disposal facilities.

In choosing among disposal options, however, one of the most significant factors for DoD was the additional oversight and controls provided at disposal and destruction facilities with environmental permits. We recognize the statutory authority and responsibility of the EPA and State environmental regulatory agencies to regulate the disposal of wastes that may threaten human health or the environment, and to issue environmental permits that are protective of human health and the environment. Section 4 of the EPA guidance thus focuses on considering vulnerable populations and community engagement in the regulatory siting or permitting processes for destruction and disposal facilities. DoD acknowledges that more work is needed to ensure that the impacts associated with the operation of destruction and disposal facilities are equitable. While DoD does not have a regulatory role, we encourage regulators and disposal facilities to consider PFAS in these regulatory processes. In addition, to facilitate engagement with communities near our military installations, as well as possibly adjacent to PFAS destruction and disposal facilities, we have developed a DoD PFAS Disposal Fact Sheet that will be posted on our DoD PFAS website (<https://www.acq.osd.mil/eie/eer/ecc/pfas/index.html>). This fact sheet summarizes this DoD PFAS disposal guidance, provides background information on PFAS and potential health effects based on EPA and the Agency for Toxic Substances and Disease Registry statements, and provides information on how DoD is incorporating environmental justice principles when addressing PFAS. DoD will also explore new partnership opportunities with EPA and other federal agencies to advance environmental justice issues in accordance with Executive Order 14096.

C. DoD Implementation

DoD is therefore identifying the following options, **in order of priority**, for the DoD Components to utilize for the destruction or disposal of PFAS-containing materials, including AFFF, that are not hazardous wastes:³¹

- **Carbon reactivation units with environmental permits (for used GAC only).**
GAC is a common PFAS water treatment technique where PFAS attaches to the

³⁰ See <https://www.epa.gov/ejscreen>.

³¹ Hazardous waste is regulated pursuant to RCRA authority. See 42 U.S.C. § 6903. The regulatory definition of hazardous waste is found in 40 CFR § 261.3. PFAS is currently not a listed or characteristic hazardous waste, but a PFAS-containing material may meet the regulatory definition of hazardous waste if PFAS is mixed with a listed hazardous waste or if a PFAS-containing mixture exhibits a hazardous characteristic (e.g., ignitability). Materials that qualify as a RCRA hazardous waste must follow RCRA storage and disposal requirements and are outside of the scope of this guidance.

carbon until the carbon is full. Carbon reactivation units use high temperatures to thermally treat contaminants collected in GAC, which allows for the carbon to be used again. Carbon reactivation units permitted under RCRA and the CAA have additional regulatory oversight and include operating requirements and emission limitations to safely and effectively treat hazardous contaminants.

- **Hazardous waste landfills with environmental permits.** These landfills have stringent environmental controls in place to manage the migration of PFAS into the environment. Permitted hazardous waste landfills employ the most extensive set of environmental controls (e.g., double liner systems with leachate collection and leak detection) and practices (e.g., extensive record keeping) that are currently available for the containment of PFAS waste.
- **Solid waste landfills with environmental permits that have composite liners, and gas and leachate collection and treatment systems.** Modern municipal solid waste landfills, when constructed with appropriate controls (e.g., liner system, leachate and gas collection and management systems, permits), can also control the migration of PFAS into the environment.
- **Hazardous waste incinerators with environmental permits.** These high temperature incinerators have stringent regulatory controls on temperature and other operating parameters to achieve a 99.99 percent destruction efficiency for other (non-PFAS) organic chemicals, and evidence suggests that a similar destruction efficiency may apply to PFAS-containing materials (see below). Currently, thermal treatment is the only commercially available technology that has the potential capability to destroy PFAS, rather than contain it.

In addition to these four DoD-wide options, the DoD Components are directed to consider onsite hazardous waste storage on a site-specific basis, for storage over ninety days. The DoD Components may also consider underground injection control, on a site-specific basis. Third, the DoD Components, upon notification to OASD(EI&E), may also consider other existing and developing PFAS treatment or destruction technologies that are accepted/permitted by the appropriate State or Federal regulator, *instead of* utilizing hazardous waste incinerators, on a site-specific basis. For example, at one site with a large volume of PFAS-impacted soils, where landfills were not an option in that State, OASD(EI&E) was notified that a State permitted thermal desorption unit would be considered rather than hazardous waste incineration. The DoD Components, when selecting one of the options above for the destruction or disposal of PFAS-containing materials, must continue to make informed decisions consistent with this guidance and the Decision Tree.

2. DoD Implementation of Section 330 of the FY 2020 NDAA

Section 330 of the FY 2020 NDAA requires DoD to ensure that when PFAS-containing materials or AFFF are disposed:

- “(1) all incineration is conducted at a temperature range adequate to break down PFAS chemicals while also ensuring the maximum degree of reduction in emission of PFAS, including elimination of such emissions where achievable;
- (2) all incineration is conducted in accordance with Clean Air Act (42 USC 7401 et seq.), including controlling hydrogen fluoride;

- (3) any materials containing PFAS that are designated for disposal are stored in accordance with the requirement under part 264 of title 40, Code of Federal Regulations; and
- (4) all incineration is conducted at a facility that has been permitted to receive waste regulated under [the Resource Conservation and Recovery Act]³² (42 USC 6921 et seq.).”

This guidance addresses the second, third, and fourth criteria together, followed by the first criterion.

The second criterion in section 330 requires that all incineration of PFAS-containing materials is conducted in accordance with CAA requirements. The third criterion in section 330 requires that PFAS-containing materials stored at hazardous waste combustors prior to incineration be stored in accordance with RCRA requirements. The fourth criterion in section 330 requires that incineration is conducted at a RCRA-permitted hazardous waste facility. **Based upon the review of these three criteria, if a DoD Component chooses to incinerate PFAS-containing materials in its custody, the DoD Component must send those PFAS-containing materials, including AFFF, only to RCRA- and CAA-permitted Hazardous Waste Incinerators (HWIs).** RCRA-permitted HWIs with CAA Title V permits operate under conditions that represent the maximum commercially available destruction efficiencies for PFAS, including the control of hydrogen fluoride and other PICs. Additionally, RCRA- and CAA-permitted HWIs have experience in the proper storage of regulated hazardous wastes and must comply with part 264 of title 40, Code of Federal Regulations, concerning storage of material at their facilities. Therefore, the DoD Components will implement the CAA and RCRA permit and storage criteria in section 330 by ensuring that the HWIs utilized for the incineration of PFAS-containing materials, including AFFF, have valid RCRA and CAA operating permits.

The first criterion in section 330 requires that if DoD sends PFAS-containing materials to incinerators, the incinerators utilize a temperature range adequate to break down PFAS while also minimizing emissions of PFAS. Because the second, third, and fourth criterion in section 330 require incineration at permitted HWIs and because these permitted facilities are required to maintain minimum temperature thresholds, DoD used those minimum thresholds in determining whether it can reasonably conclude that its candidate HWIs will achieve the requirements of the first criterion in section 330.

A. Relevant RCRA and CAA permitting requirements

The regulatory requirements for RCRA- and CAA-permitted HWIs are summarized as follows:

RCRA-permitted HWIs must follow stringent regulatory requirements and are required by EPA to conduct testing to determine a Destruction and Removal Efficiency (DRE). The key factors in achieving a high DRE are time in the incinerator (residence time), high temperature, and turbulence (i.e., mixing). The purpose of DRE testing is to demonstrate that virtually all the molecules of a surrogate compound are destroyed in the incinerator.

³² The Solid Waste Disposal Act of 1965 is commonly referred to as the Resource Conservation and Recovery Act (RCRA), which significantly amended the Solid Waste Disposal Act, in 1976.

For HWIs, EPA requires a minimum DRE of 99.99%. During DRE testing, a surrogate compound is fed into the incinerator that represents classes of compounds that are extremely difficult to destroy. EPA has developed a system of ranking these surrogate compounds, based on their difficulty to destroy. After a 99.99% DRE is achieved, EPA or the delegated State, issues a CAA Title V permit that includes requirements for operation. This includes a high temperature range and other parameters that are continuously monitored, and if not complied with, the incinerator will stop the flow of materials to the combustion unit automatically and immediately.

While there are several operating conditions specified in a HWI permit, the first criterion in section 330 focuses on a temperature range adequate to break down PFAS. DoD reviewed minimum temperatures specified in nine existing HWI permits to achieve their DRE and found their permits require a minimum temperature in the kiln that range from 1200°F to 1824°F. At these facilities, the kiln is followed by an afterburner/secondary combustion chamber to maximize organic destruction and their permits require a minimum temperature in the afterburner/secondary combustion chamber that ranges from 1488°F to 2026°F. Based on the studies and information described below, HWIs at their permitted temperature range will be adequate to break down detectable PFAS chemicals.

B. Existing Data on Destruction Capabilities of Incinerators

EPA's guidance contains the following findings on the destruction capabilities of HWIs:

HWIs are designed to optimize temperatures, residence times, turbulence, and other parameters to ensure compliance with organic DRE requirements. Most commercial HWIs use rotary kilns...that maintain high temperatures. Typically, solids retention time in the kiln is 0.5 to 1.5 hours, while gas residence time through the kiln is usually around two seconds. Kiln flame/solids temperatures range from 650°C to 1,650°C (1,200°F to 3,000°F). The rotary kiln is followed by an afterburner where additional high-heating-value gaseous and liquid wastes, and auxiliary fuels are added. The afterburner is typically operated at about 1,100°C to 1,370°C (2,000°F to 2,500°F) with a gas residence time from 1 to 3 seconds to maximize organic destruction and minimize the formation of PICs.³³

Studies and information on PFAS destruction indicate that the temperature ranges used in these types of HWIs are effective in destroying the 50 PFAS that can currently be detected in air emissions through an EPA methodology:

- In 2021, EPA began conducting pilot-scale PFAS incineration studies using its “Rainbow” furnace, which allows EPA to conduct incineration experiments under controlled conditions.³⁴ This research identified fluorocarbon tracer gases (surrogates) that could potentially be used to monitor destruction efficiencies during incineration, and then began experiments. The first publication from these

³³ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 35.

³⁴ “Combustion of C₁ and C₂ PFAS: Kinetic Modeling and Experiments,” Krug et al., *Journal of the Air & Waste Management Association*. 2022, 72:3, 256-270. Published Feb. 11, 2022.

experiments suggests that PFAS can be destroyed when subjected to aggressive thermal environments above 1100°C. EPA is also conducting experiments to understand the incineration of PFAS present in AFFF.³⁵

- In 2021, the New York State Department of Environmental Conservation (NYSDEC) announced that it had completed a study to determine if the thermal treatment of PFAS-containing materials at the Norlite facility in Cohoes, New York, resulted in soil and surface water contamination. The Norlite facility is a RCRA- and CAA-permitted hazardous waste combustor that had treated AFFF over a number of years. This NYSDEC study found no clearly discernible pattern of aerial deposition of PFAS that could be traced to Norlite's operations. Sampling identified low-level detections of PFAS compounds in all soil samples collected at upwind, downwind, and at background locations, consistent with emerging research on the prevalence of PFAS in urban, suburban, and rural environments. Concentrations of PFAS found in soils in the vicinity of the facility were below guidance values NYSDEC developed, indicating that the facility successfully destroyed the PFAS material and did not emit traceable amounts of PFAS during combustion.³⁶
- In 2021, a commercial RCRA- and CAA permitted HWI conducted a PFAS-specific study. In this study, AFFF was added in high concentrations to a waste feed, and sampled at various times throughout the incineration process. A 99.9999% DRE was obtained for Perfluorooctanesulfonic Acid, Perfluorooctanoic Acid, Perfluorohexane Sulfonic Acid, and hexafluoropropylene oxide dimer acid (otherwise known as Gen-X) at a temperature of 1800 °F. The study determined that the 50 specific PFAS that can currently be measured were turned into hydrogen fluoride, which was trapped in the air pollution control system.³⁷ To measure PFAS air emissions, this study utilized EPA test method OTM-45, published in 2021, for stack gas sampling of PFAS air emissions during this testing program. This study has undergone EPA and peer review, and became publicly available in August 2022.³⁸
- In 2022, a literature review covering 163 published works on thermal treatment of PFAS was published.³⁹ This paper suggests that “complete combustion of PFAS will likely be most successful in incinerators that employ a two-stage process. In these, the waste is first fed into the primary combustion chamber where PFAS desorb and partially degrade. The gaseous byproducts are sent to a secondary chamber (the afterburner) that operates in excess air (stoichiometric excess of oxygen) at high

³⁵ Shields, E. “ER21-1288: Multi-Scale Evaluation of PFAS Thermal Destruction Requirements.” Strategic Environmental Research and Development Program In-Progress Review Meeting, Aug. 17, 2022 (Virtual).

³⁶ *Norlite Environmental Sampling Report*, pp 25-26. New York State Department of Environmental Conservation, March 2021, https://www.dec.ny.gov/docs/materials_minerals_pdf/norlitesamplingfull0321.pdf.

³⁷ EPA's Interim PFAS Disposal Guidance (Dec. 2020), page 34, recognizes that hydrogen fluoride is a break-down product of PFAS destruction, and is captured in air pollution control devices. (“...PFAS destruction is defined as the complete severing of all carbon-fluorine bonds in a PFAS molecule. Severing all carbon-fluorine bonds results in conversion to carbon dioxide, hydrogen fluoride (HF), and other compounds. HF and some of the other products of combustion can be removed in pollution control devices.”).

³⁸ <http://cleanharbors.dev-cleanharbors.acsfactory.com/services/industrial-field-services/field-services/PFAS-PFOA-PFOS-Remediation>

³⁹ “Critical Review of Thermal Decomposition of Per- and Polyfluoroalkyl Substances: Mechanisms and Implications for Thermal Treatment Processes,” Wang et al., *Environ. Sci. Technol.* 2022, 56, 5355-5370. Published April 21, 2022.

temperature (>950 °C) and short residence times (1-3 seconds).”⁴⁰ DoD notes that HWIs employ this two-stage process. This paper also stated that the “general consensus across these lab-scale studies is that even the most stable PFAS (e.g., long-chain sulfonates) desorb at temperatures less than 1000°C, and they are destroyed in the gas phase at temperatures greater than 1000°C.”⁴¹

DoD acknowledges that the studies mentioned above and the EPA guidance identified uncertainties regarding PFAS thermal treatment. According to the EPA guidance:

Key uncertainties include the lack of PFAS-specific information on these facilities. EPA currently has no emission characterizations from these sources when they burn PFAS, and is working to develop measurement methodologies as well as gather information to conclude whether potential [PICs] are adequately controlled. EPA recognizes that PICs are formed (even for nonfluorinated compounds); however, based on the unique characteristics of fluorine combustion chemistry, it needs to be determined whether thermal treatment devices and their associated post-combustion control devices are controlling fluorinated PICs.⁴²

EPA, notwithstanding its general finding that there are uncertainties with PFAS thermal treatment technologies, recognized that there is less uncertainty for the permitted facilities that DoD will use for incineration if other disposal options are not deemed viable. According to EPA, the subset of permitted HWIs “may operate under conditions more conducive to destroying PFAS and controlling related PICs relative to thermal treatment units that do not have both RCRA and CAA permits.”⁴³ EPA also recognized that permitted HWIs “are designed to optimize temperatures, residence times, turbulence, and other parameters” to “maximize organic destruction and minimize the formation of PICs.”⁴⁴ These controls include pollution control devices which can remove hydrogen fluoride and other products of combustion.⁴⁵

⁴⁰ *Id.* at page 5363.

⁴¹ *Id.* at page 5363.

⁴² EPA Interim PFAS Disposal Guidance (Dec. 2020), page 6.

⁴³ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 35.

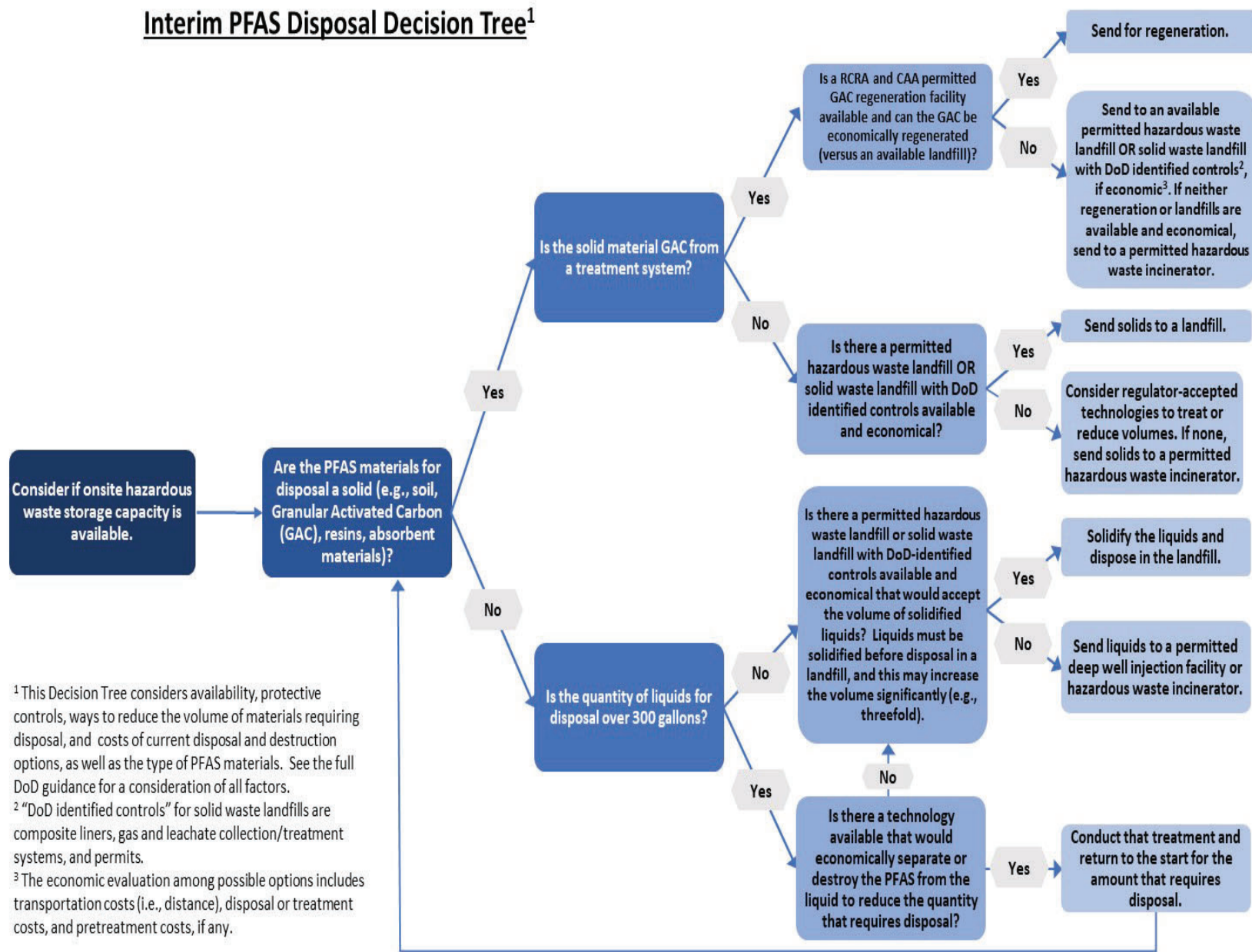
⁴⁴ EPA Interim PFAS Disposal Guidance (Dec. 2020), page 35.

⁴⁵ EPA Interim PFAS Disposal Guidance (Dec. 2020), pages 33-35, 42-43.

3. DoD's Finding

In light of the 2021 PFAS air emission methodology and studies identified above, including at a full-scale RCRA- and CAA-permitted HWI, DoD finds that incineration at these facilities at their permitted temperature range will be adequate to break down detectable PFAS chemicals while also ensuring the maximum degree of reduction in emission of detectable PFAS. Based on the above studies and information that show HWI permits specify a temperature range and other operating parameters to achieve a 99.99% DRE, and HWIs are required to have air emission control devices, RCRA- and CAA permitted HWIs meet section 330's requirements for an adequate temperature range to break down PFAS that currently can be detected in air emissions and meet emission reduction requirements. Additional research is underway, and DoD will update this guidance annually to reflect changes as technologies mature, EPA updates its guidance, and additional data, including air emission detection methods, becomes available.

Interim PFAS Disposal Decision Tree¹



¹ This Decision Tree considers availability, protective controls, ways to reduce the volume of materials requiring disposal, and costs of current disposal and destruction options, as well as the type of PFAS materials. See the full DoD guidance for a consideration of all factors.

² "DoD identified controls" for solid waste landfills are composite liners, gas and leachate collection/treatment systems, and permits.

³ The economic evaluation among possible options includes transportation costs (i.e., distance), disposal or treatment costs, and pretreatment costs, if any.

This page was intentionally left blank.

ATTACHMENT F.2: WASTE MANAGEMENT AND TRACKING LOG

This page was intentionally left blank.

WASTE INVENTORY TRACKING FORM

LOCATION : _____

PROJECT NAME: _____

ACTIVITIES: _____

Date Waste Generated	Activity Generating Waste (borehole # / well #)	Description of Waste	Field Evidence of Contamination	Estimated Volume	Type of Container (storage ID#)	Location of Container	Waste Characterization	Comments

Note: Describe whether soil or water samples have been collected for waste characterization, include date, if known.

Signature: _____

This page was intentionally left blank.