Supplemental Remedial Investigation Phase 4 QAPP

Environmental Restoration Support at Former Defense Depot Memphis, Tennessee

Contract W91278-16-D-0061, Task Order 0002

Revision 1
August 2019

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Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
BEC	BRAC Environmental Coordinator
BFB	4-bromofluoro-benzene
bgs	below ground surface
BRA	Baseline Risk Assessment
BRAC	Base Realignment and Closure
CA	corrective action
CCB	continuing calibration blank
CCV	continuing calibration verification
cDCE	cis-1,2-Dichloroethene
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CF	chloroform
CFR	Code of Federal Regulations
Chemtech	Chemtech Consulting Group
CoC	chain-of-custody
COR	Contracting Officer's Representative
CT	carbon tetrachloride
CVOC	chlorinated volatile organic compound
DL	detection limit
DDMT	Defense Depot Memphis, Tennessee
DO	dissolved oxygen
DoD	Department of Defense
DQCR	daily quality control report
DQO	data quality objective
EBT	enhanced bioremediation treatment
EICP	extracted ion current profile
ELAP	Environmental Laboratory Accreditation Program
ft	feet/foot
FTL	Field Team Leader
GC/MS	gas chromatography/mass spectrometry
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDR	HDR Environmental, Operations and Construction, Inc.
IAQ	Intermediate Aquifer
ICAL	initial calibration
ICB	initial calibration blank
ICV	initial calibration verification
ID	inside diameter
IS	internal standard
J&E	Johnson and Ettinger
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LIMS	Laboratory Information Management System
LOD	limit of detection
LOQ	limit of quantitation

LTM	long-term monitoring
MAQ	Memphis Aquifer
MCL	maximum contaminant level
mg/L	milligram per liter
MI	Main Installation
MIP	membrane interface probe
mL	milliliter
MLGW	Memphis Light, Gas & Water
MS	matrix spike
MSD	matrix spike duplicate
NAVD	North American Vertical Datum of 1988
NTU	nephelometric turbidity unit
ORP	oxygen reduction potential
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PCP	pentachlorophenol
PID	photoionization detector
PM	Project Manager
PQO	Project Quality Objective
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RA	remedial action
RAO	remedial action objective
RF	response factor
RG	remediation goal
RPD	relative percent difference
RPM	Remedial Project Manager
RRT	relative retention time
RSD	relative standard deviation
RT	retention time
SCHD	Shelby County Health Department
SMT	Site Management Team
SOP	Standard Operating Procedure
SOW	Statement of Work
SPCC	System Performance Check Compound
SRI	supplemental remedial investigation
SVOC	semi-volatile organic compound
TCE	trichloroethene
TCLP	toxicity characteristic leaching procedure
TDEC	Tennessee Department of Environment & Conservation
TIC	tentatively identified compound
TM	Technical Manager

TTA	target treatment area
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VC	vinyl chloride
VI	vapor intrusion
VISL	Vapor Intrusion Screening Level Calculator
VOC	volatile organic compound
%R	percent recovery
µg/L	micrograms per liter

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QAPP Worksheet #1 & 2: Title and Approval Page

Project Name	Environmental Restoration Support, Former Defense Depot Memphis, Tennessee (DDMT)
Site Location	Memphis, Shelby County, Tennessee
Contract Number	W91278-16-D-0061
Task Order	0002

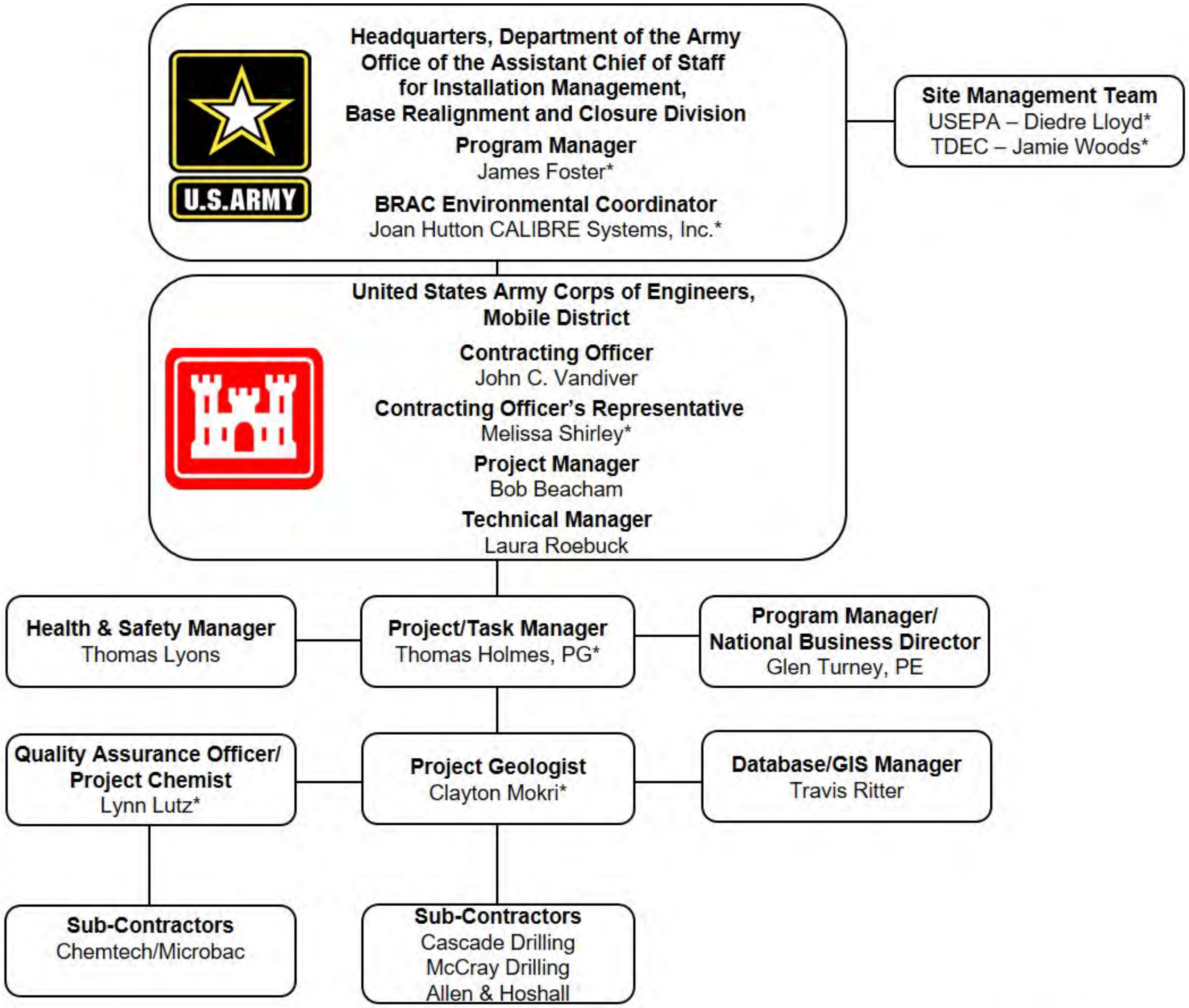
Approvals:

Role	Title	Organization	Name
Lead Organization	Program Manager	United States Army, Assistant Chief of Staff for Installation Management, Base Realignment and Closure (BRAC) Division	James Foster
Lead Organization	BRAC Environmental Coordinator (BEC)	CALIBRE Systems, Inc.	Joan Hutton
Stakeholder Agency	Contracting Officer’s Representative (COR)	United States Army Corps of Engineers (USACE), Mobile District	Melissa Shirley
Stakeholder Agency	Project Manager (PM)	USACE - Mobile	Bob Beacham
Stakeholder Agency	Technical Manager (TM)	USACE - Mobile	Laura Roebuck
Federal Regulatory Agency	Remedial Project Manager (RPM)	United States Environmental Protection Agency (USEPA), Region 4	Diedre Lloyd
State Regulatory Agency	RPM	Tennessee Department of Environment & Conservation (TDEC)	Jamie Woods
Plan Preparation and Implementation	Project Manager (PM)	HDR Environmental, Operations and Construction, Inc. (HDR)	Tom Holmes
Plan Preparation and Implementation	Quality Assurance (QA) Officer / Project Chemist	HDR	Lynn Lutz
Plan Preparation and Implementation	Project Geologist	HDR	Clayton Mokri

Previous Plans and Reports Relevant to Project:

Title	Date	Author
Memphis Depot Main Installation Record of Decision Memphis Depot Caretaker, Revision 2.	February 2001	CH2M HILL
Main Installation Source Areas Investigation, Defense Depot Memphis, Tennessee, Defense Logistics Agency, Revision 0.	February 2009	e²M
Main Installation Interim Remedial Action Completion Report, Defense Depot Memphis, Tennessee, Defense Logistics Agency, Revision 1.	February 2010	HDR|e^{2}M
Preliminary Close Out Report, U. S. Defense Depot Memphis Tennessee, TN42100220570.	February 2010	USEPA
Supplemental Remedial Investigation Phase 3 QAPP, Defense Depot Memphis, Tennessee, Revision 1.	April 2018	HDR
Supplemental Remedial Investigation Phases 1 and 2 Report, Defense Depot Memphis, Tennessee, TN4210020570, Revision 1.	June 2018	HDR
Supplemental Remedial Investigation Phase 3 Summary Report, Defense Depot Memphis, Tennessee, TN4210020570, Revision 0.	November 2018	HDR
Annual Long-Term Monitoring Report-2018, Defense Depot Memphis, Tennessee, TN42100220570, Internal Draft.	February 2019	HDR

QAPP Worksheet #3 & 5: Project Organization and QAPP Distribution



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QAPP Worksheet #4, 7 & 8: Personnel Qualifications and Sign-off Sheet

ORGANIZATION: HDR

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Tom Holmes	PM	MS Geophysics 40 years	Registered Professional Geologist, Georgia	
Lynn Lutz	QA Officer / Project Chemist	BA Chemistry 31 years	Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER), 40-hour; First Aid/CPR certification	
Clayton Mokri	Project Geologist	BS Environmental Science 15 years	Registered Environmental Manager, OSHA HAZWOPER, 40-hour	
Travis Ritter	Project DB/ GIS Manager	MS Environmental Science 15 years	OSHA HAZWOPER, 40-hour; OSHA 510 Construction Industry Health and Safety	

ORGANIZATION: Chemtech

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Kurt Hummler	Laboratory PM	BA Political Science 27 years	--	

ORGANIZATION: Microbac

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Stephanie Mossburg	Customer Relations Manager	BS Biochemistry 28 years	--	

**Signatures indicate personnel have read and agree to implement this Quality Assurance Project Plan (QAPP) as written.*

QAPP Worksheet #6: Communication Pathways

Communication Driver	Responsible Entity	Name	Contact Information	Procedure (timing, pathway, etc.)
Contract Execution/ Document Review	USACE COR	Melissa Shirley	251-690-2616	Email/verbal communication with HDR PM. QA supervision for contract activities. Participate in monthly Site Management Team calls to discuss recent project activities, document review and project schedule, upcoming documents and issue resolution.
Project Oversight	ACSIM-ODB Program Manager	James Foster	703-545-2541	Provide overall project direction to the BEC, participate in project calls or meetings and interact with USEPA and TDEC representatives, when appropriate.
Regulatory Interface	BEC	Joan Hutton	571-403-3333	Communicate with USEPA/TDEC via phone and email as needed, and submit project documents for regulatory review. Monitor compliance with the Federal Facilities Agreement (FFA) (USEPA, 1995) regarding submittals and timing.
USEPA Oversight	USEPA RPM	Diedre Lloyd	404-562-8855	Review and comment on project documents. Participate in monthly Site Management Team calls to discuss recent project activities, document review and project schedule, upcoming documents and issue resolution. Documents for initial review will be submitted electronically by email or on CD via overnight delivery; in either case a paper copy of the text, tables and figures will be submitted via overnight delivery. Final documents will be submitted electronically by email or on CD via overnight delivery; paper copies will not be provided, unless requested. Communications regarding issue resolution will be initiated via phone call or email on the day the potential issue is identified.
TDEC Oversight	TDEC RPM	Jamie Woods	901-371-3041	Review and comment on project documents. Participate in monthly Site Management Team calls to discuss recent project activities, document review and project schedule, upcoming documents and issue resolution. Documents will be submitted electronically by email or on CD via overnight delivery. Communications regarding issue resolution will be initiated via phone call or email on the day the potential issue is identified.
Technical Direction	BEC	Joan Hutton	770-317-4323	Review project documents and represents the BRAC PM. Lead monthly Site Management Team calls to discuss recent project activities, document review and project schedule, upcoming documents and issue resolution.
Manage Task Order activities	HDR PM	Tom Holmes	404-295-3279	Submit task order deliverables; notify USACE TM and BEC of field-related problems by phone or email by close of business the day of the event if possible and no later than noon Central Time the following day. Prepare draft agenda, participate and prepare draft summary for monthly Site Management Team calls.

Communication Driver	Responsible Entity	Name	Contact Information	Procedure (timing, pathway, etc.)
Field Decisions	HDR PM	Tom Holmes	404-295-3279	Notify USACE TM and BEC of significant changes to field activities due to site conditions or other factors for discussion with USEPA and TDEC RPMs and regulatory buy-in. Communicate by phone or email within at least 4 hours of identifying the required change.
Manage Field Tasks	HDR Project Geologist	Clayton Mokri	530-902-7106	Supervise HDR field activities. Communicate with HDR PM and Project Chemist. Provide daily quality control reports (DQCRs) and notification of any work problems.
QAPP changes in the field	HDR QA Officer	Lynn Lutz	303-754-4266	Manage and implement in-field QAPP changes. Notify HDR PM of QAPP changes.
Reporting Lab Data Quality Issues	Laboratory PM	Kurt Hummler	908-728-3143	Notify the HDR Project Chemist regarding laboratory data quality issues including corrective actions (CAs) and data usability.
Reporting Lab Data Quality Issues	Customer Relations Manager	Stephanie Mossburg	800-373-4071	Notify the HDR Project Chemist regarding laboratory data quality issues including CAs and data usability.
Field CAs	HDR Project Geologist/FTL	Clayton Mokri	530-902-7106	Issue CAs in writing to the HDR PM for review and submittal to USACE TM and BEC.
Analytical CAs	HDR Project Chemist	Lynn Lutz	303-754-4266	Coordinate laboratory analyses, review deliverables, determine the need for CA on analytical issues and notify the HDR PM. Provide the data validation report and releases data to the HDR PM.
Stop Work Authority	All Site Workers	-	-	All site workers can issue a stop work order for issues that present immediate and imminent danger. The HDR PM and Health and Safety Officer will be consulted verbally after the Stop Work and then with a follow-up report per the Site Safety and Health Plan.
QAPP Changes	HDR QA Officer / HDR PM	Lynn Lutz/ Tom Holmes	303-754-4266 404-295-3279	Manage and implement QAPP changes. Provide revisions to all QAPP recipients via email or hard copy, as applicable.

QAPP Worksheet #9: Project Planning Session Summary

No planning sessions were held, but the supplemental remedial investigation (SRI) has been discussed on monthly Site Management Team (SMT) calls.

The Main Installation (MI) SRI was initiated in 2015. The Statement of Work (SOW) for Contract No. W90FYQ-09-D-0005-CK04 (USACE, 2014) defined the work to be performed in Task 2, Supplemental Remedial Investigation; the initial step was review of site documents to identify data requirements for site hydrogeology and contaminant extent and for evaluation of remedial alternatives. The SRI was conducted in two phases following the document review. Phase 1 included installation of monitoring wells to provide hydrogeology and contaminant extent data as discussed with USEPA and TDEC in the May 2014 project review meeting, and Phase 2 included installation of additional wells and field data collection to evaluate remedial alternatives

The *Supplemental Remedial Investigation Phase 1 Work Plan, Revision 1* (HDR, 2015) was approved by TDEC in March 2015 and by USEPA in April 2015. The *Supplemental Remedial Investigation Phase 2 Work Plan, Revision 1* (HDR, 2016) was approved by TDEC in June 2016 and by USEPA in August 2016. Initial SRI field investigations were performed from April to August 2015 for Phase 1 and from October 2016 to April 2017 for Phase 2. The *Supplemental Remedial Investigation Phases 1 and 2 Report, Revision 1* (HDR, 2018e) was approved by TDEC in January 2018 and by USEPA in June 2018.

The *Supplemental Remedial Investigation Phase 3 QAPP, Revision 1* (Phase 3 QAPP) (HDR, 2018c) was approved by TDEC in January 2018 and by USEPA in April 2018. The Phase 3 QAPP identified locations for 24 monitoring wells, with 19 wells on the MI and 5 wells off-site. The off-site wells were not installed because access agreements could not be completed prior to completion of field work.

The SRI Phase 3 field investigation was performed from June to August 2018 with 19 wells installed on the MI. The *Supplemental Remedial Investigation Phase 3 Summary Report, Revision 0* (HDR, 2018f) was submitted to USEPA and TDEC for review on 30 November 2018. The report recommended additional well locations to address data gaps identified through the on-site Phase 3 wells.

The SOW for Contract No. W91278-16-D-0061-0002 (USACE, 2016) defined the work to be performed in Task 2, SRI Phases 3 and 4. The SOW includes installation of 33 monitoring wells on the MI and off-site during Phases 3 and 4 with groundwater sampling and analysis for volatile organic compounds (VOCs). Following installation and initial sampling, the wells will be incorporated into long-term monitoring (LTM) and will be sampled semiannually until a sample frequency can be determined in accordance with the criteria described in annual LTM reports. Fourteen wells are to be installed during Phase 4, including the five off-site wells that could not be installed in Phase 3.

In addition to installation of monitoring wells described above, the SOW includes vertical delineation of soil and groundwater contamination at two locations on the MI. The delineation in each area will consist of drilling, soil sampling, field monitoring for VOCs in the soil samples, and installation of a nested well for groundwater sampling.

The Phase 3 findings are described further in Worksheet 10, Recent Findings and Data Gaps and the Phase 4 field activities are described further in Worksheets 11, 14/16 and 17.

QAPP Worksheet #10: Conceptual Site Model

Background Information

Site History

DDMT is located in southeastern Memphis, Tennessee and consists of approximately 634 acres at the MI and Dunn Field. The MI contains approximately 567 acres with open storage areas, warehouses, former military family housing, and outdoor recreational areas. Dunn Field, which is located across Dunn Avenue from the northwest section of the MI, contains approximately 67 acres with former mineral storage and waste disposal areas.

DDMT originated as a military facility in the early 1940s to provide stock control, material storage, and maintenance services for the U.S. Army. DDMT was selected for closure under BRAC in 1995; storage and distribution activities ceased in September 1997.

During operations from 1942 to 1997, DDMT received, warehoused, and distributed supplies to U.S. military services and civilian agencies. The supplies included hazardous substances; textile products; food products; electronic equipment; construction materials; and industrial, medical, and general supplies.

Topography

DDMT is located in the Gulf Coastal Plain approximately three miles east of the bluffs at the edge of the Mississippi Alluvial Plain. Ground surface at the MI is nearly level with elevations generally from 290 to 305 feet, based on the North American Vertical Datum of 1988 (ft NAVD). The highest point is at 312 ft NAVD along Dunn Avenue near the northwest MI and the lowest point is at 267 ft NAVD below the earthen dam for Lake Danielson on the golf course in the southeast MI.

There are no naturally flowing streams or creeks on DDMT. Drainage occurs by overland flow via swales, ditches, concrete-lined channels, and a storm drainage system, which directs storm water into a series of storm drains for transport to discharge points around the perimeter. DDMT is generally level with or above surrounding terrain, so it receives little runoff from adjacent areas.

Geology and Hydrogeology

The geologic units of interest at DDMT are (from youngest to oldest): loess, including surface soil; fluvial deposits; Jackson Formation/Upper Claiborne Group (Jackson/Upper Claiborne); and Memphis Sand.

The loess consists of wind-blown and deposited brown to reddish-brown, low-plasticity clayey silt to silty clay. The loess deposits are about 20 to 30 ft thick and are continuous throughout the DDMT.

The fluvial (terrace) deposits at DDMT consist of two general layers. The upper layer is silty, sandy clay to clayey sand and ranges from about 0 to 30 ft thick. The lower layer is composed of interlayered sand, sandy gravel, and gravelly sand, and ranges from 30 to 100 ft thick. The uppermost aquifer is the unconfined Fluvial Aquifer, consisting of saturated sands and gravelly sands in the lower portion of the deposits. The saturated thickness ranges from 0 ft (dry) to approximately 70 ft. The groundwater level and saturated thickness of the Fluvial Aquifer are mainly controlled by the surface of the uppermost clay in the Upper Claiborne and areas of downward leakage where the clay layer is thin or absent, as noted below. The groundwater level does not reflect the nearly level ground surface at the MI. The groundwater in the Fluvial Aquifer is not a drinking water source for area residents; however, the current Tennessee groundwater classification at DDMT is General Use (TDEC Chapter 1200-04-03).

The Jackson/Upper Claiborne forms the upper confining unit for the Memphis Aquifer (MAQ) on a regional basis and separates the Fluvial Aquifer from the MAQ at DDMT. The Upper Claiborne Group includes the Cockfield and Cook Formations, and the individual formations of the Jackson/Upper Claiborne consist of clays, silts, and sands deposited in lenses or individual beds that are not areally extensive. The Jackson Formation is reported to be absent in the area of DDMT. The Cockfield Formation consists of inter-fingering fine sand, silt, clay, and local lenses of lignite. The Cook Mountain Formation consists primarily of clay with varying amounts of fine sand and is reported to be the most persistent clay layer in the Jackson/Upper Claiborne confining unit. The IAQ is locally developed in sand units within the Upper Claiborne.

The Memphis Sand primarily consists of thick bedded, white to brown or gray, very fine grained to gravelly, partly argillaceous and micaceous sand. The Memphis Sand ranges from 500 to 890 ft in thickness, and begins at a depth below ground surface (bgs) of approximately 120 to 300 ft. The MAQ is a regional deep, confined aquifer and is the primary source of water for the City of Memphis. Memphis Light, Gas & Water (MLGW) extracts groundwater from several well fields in the Memphis area, which has created a regional cone of depression in the potentiometric surface, with steeper local cones of depression at each well field. The Allen Well Field is the closest well field and is located approximately 1 mile west of DDMT.

Downward leakage from the Fluvial Aquifer is widespread in the Memphis area, particularly where the confining unit is thin or absent and in the vicinity of MLGW well fields. A connection or ‘window’ between the Fluvial Aquifer and IAQ was initially identified in the northwestern MI through numerous soil borings, water level measurements and groundwater samples showing chlorinated volatile organic compounds (CVOCs) in the IAQ monitoring wells within the area. Sands in the fluvial deposits and in the Upper Claiborne, observed to be in contact at several well borings in the central MI, act as a single water table aquifer in that area. The Upper Claiborne sand continues into the window, increases in thickness to the northwest and provides a connection to the Memphis Sand.

The SRI has also identified an area of downward leakage, based on Fluvial Aquifer groundwater elevations, in the south-central MI near MW-259. An IAQ well (MW-302) was installed near MW-259 during Phase 3; the groundwater sample contains the same CVOCs as MW-259, but at lower concentrations.

Land Use Considerations

All 567 acres on the MI have been transferred through public benefit and economic development conveyances. Land use controls implemented for the MI prevent residential use, drilling of groundwater wells and production or consumptive use of groundwater except in the eastern section of Functional Unit 6, Administrative and Residential Areas (Figure 1) which is available for unrestricted use (CH2M HILL, 2004). The MI is primarily used for warehousing within the Memphis Depot Industrial Park and for general operations at Barnhart Crane and Rigging.

Site Contaminants

Types of past activities that could have resulted in the presence of hazardous materials in environmental media at the MI include repackaging hazardous substances for storage or shipment, pesticide application, painting and sandblasting, vehicle maintenance, and hazardous material handling/storage. Other historical activities in open and enclosed storage areas included storing transformers with polychlorinated biphenyls (PCBs), storing and using pesticides/herbicides, and treating wood products with pentachlorophenol (PCP). These industrial activities resulted in the presence of metals, pesticides, and other less frequently detected chemicals in surface soil, surface water, and sediment, and CVOCs in groundwater at the MI.

Known or Suspected Contaminants or Classes of Contaminants

The MI remedial investigation (RI) (CH2M HILL, 2000) only found soil contamination in near-surface soils; contaminants consisted primarily of metals, PCBs, semi-volatile organic compounds (SVOCs), and a pesticide, dieldrin. Groundwater contaminants were limited to CVOCs primarily tetrachloroethene (PCE) and trichloroethene (TCE); carbon tetrachloride (CT) and chloroform (CF) were detected in the southeast MI, in addition to PCE and TCE. CVOCs were not detected at high concentrations in soil samples on the MI.

Additional investigation was performed in 2008 to identify potential source areas for the observed groundwater plumes on the MI (e2M, 2009). The field investigation consisted of a membrane interface probe (MIP) survey and confirmation soil samples on grids overlaying the upgradient areas of the plumes. Results of soil sample analyses were compared to the soil remediation goals (RGs) established for Dunn Field, which has similar proposed land use and potential for impacts to groundwater. Only five soil samples contained CVOCs at concentrations above an RG, and three were only slightly above the RGs. The generally low CVOC concentrations were not considered to warrant remedial action (RA).

Primary Release Mechanism

Release of contaminants to soil on the MI was associated with site operations and maintenance, and the release of CVOCs to groundwater is believed to be due to multiple, small spills and leaks.

Secondary Contaminant Migration

Secondary contaminant migration was limited to CVOCs on the MI. Following release through spills, contaminants are held in the loess because of limited permeability and adsorption to clay and organic matter in the fine-grained soils. CVOCs migrate into the fluvial soils beneath the loess with infiltration of rainwater and then to groundwater.

Fate and Transport

The contaminants of concern are CVOCs in groundwater, which migrate with groundwater. Groundwater in the Fluvial Aquifer flows onto the MI from all sides with flow off the MI through vertical leakage at the ‘window’ in the northwest MI and the sink in the south-central MI.

Naturally occurring biodegradation of CVOCs does not appear to be a significant contributor to natural attenuation in the Fluvial Aquifer at the MI based on the aquifer's low natural carbon content and high dissolved oxygen (DO), and the absence of reductive dechlorination products outside of the enhanced biological treatment (EBT) areas. However, first order decay rates calculated for the 2009 groundwater model had good agreement with PCE and TCE concentrations at wells along the flow paths, which indicate attenuation is occurring through physical processes of dispersion, dilution, sorption and volatilization (HDR, 2018e).

Groundwater contamination in the IAQ and MAQ in the Memphis area is the result of vertical migration of contaminants from the Fluvial Aquifer. Contaminant concentrations in the MAQ wells at DDMT are below maximum contaminant levels (MCLs); groundwater remediation in the Fluvial Aquifer is considered the most effective approach to protecting water quality in the deeper aquifers.

Potential Receptors and Exposure Pathways

Risk Assessment

The Baseline Risk Assessment (BRA) conducted during the MI RI (CH2M HILL, 2000) included a human health risk assessment. Health risks to industrial workers were within acceptable levels for future industrial use of the property, except for lead in a limited surface soil area. The area of lead contamination was excavated in 2001 (Jacobs, 2002). The BRA concluded that soil contaminants of concern were present at levels that do not allow for unrestricted use and unlimited exposure. The BRA also concluded that contaminated groundwater in the Fluvial Aquifer poses an unacceptable risk through the ingestion pathway; however, land use controls prevent drilling of groundwater wells and production or consumptive use of groundwater on the MI, except in Functional Unit 6 as noted previously.

An updated Human Health Risk Assessment (HHRA) for potential groundwater exposures and reviews of the HHRA for potential soil exposures and of the Screening Level Ecological Risk Assessments (SLERAs) for the Main Installation (MI) were performed in 2018; the *Human Health and Ecological Risk Assessment* (HDR, 2018d) was submitted to USEPA and TDEC for review in April 2018. Revised responses to USEPA comments on the report were submitted in December 2018.

The Groundwater HHRA update confirmed the BRA finding that there is potential for receptors to experience adverse health effects from exposure to contaminated on-site groundwater, and that exposures are currently being prevented by the existing land use restrictions at the MI. As long as these restrictions are maintained, the exposure pathways related to the contaminated groundwater are not complete, with the possible exception of vapor intrusion.

The Soil HHRA review found that most organic and inorganic constituents detected at the former Depot are present at levels that do not exceed current Industrial USEPA Regional Screening Levels (RSLs). However, additional risk assessment is recommended in a few areas to assure protectiveness of the remedy: additional soil sampling for lead in Parcels 28 & 35; additional sampling for chromium speciation analysis to evaluate the potential risks based on total chromium concentrations; and review of the current status and enforcement of the dioxin-related land use restrictions for the former Dip Vat area and the PCP-related restrictions in the 2005 MI Notice of Land Use Restrictions.

The SLERA review found that concentrations of certain COCs in environmental media exceed their respective ecological screening levels. In 2000, it was noted that there is minimal to no suitable ecological habitat throughout the MI; these conditions have not changed and there are no apparent complete ecological pathways of exposure on-site. However, the detection of dioxin/furans in on-site soils, as well as in local surface water and sediment warrants additional study.

Additional risk assessment is planned in 2019 in accordance with the recommendations in the HHERA report and the responses to USEPA comments on the report.

Vapor Intrusion

A soil vapor study is being performed on the MI to evaluate potential vapor intrusion (VI) risk from volatile organic compounds (VOCs) in soil and groundwater. A screening level assessment (HDR, 2017) was performed, which included identification of constituents of potential concern (COPCs); calculation of a groundwater screening level protective of VI risk for each COPC; and estimating VI risk based on recent sample analyses from three MI wells with the highest concentrations of the COPCs. The screening levels (SLs) and risk estimates were calculated using the USEPA's Vapor Intrusion Screening Level (VISL) Calculator; risk estimates were also calculated using the Johnson and Ettinger Model (JEM). Cumulative cancer risk greater than $1x10^{-6}$ and a non-cancer Hazard Index (HI) greater than 1.0 were identified. Due to the VI potential risk estimates, soil vapor sampling was recommended to further evaluate VI risk.

Soil vapor samples were collected in August 2018 at ten locations on the MI, with some samples collected from shallow soil borings at a depth of 5 feet and other samples collected from sub-slab locations; geotechnical test samples were collected at three locations adjacent to vapor samples; the report (HDR, 2019a) was submitted to USEPA and TDEC for review in January 2019. The report had the following conclusions:

- Primary CVOCs (PCE, TCE, CT and CF), as well as benzene and ethyl benzene, were each reported in multiple soil vapor samples at concentrations exceeding screening levels.
- Risk estimates for commercial exposure by the VISL Calculator and JEM indicated cumulative cancer risks above $1x10^{-6}$ at three locations and cumulative HI above 1.0 at two locations.
- The presence of VOCs in soil vapor samples at locations where those analytes have not been detected in groundwater suggests residual soil contamination in those areas.
- Geotechnical analysis of soil samples identified the shallow soil (loess) as lean clayey silt with permeability test results of $4.6x10^{-8}$ to $9x10^{-8}$ centimeters per second.

Additional sampling for VI is planned in 2019.

Nature and Extent of Contamination

Remedial action objectives (RAOs) and the selected remedy for the MI were established in *the Main Installation Record of Decision, Revision 2* (MI ROD) (CH2M HILL 2001). The MI groundwater RAOs include restoration of groundwater quality to levels at or less than MCLs and prevention of off-site migration (horizontally or vertically) of groundwater contaminants in excess of MCLs. The selected groundwater remedy for the MI was EBT, land use controls and LTM. The remedy required EBT to be implemented in the most contaminated parts of the plume, while untreated parts of the plume were allowed to degrade under natural attenuation processes.

EBT was conducted in areas with CVOC concentrations above 100 micrograms per liter [µg/L] from September 2006 to March 2009 (EBT-1) and November 2012 to November 2014 (EBT-2). While CVOC concentrations were reduced, the RA was not sufficient to meet the RAOs for the MI.

LTM has been performed at the MI since 2004. MI LTM wells, including SRI Phase 3 wells, are shown on Figure 2 (LTM and SRI Ph3 wells). As noted in the figure legend, the well symbols indicate the aquifer (Fluvial, Intermediate or Memphis) and are color coded by area (Background, B-835, North-Central, South-Central, West-Central, Southeast, Target Treatment Area (TTA)-1 North, TTA-1 South, TTA-2 and Window).

Groundwater contamination above MCLs is documented through semiannual LTM sampling. Although several CVOCs have been detected above MCLs, the CVOCs detected most frequently above MCLs are PCE and TCE. The most recent analytical results for the primary CVOCs from the biennial event in October 2018, are shown for Fluvial Aquifer wells by area on Table 1 and for IAQ/UC and MAQ wells by area on Table 2; non-detect results are not listed.

Recent Findings and Data Gaps

The SRI Phase 3 consisted of installation of 16 wells in the Fluvial deposits and three wells in Upper Claiborne sands on the MI. The wells were installed from June to August 2018 and were initially sampled in August 2018. The Phase 3 wells were sampled again during the October 2018 biennial LTM event. The locations of the installed wells and the remaining off-site locations are shown on Figure 2. Findings from the SRI Phase 3 Summary report (HDR, 2018f) and the 2018 LTM report (HDR, 2019b), and the remaining data gaps are discussed below.

Groundwater Flow

Groundwater flow in the Fluvial Aquifer is relatively well defined; flow is onto the MI from all sides with flow off the MI through vertical leakage at the window in the northwest MI and the sink in the south-central MI. Groundwater flow in the IAQ is to the northwest in the northwestern area of the MI; there are not enough IAQ wells in other areas of the MI to determine flow direction. The Phase 3 wells provided additional definition for Fluvial Aquifer and IAQ groundwater elevation contours (Figures 3 and 4) as discussed below.

Groundwater elevations from water level measurements in October 2018 are shown for the Fluvial Aquifer on Figure 3. Near Building 720 in the window, the groundwater elevations at MW-286, MW-285 and MW-288 shifted the 215 ft and 220 ft contours to the southwest and shifted the 210 ft contour into the window. Near Building 350 southeast of the window, the groundwater elevation at MW-295 shifted the 230 ft to 210 ft contours to the southwest increasing the hydraulic gradient to the southwest toward MW-64.

Groundwater elevations for the IAQ in October 2018 are shown on Figure 4; the only difference from recent IAQ groundwater elevation figures is the addition of a 205 ft contour north of MW-302, indicating a southerly flow direction in that area of the MI. The hydraulic gradient in the IAQ may be variable due to individual sand layers being discontinuous and interconnected (Parks, 1990).

MW-290, located north of Building 560 (Figure 2), was intended to be an IAQ well. However, the screened interval is apparently in connection with the Memphis Aquifer; the groundwater elevation is more than 25 feet lower than nearby IAQ wells and is consistent with the MAQ wells in the northwestern MI (MW-140, MW-254 and MW-255). MW-290 is classified as an MAQ well.

Phase 3 Fluvial/IAQ well pairs at MW-285/MW-293 and MW-286/MW-107T had differences in groundwater elevations of approximately 2 ft, and downward, vertical hydraulic gradients of 0.04 and to 0.07 based on October 2018 groundwater elevations; horizontal hydraulic gradients at these locations were approximately 0.02. At the locations near the window (MW-285/MW-293 and MW-286/MW-107T), a clay layer was not encountered between the fluvial deposits and the Upper Claiborne indicating that contaminant migration would occur with vertical flow. An intervening clay layer was also not encountered at several other well pairs south of the window (MW-39/A, MW-197A/B, MW-203A/B, MW-205A/B, MW-208A/B and MW-215A/B). At most of these well pairs, the difference in groundwater elevations is less than 0.2 ft; the difference is approximately 2 ft at MW-39/A with an upward vertical hydraulic gradient of 0.04. The sink in the south-central MI extends to the northwest with a secondary low point at MW-39 (Figure 2).

Groundwater elevation data from the October 2018 LTM event was used to prepare the Fluvial Aquifer flow direction map shown on Figure 5; flow direction is shown as a series of flow vectors oriented perpendicular to groundwater elevation contours. A line was added showing the approximate area of capture by the window based on the flow vectors. The dividing line runs from MW-16 in the northeast corner of the MI to the southern edge of the window, as indicated by the dewatered section of the Fluvial Aquifer, just south of MW-285. The figure indicates flow into the window is primarily from the northeastern MI, which encompasses only the North-Central plume and the potential source area near Building 720. The flow vectors indicate horizontal groundwater flow directions and do not incorporate the vertical hydraulic gradients noted above.

Remaining data gaps for groundwater flow are the hydraulic gradients in the Fluvial Aquifer at the northeast edge of the window and in the IAQ south of the window.

CVOC Concentration Trends

CVOC concentrations are generally stable as shown on trend plots in the 2018 Annual LTM report (HDR, 2019b). CVOC concentrations exceeded the MCL in 96 of 165 MI LTM wells in October 2018, mainly for PCE and TCE. Of the 96 MI LTM wells with concentrations above the MCL, 18 Fluvial Aquifer wells and one IAQ well (MW-107B) exceeded an MCL by a factor of 10 (>50 µg/L for PCE, TCE and CT and >20 µg/L for vinyl chloride [VC]).

CVOC concentrations in former EBT areas show decreasing effects from carbon source (sodium lactate) injections which ended in 2014. The parent CVOCs (PCE and TCE) have rebounded at many wells, even where products of past reductive dechlorination (cDCE and VC) remain. Areas near wells with relatively quick rebound of CVOC concentrations following EBT or consistently high concentrations of parent compounds may be near past releases and should be considered for additional investigation prior to implementation of additional RA. These wells include: PMW21-02, PMW21-03, and PMW21-04 in TTA-1 North and DR2-1, MW-92 and PMW85-05 in TTA-2. Additional investigation could include MIP surveys, soil gas sampling in loess or fluvial deposits and/or additional soil sampling.

Plume Delineation

CVOC concentrations in a number of LTM wells are consistently above MCLs and showed no impact from previous EBT indicating the areal extent of RA will need to be expanded to meet the RAO for concentrations below the MCLs throughout the MI. Delineation of identified plumes should be completed during the SRI to effectively determine the extent of remedial activities.

Groundwater elevation contours are shown with the concentrations and isopleths from the October 2018 biennial LTM event for PCE on Figure 6 and for TCE on Figure 7.

Findings from the initial Phase 3 well samples in August 2018 and October 2018 LTM sampling are summarized below:

- Three Fluvial Aquifer wells (MW-285, MW-286 and MW-288) and one IAQ well (MW-293) were installed to investigate the extent of CVOCs and the groundwater flow direction at the window and to assess potential contaminant sources at MW-107 near Building 720.
    - PCE concentrations (98.6 and 67.7 µg/L) at MW-286 indicates a possible contaminant source near Building 720. MW-286 is adjacent to IAQ well MW-107 which has had variable PCE concentrations of 5 to 80 µg/L from 2011 through 2018. TCE concentrations (2.5 and 1.62 µg/L) at MW-286 indicates limited groundwater migration of TCE exceeding the MCL into the window.
    - PCE and TCE concentrations at MW-285 and MW-288 indicates possible extension of the North-Central plume.
    - IAQ well, MW-293, was installed adjacent to MW-285. PCE and TCE were detected at approximately 1 µg/L in both samples.
- Three Fluvial Aquifer wells (MW-292, MW-294 and MW-295) were installed to investigate the extent of CVOCs upgradient of TTA-2 West. PCE and TCE concentrations at MW-292 and MW-295 limit the extent of the TTA-2 plume, while the concentrations at MW-294 indicates the source area may be further to the north.
- Three Fluvial Aquifer wells (MW-287, MW-289 and MW-291) were installed to investigate the extent of CVOCs in the North-Central Plume. Low PCE and TCE concentrations in the wells limit the extent of the North-Central plume, except for TCE at 12.5 µg/L at MW-291 which extends the moderate concentration area (>10 µg/L) further south from the MI northern boundary. The upgradient section of the TCE plume is not bounded to the southeast.
- Two Fluvial Aquifer wells (MW-299 and MW-300) were installed to investigate the extent of CVOCs in the Building 835 Plume. TCE concentrations at MW-300 extend the area slightly exceeding the MCL north from MW-143, while concentrations below the reporting limit (RL) at MW-299 limit the extent of the plume.
- Three Fluvial Aquifer wells (MW-296, MW-297 and MW-298) were installed to investigate the extent of CVOCs in the South-Central Plume and to replace PZ-03.
    - MW-297 is located 95 feet east of PZ-03. TCE concentrations at MW-297 (16.3 and 18.9 µg/L) are similar to recent concentrations reported at PZ-03, which was last sampled in October 2016.
    - TCE was not detected above the RL at MW-298 which limits the upgradient extent of the plume.

  - Low TCE concentrations at MW-296 support the down-gradient extent of the South-Central plume while PCE concentrations (9 and 12.4 µg/L) indicates migration of the West-Central Plume towards the sink.

- A Fluvial Aquifer well (MW-301) was installed to investigate the extent of CVOCs in the southeast MI, near MW-270. PCE concentrations (4.3 and 4.96 µg/L) indicate low-level contaminant migration towards the sink from MW-52. TCE concentrations (29.2 and 40.9 µg/L) indicates the source area may be to the northeast of MW-301; MW-52 has not had TCE reported above 3 µg/L. The TCE plume may extend off-site to the south-southwest.

- A Fluvial Aquifer well and IAQ well were planned to be installed in the central MI to investigate the extent of CVOCs and groundwater flow direction in an area without previous groundwater monitoring.
  - The Fluvial Aquifer well (MW-284) was installed as planned. PCE concentrations (11.9 and 16.8 µg/L) and TCE concentrations (5 and 5.63 µg/L) extend the West-Central plume southeast toward the sink.
  - The deeper well (MW-290) was installed adjacent to MW-284, but the expected clay layer at the base of the Fluvial Aquifer was observed below the transition from fluvial deposits to Upper Claiborne sand and, as noted previously, the groundwater elevation resulted in MW-290 being classified as an MAQ well. CVOCs have not been detected at MW-290.

- An IAQ well (MW-302) was installed adjacent to MW-259 in the central area of the sink to investigate potential CVOC contamination and groundwater flow direction in the IAQ. CVOCs were detected at low concentrations above the RL: CT (2.7 and 3.11 µg/L), PCE (3.8 and 5.45 µg/L) and TCE (2.2 and 1.82 µg/L). The October 2018 sample at MW-259 contained the same CVOCs at higher concentrations: CT (4.01 µg/L), PCE (14.3 µg/L) and TCE (19.2 µg/L).

Based on the Phase 3 well samples collected in August 2018 and October 2018, additional data gaps for plume extent were identified: contaminant extent near Building 720, contaminant migration into the window from the West-Central and North-Central plumes, upgradient extent of the TTA-2 plume, upgradient and down-gradient (off-site) extent of the Southeast (MW-270) plume, and contaminant extent in the IAQ beneath the sink. These additional data gaps and the remaining data gaps for the Phase 3 offsite wells are listed in Step 1 on Worksheet #11.

SRI Phase 4 and related SRI activities (vertical profiling, site stratigraphy review and SVE pilot test) will provide additional information for an updated conceptual site model in the final SRI report to be prepared after completion of SRI Phase 4

QAPP Worksheet #11: Project Data Quality Objectives

DQOs for Phase 4 well installation and sampling were established using the seven step process developed by the USEPA in the *Guidance on Systematic Planning Using the Data Quality Objective Process* (USEPA, 2006). The purpose of these DQOs are to identify the project objective and establish performance and acceptance criteria, which serves as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of the study (USEPA, 2006).

Step 1: State the Problem

Due to the number of LTM wells exceeding MCLs and the CVOC concentrations at wells located outside areas impacted by previous EBT, the Army is re-evaluating the selected remedy for the MI. Further investigation is recommended to address data gaps identified in Worksheet #10 and the remaining data gaps for Phase 3 off-site wells.

- Hydraulic gradient in the Fluvial Aquifer at the northeast edge of the window and in the IAQ south of the window.
- Contaminant extent near Building 720.
- Lateral extent of the North-Central plume.
- Contaminant migration into the window or the sink from the West-Central and North-Central plumes.
- Upgradient extent of the TTA-2 plume.
- Upgradient and down-gradient (off-site) extent of the Southeast (MW-270) plume.
- Contaminant extent in the IAQ beneath the sink.
- Offsite extent of CVOCs and groundwater flow direction in IAQ northwest of the MI.
- Offsite extent of CVOCs upgradient of TTA-1N, TTA-1S and North-Central plumes.

Step 2: Identify the Goal of the Study

The goal of the SRI Phase 4 investigation is to collect hydrogeological and analytical data from new monitoring wells in the Fluvial Aquifer and the IAQ.

Step 3: Identify Information Inputs

Additional investigation will provide soil lithology from boring logs, groundwater elevations and VOC analytical data, soil geotechnical and VOC analytical data, and two nested wells to evaluate CVOC concentrations at multiple depths. The data will be used with LTM data to determine groundwater flow direction within and across lithological units, areas where MCLs are exceeded, trends in CVOC concentrations, and potential source areas/receptors.

Groundwater samples for VOC analysis will be collected from the new monitoring wells, including two nested wells each with up to four 1-inch wells screened at different depths. Soil samples for geotechnical and VOC analysis will be collected from direct push technology (DPT) and/or rotasonic well borings; soil samples from rotasonic borings will be collected with a soil sampler advanced ahead of the drill core. Geotechnical parameters will include grain size, permeability, dry bulk density, porosity and water-filled porosity.

Step 4: Define the Boundaries of the Study

The study area is defined by the former DDMT property boundary for the MI and groundwater plumes migrating onto or away from the property; the area is approximated by the LTM wells shown on Figure 2.

An initial groundwater sample will be collected and water level measured from each well following installation. The new wells will be incorporated into MI LTM and sampled semiannually until sufficient data is available to revise the sample frequency.

Groundwater analytical data have been collected at DDMT since 1993 and are maintained in a database for use in trend analyses and other review. LTM will continue until groundwater RAOs are met.

Step 5: Develop the Analytic Approach

The groundwater contaminants at DDMT are CVOCs, but sample analyses include a full list of VOCs to identify degradation products and potential off-site impacts. Groundwater samples will be analyzed for VOCs by Method SW8260; the analyte list is shown below.

VOC Analytes		
1,1,1-Trichloroethane	Acetone	Isopropylbenzene
1,1,2,2-Tetrachloroethane	Benzene	m-,p-Xylene
1,1,2-Trichloroethane	Bromochloromethane	Methyl t-butyl ether (MTBE)
1,1-Dichloroethane	Bromodichloromethane	Methyl Acetate
1,1-Dichloroethene	Bromoform	Methylene chloride
1,2,3-Trichlorobenzene	Bromomethane	Methylcyclohexane
1,2,4-Trichlorobenzene	Carbon disulfide	o-Xylene
1,1,2-Trichlorotrifluoroethane	Carbon tetrachloride	sec-Butylbenzene
1,2-Dibromo-3-chloropropane(DBCP)	Chlorobenzene	Styrene
1,2-Dibromoethane (EDB)	Chloroethane	tert-Butylbenzene
1,2-Dichlorobenzene	Chloroform	Tetrachloroethene
1,2-Dichloroethane	Chloromethane	Toluene
1,2-Dichloropropane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene
1,3-Dichlorobenzene	cis-1,3-Dichloropropene	trans-1,3-Dichloropropene
1,4-Dichlorobenzene	Cyclohexane	Trichloroethene
2-Butanone (MEK)	Dibromochloromethane	Trichlorofluoromethane
2-Hexanone	Dichlorodifluoromethane	Vinyl chloride
4-Methyl-2-pentanone (MIBK)	Ethylbenzene	Up to 20 TICs*

*The laboratory will report up to 20 tentatively identified compounds (TICs) on the largest GC/MS peaks that are not on the standard analyte list.

The findings of the SRI will be used with related studies including additional risk assessment, conceptual site model update and the VI study to evaluate the RAOs and determine the appropriate RA.

Lithology at each boring will be described using the Unified Soil Classification System (American Society for Testing and Materials [ASTM] D2487-83).

Field and laboratory analysis of soil samples will be used to identify potential source areas. Geotechnical analysis will be used to document soil type, permeability, and moisture content.

Groundwater elevations will be determined from water level measurements referenced to a surveyed benchmark elevation.

Initial samples will be collected by low-flow sampling with measurement of water quality parameters. Passive diffusion bag (PDB) samplers will be installed, where appropriate, for sampling during LTM.

Groundwater concentrations above the MCLs will be used to determine where RA is necessary.

Step 6: Specify Performance or Acceptance Criteria

Groundwater samples will be collected from new monitoring wells and analyzed at a United States Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) laboratory for VOCs by USEPA Method SW8260.

Performance criteria for analytical data are presented in Worksheet #12. Acceptance criteria will be based on compliance with the task descriptions in Worksheet #14/16 and the applicable Standard Operating Procedures (SOPs).

A Tennessee-registered land surveyor will establish horizontal and vertical control for all new monitoring wells. Vertical control will be established to 0.01 ft and will be based on the North American Vertical Datum of 1988. Horizontal control will be established to 0.1 ft and will be based on the Tennessee State Plane Coordinate System.

Well installation and development, groundwater sampling, laboratory analysis, and data validation will be conducted in accordance with:

- this QAPP;
- DDMT Uniform Federal Policy – Quality Assurance Project Plan (DDMT UFP QAPP) (HDR, 2018a);
- Low Stress Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (USEPA, 2017)
- DoD General Data Validation Guidelines (DOD, 2018); and
- Environmental Quality Guidance for Evaluating Performance-Based Chemical Data, EM 200-1-10 (USACE, 2005).

Step 7: Develop the Plan for Obtaining Data

The project schedule and task summaries are provided on Worksheet #14/16, and sampling design and rationale are provided on Worksheet #17.

QAPP Worksheet #12: Measurement Performance Criteria

Matrix: Groundwater, Investigation Derived Waste (IDW) Soil Toxicity Characteristic Leaching Procedure (TCLP)
Analytical Group: VOCs
Concentration Level: Low/Medium

Data Quality Indicators	QC Sample and / or Activity Used to Assess Measurement Performance	Measurement Performance Criteria
Precision-overall	Field duplicate*	≤ 20% Relative Percent Difference (RPD)
Precision-overall	Matrix Spike/Matrix Spike Duplicate (MS/MSD)*	≤ 20% RPD
Precision-lab	Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)	± 20% RPD
Accuracy/bias	Surrogate spike recoveries	Quality Systems Manual (QSM) v.5.1 App. C Table 24 (or lab if not in QSM) control limits
Accuracy/bias	MS/MSD recoveries*	QSM v.5.1 App. C Table 24 (or lab if not in QSM) control limits
Accuracy/bias	LCS/LCSD recoveries	QSM v.5.1 App. C Table 24 (or lab if not in QSM) control limits
Accuracy/bias-contamination	Method blanks	No analyte detected at ≥1/2 reporting limit (RL) or > 10% sample concentration or regulatory limit
Accuracy/bias-contamination	Equipment blanks, ambient blanks, trip blanks*	No analyte detected at ≥ RL

**Samples of water and soil IDW will be collected at the completion of field work or before if storage capacity is reached; field quality control (QC) samples are not required by the disposal facility and will not be collected.*

Matrix: Soil, IDW Soil (total)
Analytical Group: VOCs
Concentration Level: Low/Medium

Data Quality Indicators	QC Sample and / or Activity Used to Assess Measurement Performance*	Measurement Performance Criteria
Precision-lab	LCS/LCSD	≤ 20% RPD
Accuracy/bias	Surrogate spike recoveries	QSM v.5.1 App. C Table 23 (or lab if not in QSM) control limits
Accuracy/bias	LCS/LCSD recoveries	QSM v.5.1 App. C Table 23 (or lab if not in QSM) control limits
Accuracy/bias-contamination	Method blanks	No analyte detected at ≥1/2 reporting limit (RL) or > 10% sample concentration or regulatory limit

** Samples of soil IDW will be collected at the completion of field work or before if storage capacity is reached; field quality control (QC) samples are not required by the disposal facility and will not be collected.*

QAPP Worksheet #13: Secondary Data Uses and Limitations

Source	Data Type	Data Uses for Current Project
e²M, *Main Installation Source Areas Investigation, Defense Depot Memphis, Tennessee, Defense Logistics Agency, Revision 0.* February, 2009.	Site assessment and soil sample results	Background information
HDR. *Fourth Five-Year Review, Defense Depot Memphis Tennessee, Revision 2*. March 2018.	Latest Five-Year Review	Background information
HDR, *Supplemental Remedial Investigation Phases 1 and 2 Report, Defense Depot Memphis, Tennessee, TN4210020570, Revision 1*. June 2018	Description of previous investigations; lithology, groundwater elevation and analytical data	Background information
HDR, *Supplemental Remedial Investigation Phase 3 Summary Report, Defense Depot Memphis, Tennessee, TN4210020570, Revision 0*. November 2018	Lithology, groundwater elevation and analytical data	Background information and selection of well locations.
HDR. *Annual Long-Term Monitoring Report-2018, Defense Depot Memphis Tennessee, TN4210020570, Internal Draft*. February 2019	Recent groundwater elevation and analytical data	Background information and selection of well locations.

QAPP Worksheet #14/16: Project Tasks & Schedule

The tasks and schedule for SRI Phase 4 and submittal of deliverables for regulatory agency review are shown below.

Activity	Responsible party	Planned start date	Planned completion date	Deliverable(s)	Planned Deliverable due date
Draft Work Plan	HDR	1/7/19	4/19/19	Phase 4 QAPP, Revision 0	4/19/19
Regulatory Review	USEPA & TDEC	4/22/19	6/21/19	Comments or Approval Letter	6/21/19
Final Work Plan	HDR	6/22/19	7/5/19	Phase 4 QAPP, Revision 1	7/5/19
Well Access Agreements	Army	4/25/19	7/5/19	Final agreements to file	7/5/19
SRI Phase 4 Field Tasks	HDR/ Cascade & McCray	8/5/19	9/13/19	Field reports, boring logs and well diagrams to file	9/16/19
Well Sampling	HDR	9/3/19	9/13/19	Samples to laboratory, field reports to file	9/16/19
Phase 4 Soil Geotechnical Analysis	McCray	8/19/19	8/30/19	Data report	9/3/19
Phase 4 Soil and Groundwater Chemical Analysis	Chemtech and Microbac	9/16/19	9/27/19	Stage 4 report and Electronic Data Deliverable	10/7/19
Analytical Data Validation	HDR	10/7/19	10/21/19	Data validation report and final data flags	10/21/19
Report Preparation	HDR	9/16/19	12/20/19	Final SRI Report, Revision 0	12/23/19

The Phase 4 field, analytical and data review tasks are summarized below. Additional details are provided in the SOPs (see Worksheets 21 and 23).

The well locations are shown on Figures 8 and 9. Additional information is provided on Worksheet 17, Sampling Design and Rationale.

Well Access

Access for well locations on the MI will be cleared with the property manager and tenants/owners by HDR. Access for off-site locations will be obtained from the property owners by the Army with assistance from HDR, as requested. Agreements are in place for all six off-site well locations.

Well Installation

Permits for well installation from Shelby County Health Department (SCHD) and utility clearances will be obtained by the drilling contractor.

The off-site wells not installed during Phase 3 will be installed initially, and the lithology and groundwater elevation measurements will be reviewed to evaluate whether any Phase 4 well locations or depths should be revised. No changes will be made prior to review and discussion with USEPA and TDEC.

Borings for Fluvial Aquifer wells will be advanced by rotasonic drilling to the uppermost clay beneath the water table. Each boring will be backfilled to the top of clay and the well installed using Schedule 40 polyvinyl chloride (PVC) casing and screen.

Nested wells will be installed at two locations in areas where the clay between the Fluvial and Upper Claiborne sands is not expected to be present. Each boring will be installed to the target depth; up to 4, small-diameter (1-inch) wells will be installed with screens at varied depths and constructed using Schedule 80 PVC casing and screen.

Borings for IAQ wells will be advanced by rotasonic drilling 5-10 ft into the clay at the base of the Fluvial Aquifer. Surface casing will be installed to the bottom of the boring and grouted in place; boring will then be advanced to the target depth and the well installed using Schedule 80 PVC casing and screen. The clay between the Fluvial and Upper Claiborne sands was not observed in the boring for MW-290 and surface casing is not expected to be necessary at Phase 4 well I-5.

Wells will be developed no sooner than 24 hours after completion.

Soil cuttings from all well borings will be contained in a roll-off or on plastic sheeting for testing prior to disposal. Cuttings with suspected contamination due to elevated photoionization detector (PID) readings or visible staining will be placed in a covered drum after logging and screening the soil core. Wastewater generated during drilling, well installation and development will be contained for sampling and analysis to determine disposal requirements.

Horizontal and vertical control for each new well will be determined by Tennessee-registered land surveyor after installation.

Project-specific requirements for well installation are provided in the attachment at the end of this worksheet.

Sampling

Water levels will be measured at the new wells and nearby LTM wells during a one-day sweep; the LTM wells selected for water level measurements are listed on Table 3. Measurements will be made at least 24 hours after well development or sampling.

Initial groundwater samples will be collected using bladder pumps and Teflon® lined tubing for low-flow sampling; if the saturated thickness or recharge is insufficient for a bladder pump, samples will be collected using disposable Teflon® bailers. Water quality parameters will be measured to confirm well stabilization prior to sampling. PDBs will be installed after the initial sample if the saturated screened interval is 5 ft or greater.

Samples will be collected from IDW (soil cuttings by HDR and wastewater by the drilling contractor) to determine disposal requirements. Additional samples will be collected if cuttings with suspected contamination are observed.

Analysis

Analyze groundwater samples for VOCs. Analyze soil samples for VOCs by standard analysis. Analyze soil IDW samples for VOCs by standard analysis and TCLP. Analyze wastewater samples per analytical requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-approved disposal facility.

Quality Control

Follow SOP 1-General Procedures for Field Personnel; SOP 2-Drilling and Soil Sampling; SOP 3-Well Installation, Development and Abandonment; SOP 4-Groundwater Sample Collection; SOP 7-Sample Control and Documentation; SOP 8-Sample Packing and Shipping; SOP 9-Equiment Decontamination. Field quality control (QC) samples are described on Worksheet #20-Field QC Summary and laboratory QC on Worksheet #28-Analytical Quality Control and Corrective Action.

Data Management

Laboratories will provide complete analytical data package including raw data (Stage 4) for groundwater samples in accordance with Appendix E, SW-846 Reporting Requirements, of the DoD Quality Systems Manual Version 5.1 (January 2017).

Analytical data will be added to the DDMT database after validation.

Documentation and Records

All well locations will have final coordinates documented with surveyor stamped plats. Field measurements and sample data will be noted in field records and maintained in project files.

Groundwater sample analytical results will be provided in summary tables for analytes detected and in tables showing complete analytical results in an appendix. The complete laboratory analytical reports and data validation will also be provided in appendices to the SRI report.

Assessment/Audit Tasks

Field sampling procedures are reviewed in biennial audits by QA officer.

Annual laboratory audits are performed through DoD ELAP.

Data Review Tasks

Laboratories will verify that data are complete for samples received. All data package deliverables requirements will be met. Data will be reviewed by HDR at the Step I (Verification)/Steps IIa and IIb (Validation) levels as described in the *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual* (Intergovernmental Data Quality Task Force, 2005) and Stages 1VM, 2AVM and 2BVM on 100% of the data and Stage 3VM on 10% of the data as described in the *General Data Validation Guidelines* (U.S. Department of Defense, Environmental Data Quality Workgroup, February 09, 2018). Qualification recommendations from the *General Data Validation Guidelines* (U.S. Department of Defense, Environmental Data Quality Workgroup, February 09, 2018) will be followed. Achievement of project-specific measurement performance criteria specified in the QAPP and data validation criteria will be evaluated during the data verification and validation, and the analytical measurement error will be assessed. A Data Validation Report will be produced for each Sample Delivery Group.

Validated data and related field logs/notes/records will be reviewed to assess total measurement error and determine overall usability of the data for project purposes. Data limitations will be determined and data will be compared to Project Quality Objectives (PQOs) and required Action Limits. CA is initiated, as necessary. Final data are placed in a database, with any necessary qualifiers, and tables, charts, and graphs are generated.

Attachment – Phase 4 Well Installation Summary

Borings will be advanced using rotasonic drilling methods and continuous soil cores will be collected from ground surface to the termination depth of each boring. Drilling and well installation will be performed by Cascade Drilling, a licensed Tennessee well driller. An HDR field geologist will record field observations and log the soil core. Headspace analysis with a PID will be made on grab samples selected from each soil core based on field observations; the PID readings will be recorded on the boring log.

Fluvial Aquifer Wells

A 6-inch borehole will be advanced to the target depth; borings terminated in a clay layer beneath the water table will be back-filled with bentonite pellets to just below the top of clay.

Well casings will be new, unused, 10-ft sections of 2-inch I.D. Schedule 40 PVC pipe with internal flush, threaded joints. Well screens will be one 10-ft section of Schedule 40 PVC continuous slotted 0.010-inch screen. A threaded PVC cap or point will be placed at the bottom of the screen. Centralizers will be used at the top of the screened section, and every 30 ft along the riser.

A filter pack of clean, inert, hard, well-rounded sand (less than 2% flat particles) will be installed from approximately 1 ft below to 5 ft above the well screen in accordance with SOP 3 (Appendix A). A minimum 5-ft-thick bentonite seal will be placed above the filter pack and hydrated with potable water for at least one hour. Cement-bentonite grout will be placed in the annular space above the bentonite seal to approximately 6 inches bgs.

Wells will generally be set as flush-mounted completions with brightly painted bollards used where appropriate for protection or location. The number and location of bollards required at each well will be determined by the FTL. Each well pad will be 3 by 3 ft square and 4 inches thick constructed using Quikcrete® crack resistant (No. 1006) or equivalent concrete mix. The manhole will be a Morrison Bros. Co. 519 9-inch diameter powder-coated single-bolt water tight manhole (or equivalent) placed in the center of the pad and approximately 1-inch higher than the edge of the pad. The manhole will have an identification brass label stamped to clearly show the well identification. Wells will be secured as soon as possible after drilling with corrosion resistant locks.

The wells will be developed by surging and pumping. Well development will be initiated no sooner than 24 hours following grout installation. Development will continue until clear, sand-free formation water is produced from the well and water quality parameters have stabilized. Stabilization of water quality parameters is achieved after three successive readings are within ± 0.1 for pH, ± 3% for specific conductance, ± 10% for DO values greater than 0.5 milligrams per liter (mg/L) or three successive DO values less than 0.5 mg/L, ± 10 millivolts for oxidation reduction potential (ORP), 3% for temperature, and 10% for turbidity values greater than 5 nephelometric turbidity units (NTU) or three successive values less than 5 NTU (USEPA, 2017). If stabilization parameters are not met after four hours of development the PM will be contacted and a determination will be made whether or not to continue development.

Intermediate Aquifer Wells

A 12-inch borehole will be advanced 5 to 10 ft into the uppermost clay at the top of the Jackson Formation/Upper Claiborne Group (base of Fluvial Aquifer). An 8-inch diameter, threaded Schedule 80 PVC or steel surface casing will be installed. After placing the surface casing, the driller will lower a tremie pipe connected to a grout pumping unit through the inner annulus of the casing. The driller will pump grout through the injection pipe until the grout returns to the ground surface. The grout will cure for 24 hours before continuing to advance the borehole. Water present in the inner annulus of the casing will be pumped to a holding tank before a 6-inch borehole is advanced to the target depth.

Well casings will be new, unused, 2-inch I.D. Schedule 80 PVC pipe with internal flush, threaded joints. The well screens will be one 10-ft section of new, unused, 2-inch I.D. Schedule 80 PVC continuous slotted 0.010-inch screen. A threaded PVC cap or point will be placed at the bottom of the screen. Centralizers will be used at the top of the screened section and every 30 ft along the riser.

A filter pack of clean, inert, hard, well-rounded sand (less than 2% flat particles) will be installed from approximately 1 ft below to 5 ft above the top of the well screen in accordance with SOP 3 (Appendix A). The bentonite seal, cement-bentonite grouting, surface completion and well development will be as described for Fluvial Aquifer wells.

Vertical Delineation and Nested Wells

Vertical delineation of soil and groundwater contamination will be investigated at two locations. Soil samples from DPT borings will be collected at three depths in the loess and upper fluvial deposits. Deeper soil samples from a rotasonic boring advanced for installation of a nested well will be collected at two depths in the fluvial deposits and/or Upper Claiborne sand. The soil samples will be submitted for VOC analyses and for geotechnical testing. Each nested well will have up to four separate 1-inch inside diameter (ID), Schedule 40 PVC wells with 2.5-foot long well screens.

An 8-inch diameter borehole will be advanced to a depth of approximately 150 feet bgs; based on previous well borings at the planned locations, a clay layer is not present between the fluvial deposits and Upper Claiborne sand. Each nested well will consist of up to four 1-inch ID wells constructed within the 8-inch diameter boring. The 1-inch ID wells will be constructed with Schedule 80 PVC well casing and screen for increased rigidity and strength, and will have one 2.5-feet long, pre-packed screen with a 2-inch diameter centralizer placed approximately one foot above the screen. Schedule 80 PVC well casing will extend from each screen interval to the ground surface.

A filter pack of clean, inert, hard, well-rounded (less than 2 percent flat particles) will be installed from approximately 2 feet below to 2 feet above each well screen, except for a filter pack extending only 1 foot below the deepest screen, in accordance with SOP 3 (Appendix A). The filter pack will be installed in 1 to 2 foot lifts as the casing is vibrated from the hole.

A minimum 5-foot-thick bentonite seal will be placed above the filter pack for each screened interval; the bentonite seal may be greater than 10 feet, depending on the depth of individual wells. The 100% sodium bentonite seal will be allowed to hydrate for at least one hour prior to installation of the next screen.

Bentonite-cement grout will be placed in the annular space above the uppermost bentonite seal to approximately 6 inches below ground surface as described for Fluvial Aquifer wells. The surface completion and well development will be as described for Fluvial Aquifer wells except that a small diameter pump will be required for development.

Investigation Derived Waste

IDW consisting of soil cuttings from the borings, wastewater from equipment decontamination and groundwater from well development will be stored for analysis prior to disposal.

Soil cuttings from the well borings will be transported to Dunn Field and placed on plastic sheeting; the cuttings will be covered by plastic sheeting held in place by perimeter weights. Upon completion of drilling, one soil sample will be collected for approximately each 5 cubic yards of soil cuttings. At each sample location, approximately 6 inches of surface soil will be removed and samples will be collected for VOC analysis by standard extraction and by TCLP extraction. Soil samples for standard extraction will be collected with a Terracore sampler. Soil samples for TCLP extraction, which requires greater sample volume, will be collected by completely filling a 4-ounce jar for each location. If standard analysis demonstrates the VOC concentrations are less than the Dunn Field RGs, the soil cuttings will be spread on Dunn Field. If the soil concentrations exceed the RGs, TCLP VOC results will be reviewed to confirm the soil meets requirements for disposal as non-hazardous waste at a CERCLA-approved facility in the Memphis area.

Water IDW will be stored in a Baker frac tank at a location to be determined during mobilization. The tank will be properly labeled with the water source (equipment decon and well development) and the start/end dates. After well installation, development and sampling are completed, grab samples of wastewater will be collected by the drilling contractor for complete TCLP analysis and disposal as non-hazardous waste at a CERCLA-approved facility in the Memphis area.

QAPP Worksheet #15: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: MI Groundwater (Initial Phase 4 Samples)
Analytical Method: VOCs – Chemtech
Concentration level: Low/Medium

Analyte	Project Action Limit (MCL)	Project Quantitation Limit Goal	Achievable Laboratory Limits[1]		
			DLs	LODs	LOQs
	(µg/L)	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*
Carbon tetrachloride	5	1	0.2	0.2	1
Chloroform	80	1	0.2	0.2	1
Tetrachloroethene	5	1	0.2	0.2	1
Trichloroethene	5	1	0.2	0.2	1
Vinyl chloride	2	1	0.2	0.2	1
cis-1,2-Dichloroethene	70	1	0.2	0.2	1

[1] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Project Action Limits for groundwater on the MI are the current (November 2018) USEPA MCLs.

Matrix: MI Groundwater (LTM Samples from Phase 4 Wells)
Analytical Method: VOCs - Microbac
Concentration level: Low/Medium

Analyte	Project Action Limit (MCL)	Project Quantitation Limit Goal	Achievable Laboratory Limits[1]		
			DLs	LODs	LOQs
	(µg/L)	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*
Carbon tetrachloride	5	1	0.25	0.5	1
Chloroform	80	1	0.125	0.25	1
Tetrachloroethene	5	1	0.25	0.5	1
Trichloroethene	5	1	0.25	0.5	1
Vinyl chloride	2	1	0.25	0.5	1
cis-1,2-Dichloroethene	70	1	0.25	0.5	1

[1] Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.
Project Action Limits for groundwater on the MI are the current (November 2018) USEPA MCLs.

Matrix: Soil, Soil IDW
Analytical Method: VOCs, total - Chemtech
Concentration level: Low

Analyte	Project Action Limit	Project Quantitation Limit Goal	Achievable Laboratory Limits[1]		
			DLs	LODs	LOQs
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*
Carbon tetrachloride	0.215	0.005	0.0005	0.0005	0.005
Chloroform	0.917	0.005	0.0005	0.0005	0.005
Tetrachloroethene	0.1806	0.005	0.0005	0.0005	0.005
Trichloroethene	0.182	0.005	0.0005	0.0005	0.005
Vinyl chloride	0.0294	0.005	0.0005	0.0005	0.005
cis-1,2-Dichloroethene	0.755	0.005	0.0005	0.0005	0.005

Project Action Limits for Total VOCs – RGs in Dunn Field ROD

[1] *Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.*

Matrix: Soil IDW
Analytical Method: VOCs, TCLP - Chemtech
Concentration level: Low

Analyte	Project Action Limit	Project Quantitation Limit Goal	Achievable Laboratory Limits[1]		
			DLs	LODs	LOQs
	(mg/L)	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*
Benzene	0.5	0.005	0.0032	0.0005	0.005
Carbon tetrachloride	0.5	0.005	0.0002	0.0005	0.005
Chlorobenzene	100.0	0.005	0.00049	0.0005	0.005
Chloroform	6.0	0.005	0.00034	0.0005	0.005
1,4-Dichlorobenzene	7.5	0.005	0.0032	0.0005	0.005
1,2-Dichloroethane	0.3	0.005	0.00048	0.00075	0.005
1,1-Dichloroethene	0.7	0.005	0.00047	0.0005	0.005
Methyl ethyl ketone (MEK) (2-Butanone)	200.0	0.025	0.00132	0.0025	0.025
Tetrachloroethene	0.7	0.005	0.00027	0.0005	0.005
Trichloroethene	0.5	0.005	0.00028	0.0005	0.005
Vinyl chloride	0.2	0.005	0.00034	0.0005	0.005

Project Action Limits for TCLP VOCs – Resource Conservation and Recovery Act TCLP regulatory limits (hazard characteristic)

[1] *Achievable DLs, LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.*

QAPP Worksheet #17: Sampling Design and Rationale

The sampling activities will be conducted in accordance with the field SOPs listed on Worksheet #21 and provided in Appendix A. The number of samples and the analytical parameters are summarized on Worksheet #18. Samples to be collected consist of groundwater samples and soil cuttings from well borings.

Physical Boundaries for the Area

The sampling area is defined by the former DDMT property boundary for the MI and groundwater plumes migrating onto or away from the property; the extent is approximated by the LTM wells shown on Figure 2. The area may be expanded as the SRI proceeds.

Basis for the Placement and Number of Sample Locations

Well locations were selected to address the data gaps listed in Worksheet #11 based on review of analytical results and groundwater elevation contours from October 2018 LTM, which included the SRI Phase 3 wells. Isopleths for primary contaminants (PCE and TCE), groundwater elevation contours and proposed locations are shown on Figures 8 and 9. The rationale and general location for each well is in Table 4 below. The planned well construction data for Phase 4 wells including location coordinates, aquifer to be screened, and estimated depths for groundwater, top of clay, surface casing (where needed) and top of screen are listed on Table 5. The planned screen length is 10 feet for all standard wells and 2.5 feet for the nested wells. Construction data for existing MI wells are provided on Table 6.

Table 4. Phase 4 Well Locations

Rationale	Boring ID and Location
Off-site extent of CVOCs upgradient of TTA-1S	F-4: West southwest of MW-279.
Off-site extent of CVOCs upgradient of TTA-1N	F-5: Northwest of MW-269.
	F-6: South of MW-269.
Off-site extent of CVOCs in North-Central plume	F-10: Upgradient (off-site) northeast of MW-263.
Extent of PCE near Building 720; vertical delineation of contamination and water levels	F-21-NW: Upgradient (southeast) of MW-286.
	F-22: Down-gradient (northwest) of MW-286.
Groundwater elevation and extent of contaminant migration into window	F-23: Northeast area of window, northeast of MW-286.
	F-24: Southwest area of window, between MW-285 and MW-207A/B
Upgradient extent of TTA-2 plume	F-25: North of MW-294
Potential contaminant migration towards sink; vertical delineation of contamination and water levels	F-26-NW: South of Building 650, between MW-207A/B and MW-284
	F-27: East of MW-291, near northeast corner of Building 429

Rationale	Boring ID and Location
Extent of the SE plume and groundwater flow direction	F-28: Southwest of MW-270 and south of Ball Road
	F-29: West-northwest of MW-301
Lateral extent of North-central Plume	F-30: Near northeast corner of Building 670
Offsite extent of CVOCs and groundwater flow direction in IAQ at northwest MI	I-1: North of MW-256
IAQ groundwater flow direction in south-central MI	I-5: North of Building 560 center, near MW-284 and MW-290

Locations for vertical delineation through soil sampling and nested wells were selected in areas where the clay between the Fluvial and Upper Claiborne sands is not expected to be present. F-21-NW will be installed near Building 720 to evaluate potential residual soil contamination and variation in groundwater elevation and PCE concentrations with depth. F-26-NW will be located near the southwest corner of Building 650, where the groundwater flow directions in the Fluvial and Intermediate aquifers appear to change from the northwest to the south and the West-Central, North-Central and Building 835 plumes appear to converge.

A PID will be used to screen soil cores for the presence of VOCs as the vertical delineation borings are advanced. Soil samples will be collected based on PID readings and field observations. Up to 3 samples from each of the two borings will be submitted to the laboratory for analysis by Method SW-8260.

Soil IDW samples will be collected upon completion of drilling. One soil sample will be collected for approximately each 5 cubic yards of soil cuttings. At each sample location, approximately 6 inches of surface soil will be removed prior to sampling.

Water IDW samples will be collected after well installation, development, and sampling are completed; grab samples of wastewater will be collected and analyzed by the drilling contractor per requirements of the disposal facility.

Sample Identification

Individual samples will be identified by a unique alphanumeric code (also referred to as a sample ID number) which will be written on the sample label and recorded on the chain-of-custody (CoC) form. The sample ID will include the type [monitoring well (MW), nested well (NW) or soil boring SB)], location (xxx) and sampling event (SRI4). The individual well screens in the nested wells will be designated by a letter, starting with ‘A’ for the deepest screen and B, C and D for the higher screens. Soil samples collected at different depths include the depth. Examples: MW-305-SRI4; NW-310B-SRI4 or SB-10-143-SRI4.

IDW samples will include the medium (S for soil and W for water), the sequence and sample event, for example IDW-Sxx-SRI4).

Prefixes will replace the location for trip blanks (TB-x-SRI4) and rinse blanks (RB-x-SRI4) and suffixes will identify the locations of MSs or duplicates (MW-xxx-SRI4-MS). Additional information is provided in SOP 7, *Sample Control and Documentation*.

QAPP Worksheet #18: Sampling Locations and Methods/SOP Requirements

Sampling Location	Number of Locations	Matrix	Depth (ft)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference[1]	Rationale for Sampling Location
SRI Phase 4 Fluvial Aquifer Wells	12	GW	50-120	VOCs	Low	12 field, 2 duplicate	SOP 4	Determination of hydraulic gradient and contaminant extent
SRI Phase 4 IAQ Wells	2	GW	110-160	VOCs	Low	2 field, 1 duplicate	SOP 4	Determination of hydraulic gradient and contaminant extent
SRI Phase 4 Nested Wells	8 (up to 4 per well)	GW	90-170	VOCs	Low	8 field, 1 duplicate	SOP 4	Determination of hydraulic gradient, contaminant extent, and stratification of contaminants
Vertical Delineation Borings	2	SO	10-150	VOCs	Low	10 field, 1 duplicate	SOP 2	Evaluate potential contaminant source areas
Vertical Delineation Borings	2	SO	10-150	ASTM Geotechnical	NA	6 field	SOP 2	Measure soil parameters for contaminant migration
Soil IDW	1 per 5 cubic yard soil cuttings	SO	NA	VOCs, TCLP VOCs	Low	1 per 5 cubic yard soil cuttings	SOP 2	Determination of waste classification for disposal
Water IDW	1 per full Baker tank	Water	NA	per disposal facility requirements	Low	1 per full Baker tank	SOP 4	Determination of waste classification for disposal

[1] Specify the appropriate letter or number from the Project Sampling SOP References (Worksheet #21).

GW: Groundwater

SO: Soil

QAPP Worksheet #19 & 30: Sample Containers, Preservation, and Hold Times

Analytical Laboratory (Name, sample receipt address, point of contact, e-mail, and phone numbers): Chemtech, 284 Sheffield Street, Mountainside, New Jersey 07092, Kurt Hummler, 908-789-8900, kurt@chemtech.net

Required accreditations/certifications: DoD ELAP

Back-up Laboratory: Microbac Laboratories, Inc., 158 Starlite Drive, Marietta, Ohio 45750, Stephanie Mossburg, 800-373-4071, stephanie.mossburg@microbac.com, 800-373-4071

Sample Delivery Method: FedEx next day air

Analyte Group	Matrix	Method/ SOP Reference	Accreditation Expiration Date	Containers (number, size & type per sample)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)	Data Package Turnaround
VOCs	Groundwater, DI water (blanks)	USEPA SW846 5030B/8260B (Chemtech L-3) (Microbac L-1)	Chemtech: 10/20/2021 Microbac: 12/31/2020	3 40-milliliter (mL) VOC vials w/ Teflon®-lined septa; no headspace	Chill ≤ 6 degrees Celsius (°C), hydrochloric acid (HCl) to pH<2	14 Days (preserved) 7days (unpreserved)	3 weeks for Stage 3; 4 weeks for Stage 4
VOCs	IDW Water	USEPA SW846 5030B/8260B (Chemtech L-3) (Microbac L-1)	Chemtech: 10/20/2021 Microbac: 12/31/2020	3 40-milliliter (mL) VOC vials w/ Teflon®-lined septa; no headspace	Chill ≤ 6 degrees Celsius (°C), hydrochloric acid (HCl) to pH<2	14 Days (preserved) 7days (unpreserved)	1 week for Stage 3; 3 weeks for Stage 4
VOCs	Soil, IDW Soil (total)	USEPA SW846 5030B/8260B (Chemtech L-3)	Chemtech: 10/20/2021	Terracore kit (2 vials with water/sodium bisulfite, one vial with methanol)	Chill ≤ 6 degrees Celsius (°C)	14 Days	1 week for Stage 3; 3 weeks for Stage 4
VOCs	IDW Soil (TCLP)	USEPA SW846 1311 (Chemtech L-4)	Chemtech: 10/20/2021	8 ounce glass jar Teflon®-lined septum	Chill ≤ 6 degrees Celsius (°C)	14 Days	1 week for Stage 3; 3 weeks for Stage 4

Analytical Laboratory (Name, sample receipt address, point of contact, e-mail, and phone numbers): McCray Drilling, LLC., 6756 Buckles Cove, Memphis, TN 38133. David McCray 901-385-1199, david@mccraydrilling.com

Required accreditations/certifications: None

Back-up Laboratory: None

Sample Delivery Method: Hand Delivery

Analyte Group	Matrix	Method/SOP Reference	Accreditation Expiration Date	Containers (number, size & type per sample)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)	Data Package Turnaround
Grain Size	Soil	ASTM D-422	None	1 Shelby Tube or 1 quart zip top bag	None	None	3 weeks
Permeability	Soil	ASTM D-5084	None	1 Shelby Tube**	None	None	3 weeks
Dry Bulk Density, Porosity, and Water Filled Porosity	Soil	Method 9100*	None	1 Shelby Tube**	None	None	3 weeks

* = Method 9100 of Test Methods for Evaluating Solid Waste, Third Edition SW-846; in general accordance with ASTM D-5084-90.
** = Can be analyzed from Shelby Tube provided for grain size analysis.

QAPP Worksheet #20: Field QC Summary

Matrix[1]	Analyte/ Analytical Group	Field Samples	Field Duplicates	Matrix Spikes	Matrix Spike Duplicates	Field Blanks	Equipment Blanks	Trip Blanks	Other	Total # analyses
Groundwater - Initial	VOCs	22	4	3	3	0	6	2	0	40
Groundwater - LTM	VOCs	22	4	3	3	0	0	2	0	34
Soil	VOCs	10	1	1	1	0	3	3	0	19
Soil	Geotechnical Parameters[2]	6	0	0	0	0	0	0	0	10
IDW Soil[3]	VOCs. TCLP VOCs	2	0	0	0	0	0	0	0	2
IDW Water[3,4]	VOCs, Metals (Cu, Zn), TBD	4	0	0	0	0	0	0	0	4

Note:

1) *Initial groundwater samples will be collected using low-flow method over 5 to 6 days. Following the initial samples, passive diffusion bags will be installed, where appropriate, for sampling during LTM. LTM samples will be collected over 2 days.*
2) *Soil parameters are grain size, permeability, dry bulk density, porosity and water-filled porosity*
3) *Samples of IDW soil and water will be collected at completion of field work or before if storage capacity is reached; field quality control (QC) samples are not required by the disposal facility and will not be collected.*
4) *Water IDW generated during drilling and well development will be stored in a tank provided by the drilling contractor and samples will be collected by the contractor for analyses to be determined (TBD) by the CERCLA-approved disposal facility. Water IDW generated during sampling will be stored in the condensate tank on Dunn Field and samples will be collected by HDR for analysis of VOCs, copper (Cu) and zinc (Zn) per discharge requirements established by TDEC.*

QAPP Worksheet #21: Field SOPs

Method/ SOP Reference	Title, Revision Number and Date	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)
SOP 1	General Procedures for Field Personnel, Rev. 2, August 2017	HDR	Log books, first aid kit, personal protective equipment	N
SOP 2	Drilling and Soil Sampling, Rev. 3, August 2017	HDR	Drilling equipment, sample jars, disposable scoops	N
SOP 3	Well Installation, Development and Abandonment, Rev. 1, November 2014	HDR	Well construction materials, cement/bentonite grout, concrete	Y
SOP 4	Groundwater Sample Collection, Rev. 1, November 2014	HDR	YSI6920 or similar multi-probe device with flow-through cell, non-dedicated bladder pumps, disposable Teflon bailers, passive diffusion bags	N
SOP 7	Sample Control and Documentation, Rev. 3, August 2017	HDR	Sampling log book, DQCR forms, digital camera, CoC forms	N
SOP 8	Sample Packing and Shipping, Rev. 2, October 2016	HDR	Sample bottles, bubble wrap, ice, zip lock bags, coolers, tape, custody seals	N
SOP 9	Sampling Equipment Decontamination, Rev. 2, August 2017	HDR	American Society for Testing and Materials (ASTM) Type II water (supplied by lab) or distilled water, pesticide-grade methanol, Alconox detergent, brushes	N
L-2	Standard Operating Procedure Sample Receiving and Login, Revision 20, November 2018	Microbac	Thermometers, hood, pH strips, IR temperature guns, Geiger counter, disposable gloves	N
L-5	Sample Receipt, Sample Acceptance Policy, Sample Login, Sample Identification, & Sample Storage, Revision 22, April 2018	Chemtech	Thermometers, hood, pH strips, IR temperature guns, Geiger counter, disposable gloves	N

Note: The drilling subcontractor, Cascade Drilling, will collect and submit the IDW water samples per their SOP and the disposal facility requirements.

QAPP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Activity	SOP Reference	Title or position of responsible person	Frequency	Acceptance Criteria	Corrective Action
YSI 650MDS	Water quality measurement (pH, ORP, DO, conductivity, temperature)	HDR SOP 4	FTL	Daily during use and when readings are inconsistent	Meet manufacturer's specifications	Replace components and re-try. Send to manufacturer for repair
GeoTech turbidity meter	Water quality measurement (turbidity)	HDR SOP 4	FTL	Daily during use and when readings are inconsistent	Meet manufacturer's specifications	Replace components and re-try. Send to manufacturer for repair
RAE PGM-7600 PID	VOC screening	HDR SOP 4	FTL	Daily during use and when readings are inconsistent	Meet manufacturer's specifications	Re-try. Send to manufacturer for repair
Heron Dipper-T	Water level measurement	HDR SOP 4	FTL	Daily during use	Meet manufacturer's specifications	Re-try. Send to manufacturer for repair
Solinst 101	Water level measurement	HDR SOP 4	FTL	Daily during use	Meet manufacturer's specifications	Re-try. Send to manufacturer for repair
Geotech PRO Pumpbox and Geocontrol 2	Groundwater purge and sample	HDR SOP 4	FTL	Daily during use	Meet manufacturer's specifications and project requirements	Send to manufacturer for repair

QAPP Worksheet #23: Analytical SOPs

SOP #	Title, Revision Number and Date	Definitive or Screening Data	Matrix/Analytical Group	SOP Option or Equipment Type	Modified for Project Work? (Y/N)
SOP 4	Groundwater Sample Collection, Revision 1, November 2014	Screening	Field water quality (pH, conductivity, DO, ORP, temperature, turbidity)	Field multimeter (YSI, Horiba, Geotech)	N
L-1 Microbac	Analysis of Volatile Organic Analytes by Methods 8260A and 8260B, Revision 26, January 2019 (MSV01)	Definitive	VOCs in Water	Hewlett-Packard [HP] 6890 GC equipped with HP 5973 mass spectrometer HP Enviroquant software	N
L-3 Chemtech	VOCs by gas chromatography (GC)/mass spectrometry (MS) - SW 846 Method 8260B/C (M8260B/C-SWGCMSVOA) Rev. 23 – 09011/17	Definitive	VOCs in Water and Soil	-Hewlett Packard 5890 GC -Hewlett Packard 5971/5972 mass selective detectors MS -Hewlett Packard MSD Chemstation Software	N
L-4 Chemtech	Sample Preparation for Toxicity Characteristics Leaching Procedure (M1311-TCLP) Rev. 11 – 05/25/18	Definitive	ZHE extraction of soils for TCLP VOCs	-Rotary agitator -ZHE extraction vessels -filter apparatus	N

QAPP Worksheet #24: Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference[1]
GC/MS for VOCs in Water, Soil SW-846 8260B	Mass spectral ion intensities with 4-bromofluoro-benzene (BFB)	Every 12 hours prior to initial calibration (ICAL), initial calibration verification (ICV) or continuing calibration verification (CCV)	Mass – Ion Abundance Criteria 50 – 15-40% of mass 95 75 – 30-60% of mass 95 95 – base peak, 100% relative abundance 96 – 5-9% of mass 95 173 – <2% of mass 174 174 – >50% of mass 95 175 – 5-9% of mass 174 176 - >95% and <101% of mass 174 177 - 5-9% of mass 176 (Established criteria in Table 4 of SW-846 8260B)	Retune instrument and repeat BFB check. Flagging criteria are not appropriate.	Analyst	L-1 L-3
	Initial multipoint calibration for all analytes (ICAL) (minimum five standards)	When second source calibration or continuing calibration is out of control or when system conditions have been altered.	1. Average response factor (RF) for System Performance Check Compounds (SPCCs): ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. 2. Relative Standard Deviation (RSD) for RFs for Calibration Check Compounds: ≤ 30% and one option below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression r ≥ 0.995; Option 3: non-linear regression–coefficient of determination r2 ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order).	Evaluate cause; repeat calibration; or qualify data and discuss in narrative. Flagging criteria are not appropriate.	Analyst	L-1 L-3

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference[1]
GC/MS for VOCs in Water, Soil SW-846 8260B (continued)	CCV	Once per each 12 hours, prior to sample analysis (criteria for these checks must be met prior to sample analysis)	<u>1. Average Relative RF for SPCCs</u> : ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. <u>2. %Difference/Drift for all target compounds and surrogates:</u> VOCs and SVOCs ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration).	1) Evaluate system and take CA. 2) Rerun calibration check. 3) If still out, prepare new calibration curve for any analyte not meeting criteria. 4) Reinject any samples analyzed after criteria were exceeded. 5) Qualify the data. Criteria for these checks must be met prior to sample analysis. Apply Q-flag to all results for the specific analyte(s) in all samples since last acceptable CCV.	Analyst	L-1 L-3
	Retention time (RT) window position establishment for each analyte and surrogate	Once per ICAL	Position shall be set using the midpoint standard of the ICAL curve.	NA	Analyst	L-1 L-3

[1] Specify the appropriate reference letter or number from the Analytical SOP References (Worksheet #23).

QAPP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
GC/MS for VOCs in Water, Soil	Clean mass spectrometer, change/check helium, change trap, clip column, change purge and trap ferrules, bake out column	GC/MS	Purge lines, purge flow, trap, ion source, column	Prior to calibration check and/or as necessary	Acceptable ICAL or CCV	Correct problem and repeat ICAL or CCV	Analyst / Supervisor	MSV01 (L-1) M8260B/C-SWGCMS VOA (L-3)

[1] *Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).*

QAPP Worksheet #26 & 27: Sample Handling, Custody, and Disposal

Sampling Organization: HDR
Laboratory: Chemtech
Method of sample delivery (shipper/carrier): FedEx
Number of days from reporting until sample disposal: 60

Activity	Organization and title or position of person responsible for the activity	SOP Reference
SAMPLE COLLECTION, PACKAGING, AND SHIPMENT		
Sample Collection	HDR Field Team	HDR SOP 2, HDR SOP 4
Sample Packaging	HDR Field Team	HDR SOP 8
Coordination of Shipment	HDR Field Team and Project Chemist, Laboratory (Chemtech, Microbac) PM	HDR SOP 8
Type of Shipment/Carrier: Cardboard carton (air sample in Summa^{TM} canister), shipped via FedEx Ground.	HDR Field Team	HDR SOP 8
Type of Shipment/Carrier: Cooler with ice (soil samples in Terracore kit of three 40-mL vials), shipped via FedEx next morning delivery.	HDR Field Team	HDR SOP 8
SAMPLE RECEIPT AND ANALYSIS		
Sample Receipt	Laboratory (Chemtech, Microbac) sample custodian	Microbac SOP L-2, Chemtech SOP L-5
Sample Custody and Storage	Laboratory (Chemtech, Microbac) sample custodian	Microbac SOP L-2, Chemtech SOP L-5
Sample Preparation	Laboratory (Chemtech, Microbac) sample preparation chemist or analyst	Microbac SOP L-1, Chemtech SOPs L-3, L-4
Sample Determinative Analysis	Laboratory (Chemtech, Microbac) sample analyst	Microbac SOP L-1, Chemtech SOP L-3

Activity	Organization and title or position of person responsible for the activity	SOP Reference
SAMPLE ARCHIVING		
Field Sample Storage (No. of days from sample collection): 60 days from data package report	Laboratory (Chemtech, Microbac) sample custodian.	Microbac SOP L-2, Chemtech SOP L-5
Sample Extract/ Digestate Storage (No. of days from extraction/digestion): 60 days from data package report	Laboratory (Chemtech, Microbac) sample custodian	Microbac SOP L-2, Chemtech SOP L-5
SAMPLE DISPOSAL		
Number of Days from Analysis: 60 days from data package report	Laboratory (Chemtech, Microbac) sample custodian	Microbac SOP L-2, Chemtech SOP L-5

QAPP Worksheet #28: Analytical Quality Control and Corrective Action

Matrix: Groundwater, Soil
Analytical Group: VOCs by GC/MS
Analytical Method/SOP: SW-846 8260B / Microbac L-1 & Chemtech L-3

QC SAMPLE	Number/ Frequency	Method / SOP Acceptance Limits	Corrective Action	Title/ Position Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Second-source calibration verification	One each time a five-point calibration is performed	Compounds within ± 20% expected value	Reanalyze ICV. Upon second failure, repeat ICAL.	Analyst	Accuracy/ Bias	Compounds within ± 20% expected value. Flagging criteria are not appropriate.
Evaluation of relative retention time (RRT)	Each sample.	RRT of the analyte within ± 0.06 RRT units of ICAL	Correct problem then reanalyze all samples analyzed since the last RT check. Lab may update RTs based on the CCV to account for minor performance fluctuations or after routine system maintenance (such as column clipping). With each sample, the RRT shall be compared with the most recently updated RRT. If the RRT has changed by more than ±0.06 RRT units since the last update, this indicates a significant change in system performance and the lab must take appropriate CAs as required by the method and rerun the ICAL to reestablish the RTs.	Analyst	--	RRT of the analyte within ± 0.06 RRT units of ICAL. Flagging criteria are not appropriate.

QC SAMPLE	Number/ Frequency	Method / SOP Acceptance Limits	Corrective Action	Title/ Position Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Internal standard (IS) –RT and area response checked from daily calibration check	Every field sample, standard, and QC sample.	RT ± 30 seconds and extracted ion current profile (EICP) area within -50% to +100% of *the mid-point standard in the ICAL* for each IS compound.	1) Inspect MS and GC for malfunctions. 2) Take appropriate CAs. 3) Reanalyze samples analyzed while system was malfunctioning. 4) If sample exceeds criteria, reanalyze sample. If still out, report both analyses and document CA.	Analyst	Accuracy	RT ± 30 seconds and EICP area within -50% to +100% of the mid-point standard in the ICAL for each IS compound. Apply Q-flag to analytes associated with the non-compliant IS.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a second source QC check sample	Once per analyst	Analyte-specific limits as per laboratory historical limits.	1) Recalculate results. 2) Locate and fix the source of the problem. 3) Rerun demonstration for those analytes that did not meet criteria.	Analyst	Precision, Accuracy	Analyte-specific limits as per laboratory historical limits.
MDL Study	Once per year, upon any major system change, or quarterly MDL check.	MDLs established as described in 40 Code of Federal Regulations (CFR) Part 136, App. B shall not exceed one-half the RL.	MDLs that exceed established criteria shall be submitted to the USACE for approval prior to the analysis of any project samples.	Analyst	Sensitivity	MDLs established as described in 40 CFR Part 136, App. B shall not exceed one-half the RL.
Field duplicate	Sampling: 1 for every 10 field samples Lab: NA	RPD ≤ 30%	1) Review lab QC data to determine if they are in control. 2) Qualify data. Use data to evaluate whether proper collection procedures were followed. 3) Determine further CA.	Analyst	Precision-overall	RPD ≤ 30%

QC SAMPLE	Number/ Frequency	Method / SOP Acceptance Limits	Corrective Action	Title/ Position Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
MS/MSD	Sampling: 1 pair per every 20 samples Lab: same	In-house control limits (or, if not established, control limits in DoD QSM 5.1 Table G-4. RPD ≤ 30 %	Qualify data.	Analyst	Precision- overall and accuracy/ bias	In-house control limits (or, if not established, control limits in DoD QSM 5.1 Table G-4. RPD ≤ 30 % For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.
LCS	One per preparatory batch	In-house control limits (or, if not established, control limits in DoD QSM 5.1 Table G-4. Up to 3 marginal exceedances if full list of 66 analytes is run.	1) The analytical batch must be reprocessed. 2) Reprep and analyze LCS and affected samples. 3) Qualify the data if CA was unsuccessful or was not performed	Analyst	Precision- lab	In-house control limits (or, if not established, control limits in DoD QSM 5.1 Table G-4. Up to 3 marginal exceedances if full list of 66 analytes is run. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.
Surrogate spike recoveries	Every sample, spike, standard, and reagent blank	In-house control limits (or, if not established, control limits in DoD QSM 5.1 Table G-3.	1) Recalculate result, and reanalyze sample if still out. 2) Re-extract and reanalyze sample, if still out. 3) Report both analyses and document in report that steps 1 and 2 were performed. 4) Qualify the data.	Analyst	Accuracy/ bias	In-house control limits (or, if not established, control limits in DoD QSM 5.1 Table G-3. Apply Q-flag to all associated analytes if acceptance criteria are not met.

QC SAMPLE	Number/ Frequency	Method / SOP Acceptance Limits	Corrective Action	Title/ Position Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method blanks	One per preparatory batch	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL.	1) Take and document appropriate CA 2) Reanalyze all samples processed with a contaminated blank. 3) Qualify the data if the CA was not successful or was not performed.	Analyst	Accuracy/ bias-contamination	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.
Trip blank	Sampling: 1 for each batch of samples shipped to laboratory Lab: NA	No analytes detected at > RL	1) Review lab QC data to determine if there is a laboratory problem. 2) If same compounds are found in field samples at similar concentrations, qualify the data. OR 3) Resample the batch	Analyst	Accuracy/ bias-contamination	No analytes detected at > RL Apply B-flag to all results for the specific analyte(s) in all samples associated with the trip blank.
Ambient blank	Sampling: Collected when samples are collected downwind of possible volatile sources. Lab: NA	No analytes detected at > RL	1) Review lab QC data to determine if there is a laboratory problem. 2) If same compounds are found in field samples at similar concentrations, qualify the data. OR 3) Resample the batch.	Analyst	Accuracy/ bias-contamination	No analytes detected at > RL Apply B-flag to all results for the specific analyte(s) in all samples associated with the ambient blank.

QC SAMPLE	Number/ Frequency	Method / SOP Acceptance Limits	Corrective Action	Title/ Position Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Rinsate blank	Sampling: 1 per day per sampling team per matrix if using non-dedicated equipment Lab: NA	No analytes detected at > RL	Qualify data.	Analyst	Accuracy/ bias-contamination	No analytes detected at > RL Apply B-flag to all results for the specific analyte(s) in all samples associated with the rinsate blank.
Results reported between MDL and RL.	--	--	--	--	--	Apply J-flag to all results between MDL and RL.

QAPP Worksheet #29: Project Documents and Records

Sample Collection and Field Records			
Record	***Generation***	***Verification***	***Storage location/archival***
Field Notes, and Logbooks	HDR FTL	HDR PM, Chemist	HDR Network Drive Project Folder
GIS files	HDR FTL	HDR PM	HDR Network Drive Project Folder
CoC Forms	HDR FTL	HDR PM, Chemist	HDR Network Drive Project Folder
Airbills	HDR FTL	HDR PM, Chemist	HDR Network Drive Project Folder
DQCRs	HDR FTL	HDR PM	HDR Network Drive Project Folder
Equipment Calibration Forms	HDR FTL	HDR PM	HDR Network Drive Project Folder
Logbooks	HDR FTL	HDR PM	HDR Network Drive Project Folder
Instrument data files	HDR FTL	HDR PM	HDR Network Drive Project Folder
Photo-documentation	HDR FTL	HDR PM	HDR Network Drive Project Folder

Project Assessments			
Record	***Generation***	***Verification***	***Storage location/archival***
Analytical Data Packages	Lab	HDR Project Chemist	HDR Network Drive Project Folder
Validation Checklists	HDR Project Chemist	HDR Project Chemist/ HDR PM	HDR Network Drive Project Folder
Data Validation Reports	HDR Project Chemist	HDR Project Chemist/ HDR PM	HDR Network Drive Project Folder
CA Reports	HDR Project Chemist	HDR Project Chemist/ HDR PM	HDR Network Drive Project Folder

Laboratory Records			
Record	***Generation***	***Verification***	***Storage location/archival***
CoC Forms	Lab	Lab PM, HDR Project Chemist	Lab archives, HDR Network Drive Project Folder (data package)
Equipment Logs	Lab	Lab PM, HDR Project Chemist	Lab archives, HDR Network Drive Project Folder (data package)
Sample Prep Logs	Lab	Lab PM, HDR Project Chemist	Lab archives, HDR Network Drive Project Folder (data package)
Analytical Run Logs	Lab	Lab PM, HDR Project Chemist	Lab archives, HDR Network Drive Project Folder (data package)
CA Forms	Lab	Lab PM, HDR Project Chemist	Lab archives, HDR Network Drive Project Folder (data package)
Extraction Records	Lab	Lab PM, HDR Project Chemist	Lab archives, HDR Network Drive Project Folder (data package)
Reported Sample Results	Lab	Lab PM, HDR Project Chemist	Lab archives, HDR Network Drive Project Folder (data package)
Raw Data Printouts	Lab	Lab PM, HDR Project Chemist	Lab archives, HDR Network Drive Project Folder (data package)
Laboratory Information Management System (LIMS) Reports	Lab	Lab PM, HDR Project Chemist	Lab archives, HDR Network Drive Project Folder (data package)
Data Packages and Checklists	Lab	Lab PM, HDR Project Chemist	Lab archives, HDR Network Drive Project Folder (data package)

Laboratory Data Deliverables		
Record	***VOCs (Groundwater)***	***VOCs (IDW Water and IDW Soil)***
CoC Forms	X	X
Equipment Logs	X	X
Sample Prep Logs	X	X
Analytical Run Logs	X	X
CA Forms	X	X
Extraction Records	X	X
Reported Sample Results	X	X
Raw Data Printouts	X	
LIMS Reports	X	X
Data Packages and Checklists	X	X

QAPP Worksheet #31, 32 & 33: Assessments and Corrective Action

Assessments:

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable due date
Off-Site Laboratory TSA	DoD ELAP personnel or contractor	Annual	NA	ELAP annual certification audit report	NA
Laboratory Performance Audit	HDR Data reviewer/ validator, HDR Project Chemist	Ongoing with data package data validation	NA	Email from HDR Project Chemist to Laboratory PM	14 days after receipt of analytical data package
Data Review TSA	HDR Project Chemist	Ongoing with review of data validation reports and data qualifications	NA	Email from HDR Project Chemist to Laboratory PM; Data Review Summary Report	14 days after receipt of data validation reports

Assessment Response and Corrective Action:

Assessment Type	Responsibility for responding to assessment findings	Assessment Response Documentation	Timeframe for Response	Responsibility for Implementing Corrective Action	Responsible for monitoring Corrective Action implementation
Off-Site Laboratory TSA	Laboratory Representative	Per ELAP	Per ELAP	Laboratory PM, Analysts, Technicians	Laboratory PM and HDR Project Chemist
Laboratory Performance Audit	Laboratory PM, Analysts, Technicians	Documented in data package if edits to the data package required	Corrections are to be made before final data package is issued, and included in final data package	Laboratory PM, Analysts, Technicians	HDR Project Chemist
Data Review TSA	HDR Data reviewer/ validator	Summary Report prepared for each sampling event to summarize major issues with the data	Within one week from receipt of final Data Review Report for a sampling event	HDR Data reviewer/ validator	HDR Project Chemist

QAPP Worksheet #34: Data Verification and Validation Inputs

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved QAPP	X	X
2	Field SOPs	X	X
3	Laboratory SOPs	X	X
Field Records			
4	Field Logbooks	X	X
5	Equipment Calibration Records	X	X
6	CoC Forms	X	X
7	Sampling Forms	X	X
8	Drilling Logs	X	X
9	Relevant Correspondence	X	X
10	Field Audit Reports	X	X
11	Field CA Reports	X	X
Analytical Data Package			
12	Cover Sheet (laboratory identifying information)	X	X
13	Case Narrative	X	X
14	Internal Laboratory CoC	X	X
15	Sample Receipt Records	X	X
16	Sample Chronology (i.e. dates and times of receipt, preparation and analysis)	X	X
17	Communication Records	X	X
18	Standards Traceability	X	X
19	Instrument Calibration Records	X	X
20	Definition of Laboratory Qualifiers	X	X
21	Results of Reporting Forms	X	X
22	QC Sample Results	X	X
23	CA Reports	X	X
24	Raw Data	X	X
25	Electronic Data Deliverable	X	X

QAPP Worksheet #35: Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
CoC Forms, Shipping Airbills	CoC Forms, Shipping Airbills	CoC Forms and shipping documents will be reviewed and verified for completeness and accuracy against the actual contents of the coolers represented in the shipment. Three sheet carbon CoC forms will be used with the original and second copy sent with the samples, and the third copy kept by the sampling team.	HDR FTL, Laboratory Sample Custodian
Field Notes	Field Logbook, Forms and Drilling Logs	Field notes and forms will be reviewed for completeness and accuracy prior to being placed in the site file and scanned into electronic files.	HDR FTL
Laboratory Data	Laboratory Data	All data packages will be verified internally by laboratory personnel for technical accuracy and completeness prior to delivery to HDR Upon receipt, the HDR Project Chemist will verify all data in accordance with standard data validation procedures.	Laboratory PM, HDR Project Chemist
SOPs	SOPs	Verify that all SOPs associated with field activities were met.	HDR PM, HDR FTL
Documentation of QC Sample Results	Documentation of QC Sample Results	Confirm that all method required QC samples were run and met required limits.	HDR Project Chemist
Off-site laboratory raw data	This QAPP; Environmental Quality Guidance for Evaluating Performance-Based Chemical Data (U.S. Army Corps of Engineers, EM 200-1-10, June 30, 2005); General Data Validation Guidelines (U.S. Department of Defense, Environmental Data Quality Workgroup, February 09, 2018)	Compare and evaluate all sampling procedures, sampling plans, duplicate criteria, project quantitation limits, method performance criteria, and data qualifiers as specified in the UFP-QAPP.	HDR Project Chemist

QAPP Worksheet #36: Data Validation Procedures

Data Validator: Project Chemist, HDR

Analytical Group/Method	Organics (VOCs in Soil, VOCs in Air)
Data Deliverable Requirements:	Stage 4 data package including all instrument raw data
Analytical Specifications:	Per method and this QAPP
Measurement of Performance Criteria:	DQOs in this QAPP
Percent of Data Packages to be Validated:	100%
Percent of Raw Data to be Reviewed:	10%
Percent of Results to be Recalculated:	One result per analytical method per matrix
Validation Procedure:	*General Data Validation Guidelines* (U.S. Department of Defense, Environmental Data Quality Workgroup, February 09, 2018); *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual* (Intergovernmental Data Quality Task Force, 2005); *Environmental Quality Guidance for Evaluating Performance-Based Chemical Data, EM 200-1-10* (USACE, 2005).
Validation Code:	S2bVM (100%), S3VM (10%); Step I (verification) / Step IIa and Step IIb (validation) (100%)
Electronic Validation Program/Version:	NA

Validation Code and Label Identifier Table:

Validation Code*	Validation Label	Description/Reference
S2bVM	Stage 2b Validation, Manual	DoD *General Data Validation Guidelines*
S3VM	Stage 3 Validation, Manual	DoD *General Data Validation Guidelines*
Stage I	Verification	*UFP-QAPP Manual*
Stage IIa / Stage IIb	Validation	*UFP-QAPP Manual*

Qualifier	Explanation
The following data qualifiers will be applied during data validation. Potential impacts on project-specific DQOs will be discussed in the data validation report.	
U	Not detected above MDL
J	Detected, concentration is estimated
J+	Detected, concentration is estimated, possibly biased high
J-	Detected, concentration is estimated, possibly biased low
UJ	Not detected, MDL is estimated
R	Rejected, data not usable

QAPP Worksheet #37: Data Usability Assessment

Project Manager: Tom Holmes
Project Chemist: Lynn Lutz
Field Team Leader: Clayton Mokri

Step 1	**Review the project's objectives and sampling design** Review the key outputs defined during systematic planning (i.e., PQOs or DQOs and Measurement Performance Criteria) to make sure they are still applicable. Review the sampling design for consistency with stated objectives. This provides the context for interpreting the data in subsequent steps.
Step 2	**Review the data verification and data validation outputs** Review available QA reports, including the data verification and data validation reports. Perform basic calculations and summarize the data (using graphs, maps, tables, etc.). Look for patterns, trends, and anomalies (i.e., unexpected results). Review deviations from planned activities (e.g., number and locations of samples, holding time exceedances, damaged samples, non-compliant performance testing sample results, and SOP deviations) and determine their impacts on the data usability. Evaluate implications of unacceptable QC sample results.
Step 3	**Verify the assumptions of the selected statistical method** Verify whether underlying assumptions for selected statistical methods (if documented in the QAPP) are valid. Common assumptions include the distributional form of the data, independence of the data, dispersion characteristics, homogeneity, etc. Depending on the robustness of the statistical method, minor deviations from assumptions usually are not critical to statistical analysis and data interpretation. If serious deviations from assumptions are discovered, then another statistical method may need to be selected.
Step 4	**Implement the statistical method** Implement the specified statistical procedures for analyzing the data and review underlying assumptions. For decision projects that involve hypothesis testing (e.g., "concentrations of lead in groundwater are below the action level") consider the consequences for selecting the incorrect alternative; for estimation projects (e.g., establishing a boundary for surface soil contamination), consider the tolerance for uncertainty in measurements.
Step 5	**Document data usability and draw conclusions:** Determine if the data can be used as intended, considering implications of deviations and CAs. Discuss data quality indicators. Assess the performance of the sampling design and Identify limitations on data use. Update the conceptual site model and document conclusions. Prepare the data usability summary report which can be in the form of text and/or a table.

The following is a summary of the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:
For samples analyzed by off-site laboratories, results will be subjected to data review, verification and validation, in accordance with:

- *General Data Validation Guidelines* (U.S. Department of Defense, Environmental Data Quality Workgroup, February 09, 2018);
- *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual* (Intergovernmental Data Quality Task Force, 2005); and
- *Environmental Quality Guidance for Evaluating Performance-Based Chemical Data, EM 200-1-10* (USACE, 2005).

Equations used to assess acceptance criteria include:

For Accuracy:

Percent Recovery (%R) for MS

$$\%R = \left(\frac{Spike\ conc. - Sample\ conc.}{Amount\ of\ spike\ added}\right) x\ 100$$

%R for LCS

$$\%R = \left(\frac{Spike\ conc.}{Amount\ of\ spike\ added}\right) x\ 100$$

For Precision:

RPD for MSD, and field duplicates

$$\%\ RPD = \left[\frac{|Amount\ in\ sample\ 1 - Amount\ in\ Sample\ 2|}{\frac{Amount\ in\ Sample\ 1 + Amount\ in\ sample\ 2}{2}}\right] x\ 100$$

For Completeness:

$$\%Completeness = \left(\frac{Number\ of\ usable\ measurements}{Number\ of\ planned\ measurements}\right) x\ 100$$

All data collected from the SI field activities will be evaluated against the following data quality parameters:

Precision – Precision refers to the degree to which repeated measurements are similar to one another, when obtained under prescribed conditions. Laboratory precision will be assessed by evaluating results of field and laboratory duplicates to determine RPD, LCSs, and MS/MSDs. The requirements for RPD are shown in the Worksheets above.

Accuracy – Accuracy is defined as the measure of the closeness of an individual measurement or the average of a number of measurements to the actual or 'true' value. Laboratory accuracy will be assessed by evaluating LCSs and MSs and calculating the %R. The requirements for %R are shown in the Worksheets above.

Representativeness – Representativeness is defined as a measure of the degree to which data accurately and precisely represents the characteristics and conditions of the sample from where the measurement was taken. Laboratory representativeness is assessed by ensuring that all analytical methods and laboratory procedures were followed consistently. In addition, method and instrument blanks are evaluated against the sample data to determine if results could be due to an outside source, such as glassware cross-contamination or instrument carryover. Field representativeness is evaluated in the same manner, through equipment blanks and review of sampling/decontamination techniques. Target analytes should not be present in any blanks. Data may be qualified accordingly if any analytes are detected in blank samples.

Completeness – Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data that was expected or planned for. Qualified data will be considered unless it has been rejected (R), in which case it is unusable. The goal for completeness is 100%, however rejected (unusable) data will be evaluated to determine whether data gaps exist, or if the project objectives were met, without it.

Comparability – Comparability is a measure of the confidence with which data sets may be compared to each other. Comparability is evaluated by reviewing adherence to Work Plans, SOPs, method requirements, and consistency in task execution, both in the field, and at off-site laboratories.

Sensitivity – Sensitivity is the ability of the method or instrument to detect the target analytes at the level of interest. In order to meet the project-specific DQOs, definitive data will be compared to the project's action limits or quantitation goals as listed in Worksheet #15.

Identify the personnel responsible for performing the usability assessment:
Lynn K. Lutz, Project Chemist, HDR

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:
A Data Validation Report will be included as an Appendix to the final report and will document the results of the data review, verification and validation. This report will describe the conclusions made during the data assessment regarding the data usability. Any limitations on the usability of the data will be explained, including the reasons for data qualifiers, the definitions of the qualifiers and a summary of the specific acceptance criteria that was assessed and found to be outside of control limits.

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Tables

TABLE 1
FLUVIAL AQUIFER WELL RESULTS BY AREA
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Main Installation - Defense Depot Memphis, Tennessee

			Analyte	PCE	TCE	cDCE	VC	CT	CF
			MCL	5	5	70	2	5	80
Well	Aquifer	Area	Date	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DR1-2	Fluvial	TTA-1N	10/8/2018	0.772 J	-	-	-	-	0.213 J
DR1-7	Fluvial	TTA-1N	10/7/2018	**5.53**	0.581 J	1.24	-	-	0.127 J
DR1-8	Fluvial	TTA-1N	10/8/2018	-	-	-	-	-	-
MW-21	Fluvial	TTA-1N	10/8/2018	-	2.2	**127**	-	-	-
MW-66A	Fluvial	TTA-1N	10/9/2018	0.731 J	-	-	-	-	-
MW-100B	Fluvial	TTA-1N	10/9/2018	3.53	2.02	27.1	**185**	-	-
MW-219	Fluvial	TTA-1N	10/9/2018	**152**	**11.1**	9.25	-	-	0.136 J
MW-269	Fluvial	TTA-1N	10/9/2018	**128**	**10.2**	7.58	-	-	0.273 J
MW-278	Fluvial	TTA-1N	10/9/2018	**24**	4.68	3.29	-	-	-
PMW21-01	Fluvial	TTA-1N	10/8/2018	0.282 J	-	**78.9**	-	-	-
PMW21-02	Fluvial	TTA-1N	10/8/2018	**89.6**	**57.2**	19	-	-	-
PMW21-03	Fluvial	TTA-1N	10/8/2018	**78.3**	**49**	16.2	-	-	-
PMW21-04	Fluvial	TTA-1N	10/8/2018	**265**	**156**	59.9	1.37	-	0.140 J
PMW21-05	Fluvial	TTA-1N	10/8/2018	3.83	1.98	-	-	-	-
DR1-1	Fluvial	TTA-1S	10/8/2018	1	-	-	-	-	-
DR1-1A	Fluvial	TTA-1S	10/10/2018	-	-	-	-	-	0.237 J
DR1-3	Fluvial	TTA-1S	10/11/2018	**22.9**	**6.17**	1.09	-	-	-
DR1-4	Fluvial	TTA-1S	10/9/2018	**19.2**	-	-	-	-	0.486
DR1-5	Fluvial	TTA-1S	10/8/2018	4.02	0.870 J	14.8	-	-	-
DR1-5A	Fluvial	TTA-1S	10/8/2018	-	-	46.2	0.268 J	-	-
DR1-6	Fluvial	TTA-1S	10/7/2018	3.38	-	-	-	-	0.167 J
DR1-6A	Fluvial	TTA-1S	10/7/2018	-	0.296 J	20.6	-	-	-
MW-22	Fluvial	TTA-1S	10/9/2018	-	-	-	-	-	-
MW-101B	Fluvial	TTA-1S	10/7/2018	**17.2**	-	-	-	-	0.137 J
MW-101T	Fluvial	TTA-1S	10/7/2018	**17.1**	-	-	-	-	-
MW-279	Fluvial	TTA-1S	10/8/2018	**55.5**	0.835 J	2.26	-	-	-
PMW101-02A	Fluvial	TTA-1S	10/8/2018	0.277 J	-	5.12	-	-	-
PMW101-02B	Fluvial	TTA-1S	10/8/2018	-	-	10.5	**3.37**	-	-
PMW101-03A	Fluvial	TTA-1S	10/8/2018	**29.2**	1.6	0.812 J	**2.66**	-	-
PMW101-03B	Fluvial	TTA-1S	10/8/2018	**29.4**	-	-	-	-	0.209 J
PMW101-04A	Fluvial	TTA-1S	10/8/2018	**15.6**	2.22	1.72	1.01	-	-
PMW101-04B	Fluvial	TTA-1S	10/8/2018	**35.1**	0.760 J	-	-	-	0.261 J
PMW101-06A	Fluvial	TTA-1S	10/7/2018	**21.5**	-	-	-	-	0.56
PMW101-06B	Fluvial	TTA-1S	10/7/2018	**28.8**	3.88	-	-	-	0.358
PMW101-07A	Fluvial	TTA-1S	10/7/2018	3.29	0.467 J	-	-	-	0.163 J
PMW101-07B	Fluvial	TTA-1S	10/7/2018	**9.99**	**21.2**	1.51	-	-	-
DR2-1	Fluvial	TTA-2	10/9/2018	**88.1**	3.33	4.36	-	**18.2**	2.65
DR2-2	Fluvial	TTA-2	10/6/2018	3.68	0.640 J	1.95	-	-	0.154 J
DR2-3	Fluvial	TTA-2	10/7/2018	**7.12**	0.829 J	-	-	1.96	0.412
DR2-4	Fluvial	TTA-2	10/7/2018	4.38	0.460 J	-	-	1.56	0.296 J
DR2-5	Fluvial	TTA-2	10/12/2018	-	-	1.81	-	-	-
DR2-6	Fluvial	TTA-2	10/6/2018	4.31	2.41	30.5	**15.8**	-	-
MW-25A	Fluvial	TTA-2	10/8/2018	0.890 J	0.447 J	-	-	0.813 J	0.156 J
MW-26	Fluvial	TTA-2	10/7/2018	**25.5**	0.889 J	-	-	**5.5**	0.931
MW-50	Fluvial	TTA-2	10/8/2018	1.6	2.87	0.718 J	-	-	3.46
MW-64	Fluvial	TTA-2	10/6/2018	**18.3**	**25.2**	0.429 J	-	1.64	1.41
MW-85	Fluvial	TTA-2	10/7/2018	**46.2**	**15.5**	24.7	0.381 J	**11.1**	4.14
MW-88	Fluvial	TTA-2	10/6/2018	**14.4**	1.42	-	-	2.65	0.302
MW-92	Fluvial	TTA-2	10/6/2018	**61**	4.04	4.07	1.89	-	-
MW-96	Fluvial	TTA-2	10/8/2018	0.399 J	0.361 J	-	-	0.770 J	0.278 J
MW-113	Fluvial	TTA-2	10/7/2018	3.51	1.22	27.1	**54.6 J+**	-	-

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SRI PHASE 4 QAPP
Main Installation - Defense Depot Memphis, Tennessee

Well	Aquifer	Area	Analyte MCL Date	PCE 5 µg/L	TCE 5 µg/L	cDCE 70 µg/L	VC 2 µg/L	CT 5 µg/L	CF 80 µg/L
MW-217	Fluvial	TTA-2	10/6/2018	**28.9**	**20.6**	1.37	-	**76.4**	4.88
MW-218	Fluvial	TTA-2	10/6/2018	**17.7**	**28.8**	-	-	**6**	1.89
MW-259	Fluvial	TTA-2	10/10/2018	**14.3**	**19.2**	0.279 J	-	4.01	3.52
MW-266	Fluvial	TTA-2	10/6/2018	0.834 J	0.342 J	-	-	0.311 J	0.176 J
MW-267	Fluvial	TTA-2	10/5/2018	**35.6**	**14.9**	0.317 J	-	**19.5**	0.486
MW-280	Fluvial	TTA-2	10/10/2018	**9.98**	4.74	-	-	3.6	0.325 J
MW-292	Fluvial	TTA-2	10/11/2018	**10.6**	3.52	2.96	-	**5.85**	6.24
MW-294	Fluvial	TTA-2	10/10/2018	**36.5**	**25.7**	0.398 J	-	**6.71**	1.18
MW-295	Fluvial	TTA-2	10/10/2018	2.9	**5.86**	-	-	2.14	0.503
PMW85-01	Fluvial	TTA-2	10/7/2018	-	-	14	**51.4**	-	-
PMW85-05	Fluvial	TTA-2	10/7/2018	**61.6**	**19.4**	31	**3.37**	**32**	12.7
PMW92-02	Fluvial	TTA-2	10/7/2018	**10.1**	0.955 J	14	**62.6**	-	-
PMW92-03	Fluvial	TTA-2	10/7/2018	0.572 J	-	19	**13.2**	-	-
MW-39	Fluvial	W-C	10/7/2018	1.76	3.86	9.23	-	-	-
MW-94A	Fluvial	W-C	10/7/2018	**16.4**	**6.02**	2.36	-	-	-
MW-98	Fluvial	W-C	10/7/2018	**13.2**	3.01	1.94	-	-	-
MW-197B	Fluvial	W-C	10/7/2018	2.82	**7.66**	10.2	0.842 J+	-	-
MW-200	Fluvial	W-C	10/8/2018	4.68	**5.04**	1.65	-	-	-
MW-203B	Fluvial	W-C	10/7/2018	**11.4**	**17.6**	13.7	**36.5 J+**	-	-
MW-204A	Fluvial	W-C	10/7/2018	**26.5**	0.649 J	0.748 J	-	-	-
MW-204B	Fluvial	W-C	10/7/2018	**20**	**9.81**	-	-	-	0.164 J
MW-205B	Fluvial	W-C	10/7/2018	3.19	**6.39**	9.02	0.469 J	-	-
MW-206A	Fluvial	W-C	10/7/2018	**6.01**	**9.63**	14.8	-	-	-
MW-206B	Fluvial	W-C	10/7/2018	**10.1**	**5.15**	5.8	-	-	-
MW-207B	Fluvial	W-C	10/6/2018	**28.1**	**21.3**	0.824 J	-	1.2	3.5
MW-208B	Fluvial	W-C	10/6/2018	**6.02**	3.01	-	-	-	1.02
MW-210B	Fluvial	W-C	10/7/2018	1.68	**12.2**	0.560 J	-	-	-
MW-284	Fluvial	W-C	10/10/2018	**16.8**	**5.63**	0.315 J	-	1.2	2.97
MW-62	Fluvial	B-835	10/9/2018	-	0.379 J	5.58	**24.8**	-	-
MW-142	Fluvial	B-835	10/8/2017	-	4.24	-	-	-	-
MW-142	Fluvial	B-835	10/9/2018	-	4.74	-	-	-	-
MW-143	Fluvial	B-835	10/10/2017	0.399 J	**6.71**	-	-	-	-
MW-143	Fluvial	B-835	10/9/2018	0.492 J	**6.91**	-	-	-	0.166 J
MW-198	Fluvial	B-835	10/8/2017	-	1.65	-	-	-	-
MW-198	Fluvial	B-835	10/9/2018	-	2.49	-	-	-	-
MW-199B	Fluvial	B-835	10/9/2018	0.328 J	**45.9**	0.401 J	-	-	0.244 J
MW-209B	Fluvial	B-835	10/9/2018	1.66	**13**	-	-	0.260 J	0.314
MW-212	Fluvial	B-835	10/9/2018	1.05	**44.4**	-	-	-	0.178 J
MW-213	Fluvial	B-835	10/7/2018	-	2.19	12.1	-	-	-
MW-299	Fluvial	B-835	10/10/2018	-	0.662 J	-	-	-	-
MW-300	Fluvial	B-835	10/10/2018	0.414 J	**7.3**	-	-	-	-
MW-63A	Fluvial	N-C	10/5/2018	3.21	1.86	-	-	-	0.342
MW-63B	Fluvial	N-C	10/9/2018	1.81	2.43	0.311 J	-	-	0.619
MW-103	Fluvial	N-C	10/6/2018	-	**7.87**	0.346 J	-	-	4.08
MW-104	Fluvial	N-C	10/6/2018	-	**19.1**	0.807 J	-	-	1.93
MW-215B	Fluvial	N-C	10/5/2018	4.7	1.23	-	-	1.22	0.823
MW-258	Fluvial	N-C	10/5/2018	**23.7**	**46**	1.7	-	-	1.45
MW-260	Fluvial	N-C	10/5/2018	0.541 J	2.54	-	-	-	0.557
MW-263	Fluvial	N-C	10/5/2018	1.62	**25**	2	-	-	1.41
MW-265	Fluvial	N-C	10/6/2018	**10.8**	**6.1**	0.369 J	-	-	5.18
MW-281	Fluvial	N-C	10/7/2018	**12.6**	**55.9**	2.35	-	-	5.37

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			Analyte	PCE	TCE	cDCE	VC	CT	CF
			MCL	5	5	70	2	5	80
Well	Aquifer	Area	Date	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-287	Fluvial	N-C	10/10/2018	1.33	2.79	0.529 J	-	-	0.762
MW-288	Fluvial	N-C	10/12/2018	**11.3**	**6.88**	0.413 J	-	0.521 J	3.99
MW-289	Fluvial	N-C	10/10/2018	1.81	1.26	-	-	0.304 J	1.3
MW-291	Fluvial	N-C	10/10/2018	0.783 J	**12.9**	0.980 J	-	-	0.757
MW-97	Fluvial	S-C	10/7/2018	-	**48.2**	-	-	-	0.212 J
MW-216	Fluvial	S-C	10/7/2018	-	-	-	-	-	-
MW-261	Fluvial	S-C	10/7/2018	0.301 J	3.79	-	-	-	-
MW-271	Fluvial	S-C	10/6/2018	-	**6.21**	-	-	-	-
MW-296	Fluvial	S-C	10/8/2018	**12.4**	3.86	0.923 J	-	-	-
MW-297	Fluvial	S-C	10/10/2018	0.602 J	**18.9**	-	-	-	0.193 J
MW-298	Fluvial	S-C	10/10/2018	-	0.319 J	-	-	-	-
MW-52	Fluvial	SE	10/8/2018	**11.6**	2.16	0.840 J	-	-	0.615
MW-270	Fluvial	SE	10/6/2018	-	**8.49**	1.66	-	-	-
MW-301	Fluvial	SE	10/10/2018	4.96	**40.9**	0.816 J	-	-	0.445
MW-285	Fluvial	Window	10/10/2018	**21.3**	4.54	0.597 J	-	0.253 J	0.546
MW-286	Fluvial	Window	10/10/2018	**67.7 J**	1.62 J	-	-	0.392 J	0.288 J
MW-16	Fluvial	Background	10/5/2018	-	-	-	-	-	-
MW-19	Fluvial	Background	10/9/2018	-	0.566 J	-	-	-	0.39
MW-23	Fluvial	Background	10/7/2018	-	-	-	-	-	-
MW-24	Fluvial	Background	10/6/2018	-	-	-	-	-	0.216 J
MW-53	Fluvial	Background	10/9/2018	2.08	-	-	-	-	-
MW-55	Fluvial	Background	10/7/2018	-	-	-	-	-	-
MW-93	Fluvial	Background	10/6/2018	-	-	-	-	-	-
MW-99	Fluvial	Background	10/9/2018	-	-	-	-	-	0.324
MW-102B	Fluvial	Background	10/9/2018	-	-	-	-	-	-
MW-272	Fluvial	Background	10/6/2018	-	-	-	-	-	-
MW-274	Fluvial	Background	10/8/2018	2.34	3.48	1.38	-	-	0.307
MW-275	Fluvial	Background	4/7/2018	0.372 J	-	-	-	-	-
MW-275	Fluvial	Background	10/8/2018	0.421 J	-	-	-	-	-
MW-276	Fluvial	Background	10/6/2018	-	-	-	-	-	0.258 J
MW-277	Fluvial	Background	10/6/2018	-	-	-	-	-	-
MW-282	Fluvial	Background	10/6/2018	-	-	-	-	-	-
MW-283	Fluvial	Background	10/5/2018	-	-	-	-	-	-

Notes:
1) Results above MCL shown in **bold**
µg/L: micrograms per liter
-: Analyte not detected
DQE Flags:
J: Estimated

TABLE 2
INTERMEDIATE AND MEMPHIS AQUIFER WELL RESULTS BY AREA
SRI PHASE 4 QAPP
Main Installation - Defense Depot Memphis, Tennessee

			Analyte	PCE	TCE	cDCE	VC	CT	CF
			MCL	5	5	70	2	5	80
Well	Aquifer	Area	Date	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
IAQ/UC									
MW-268	Upper Claiborne	TTA-2	10/5/2018	-	-	-	-	-	-
MW-302	Intermediate	TTA-2	10/6/2018	**5.45**	1.82	1.05	-	3.11	0.737
MW-39A	Upper Claiborne	W-C	10/7/2018	1.88	3.61	13.6	**2.1**	-	-
MW-108	Upper Claiborne	W-C	10/5/2018	2.89	**6.24**	0.316 J	-	-	2.65
MW-197A	Upper Claiborne	W-C	10/7/2018	**16.6**	0.711 J	0.566 J	-	-	0.174 J
MW-203A	Upper Claiborne	W-C	10/10/2018	-	-	24	0.970 J	-	-
MW-205A	Upper Claiborne	W-C	10/7/2018	**7.97**	**5.21**	4.81	-	-	-
MW-207A	Upper Claiborne	W-C	10/6/2018	**6.34**	**13.8**	0.584 J	-	-	3.5
MW-208A	Upper Claiborne	W-C	10/6/2018	**7.13**	**7.82**	9.7	-	-	-
MW-210A	Intermediate	W-C	10/7/2018	3.03	3.77	3.7	-	-	0.155 J
MW-199A	Intermediate	B-835	10/9/2018	-	**6.18**	-	-	-	-
MW-209A	Intermediate	B-835	10/9/2018	0.522 J	4.33	-	-	-	-
MW-214A	Upper Claiborne	N-C	10/6/2018	**5.34**	2.17	-	-	0.630 J	2.49
MW-214B	Upper Claiborne	N-C	10/6/2018	4.86	1.93	-	-	0.723 J	2.32
MW-215A	Upper Claiborne	N-C	10/5/2018	**6.49**	3.56	-	-	0.666 J	3.02
MW-264	Upper Claiborne	N-C	10/7/2018	-	-	-	-	-	-
MW-34	Intermediate	Window	10/9/2018	1.97	4.14	-	-	-	1.33
MW-38	Intermediate	Window	10/8/2018	-	-	-	-	-	-
MW-89	Intermediate	Window	10/9/2018	2.43	0.604 J	-	-	-	-
MW-90	Intermediate	Window	10/9/2018	**14.2**	3.08	-	-	-	0.677
MW-107B	Upper Claiborne	Window	10/7/2018	**7.16**	0.406 J	-	-	-	-
MW-107T	Upper Claiborne	Window	10/7/2018	**6.7**	0.417 J	-	-	-	-
MW-141	Intermediate	Window	10/9/2018	**13**	2.47	-	-	-	1.04
MW-202A	Intermediate	Window	10/9/2018	2.08	0.661 J	-	-	-	0.153 J
MW-202B	Intermediate	Window	10/9/2018	**45.6**	3.04	-	-	0.489 J	0.438
MW-211	Intermediate	Window	10/6/2018	0.279 J	-	-	-	-	-
MW-229	Intermediate	Window	10/10/2018	-	-	-	-	-	-
MW-252	Intermediate	Window	10/9/2018	-	-	-	-	-	-
MW-253	Intermediate	Window	10/9/2018	-	-	-	-	-	-
MW-256	Intermediate	Window	10/9/2018	**21.7**	**7.46**	0.298 J	-	0.491 J	1.2
MW-262	Intermediate	Window	10/9/2018	-	-	-	-	-	-
MW-273	Intermediate	Window	10/9/2018	-	-	-	-	-	-
MW-293	Upper Claiborne	Window	10/6/2018	1.39	0.986 J	-	-	-	-
MAQ									
MW-140	Memphis	Window	10/9/2018	**12.2**	0.825 J	-	-	-	0.191 J
MW-254	Memphis	Window	10/9/2018	3.42	1.75	-	-	1.03	0.364
MW-255	Memphis	Window	10/9/2018	2.77	2.06	0.253 J	-	0.508 J	0.290 J
MW-290	Memphis	Background	10/10/2018	-	-	-	-	-	-

Notes:
1) Results above MCL shown in **bold**
µg/L: micrograms per liter
-: Analyte not detected
DQE Flags:
J: Estimated

TABLE 3
LTM WELLS SELECTED FOR WATER LEVEL MEASUREMENTS
SRI PHASE 4 QAPP
Defense Depot Memphis, Tennessee

Well ID	Aquifer	Top of Casing Elevation (ft, NAVD)	Top of Screen Elevation (ft, NAVD)	Date	Depth to Water (ft, btoc)	Groundwater Elevation
MW-22	Fluvial	298.04	202.6	10/5/2018	87.06	210.98
MW-52	Fluvial	279.26	185.3	10/5/2018	70.55	208.71
MW-63A	Fluvial	305.96	176.0	10/4/2018	93.91	212.05
MW-63B	Fluvial	305.78	190.8	10/4/2018	93.54	212.24
MW-66A	Fluvial	284.22	209.6	10/5/2018	71.14	213.08
MW-89	Intermediate	303.98	157.0	10/4/2018	102.68	201.30
MW-90	Intermediate	304.19	189.2	10/4/2018	103.33	200.86
MW-93	Fluvial	294.08	202.1	10/4/2018	89.31	204.77
MW-94A	Fluvial	303.00	193.4	10/5/2018	97.31	205.69
MW-102B	Fluvial	311.40	190.9	10/5/2018	99.98	211.42
MW-104	Fluvial	291.98	221.5	10/4/2018	57.64	234.34
MW-107	Upper Claiborne	304.92	176.9	10/4/2018	96.92	208.00
MW-200	Fluvial	300.18	197.0	10/4/2018	94.45	205.73
MW-206A	Fluvial	300.32	173.0	10/4/2018	94.25	206.07
MW-206B	Fluvial	300.30	203.6	10/4/2018	94.23	206.07
MW-207A	Upper Claiborne	304.05	154.1	10/4/2018	97.93	206.12
MW-207B	Fluvial	304.06	195.6	10/4/2018	97.75	206.31
MW-208A	Upper Claiborne	302.21	118.8	10/4/2018	96.38	205.83
MW-208B	Fluvial	302.13	195.5	10/4/2018	96.16	205.97
MW-211	Intermediate	304.14	137.9	10/4/2018	98.49	205.65
MW-214A	Upper Claiborne	304.01	184.9	10/4/2018	93.93	210.08
MW-214B	Upper Claiborne	304.10	202.5	10/4/2018	93.68	210.42
MW-215A	Upper Claiborne	304.97	176.2	10/4/2018	98.76	206.21
MW-215B	Fluvial	305.03	199.6	10/4/2018	98.78	206.25
MW-219	Fluvial	295.13	197.2	10/5/2018	83.73	211.40
MW-259	Fluvial	290.77	192.2	10/5/2018	87.44	203.33
MW-269	Fluvial	290.05	197.8	10/5/2018	77.71	212.34
MW-270	Fluvial	281.74	203.3	10/5/2018	75.51	206.23
MW-271	Fluvial	294.91	160.3	10/5/2018	90.43	204.48
MW-274	Fluvial	294.30	205.0	10/5/2018	81.48	212.82
MW-275	Fluvial	272.31	191.8	10/5/2018	65.31	207.00
MW-276	Fluvial	288.68	201.2	10/9/2018	83.71	204.97
MW-278	Fluvial	292.18	201.2	10/5/2018	79.13	213.05
MW-279	Fluvial	299.89	187.9	10/5/2018	88.56	211.33
MW-280	Fluvial	306.36	230.3	10/4/2018	71.84	234.52
MW-282	Fluvial	307.81	231.8	10/4/2018	79.21	228.60
MW-283	Fluvial	304.34	227.3	10/4/2018	68.95	235.39
MW-284	Fluvial	303.99	194.9	10/4/2018	98.54	205.45
MW-285	Fluvial	304.61	205.0	10/4/2018	93.99	210.62
MW-286	Fluvial	305.04	203.9	10/4/2018	95.05	209.99
MW-287	Fluvial	304.67	220.8	10/4/2018	79.75	224.92
MW-288	Fluvial	304.69	215.2	10/4/2018	85.25	219.44
MW-291	Fluvial	303.59	229.7	10/4/2018	71.54	232.05
MW-293	Upper Claiborne	304.34	152.0	10/4/2018	95.61	208.73
MW-294	Fluvial	304.38	234.8	10/5/2018	71.15	233.23
MW-296	Fluvial	296.32	196.5	10/5/2018	91.09	205.23
MW-301	Fluvial	271.03	196.5	10/5/2018	64.20	206.83
MW-302	Intermediate	291.60	132.5	10/5/2018	90.60	201.00

Notes:

ft, btoc:	feet below top of casing
ft, NAVD:	feet above North American Vertical Datun

TABLE 5
PROPOSED WELL LOCATIONS AND ESTIMATED DEPTHS
SRI PHASE 4 QAPP
Main Installation - Defense Depot Memphis, Tennessee

Location	Easting (ft)	Northing (ft)	Ground Elevation (ft, NAVD)	Groundwater Elevation (ft, NAVD)	Top of Clay Elevation (ft, NAVD)	Groundwater Depth (ft, bgs)	Top of Clay Depth (ft, bgs)	Saturated Thickness (ft)	Surface Casing Depth (ft, bgs)	Top of Screen Depth (ft, bgs)	Total Well Depth (ft, bgs)	Total Boring Depth (ft, bgs)
F-4	800254	275875	306	212	181	94	125	31	NA	99	109	110
F-5	800060	276486	295	212	188	82	106	24	NA	87	97	98
F-6	800132	276247	299	212	187	87	112	26	NA	92	102	103
F-10	806278	279396	290	241	224	48	65	17	NA	53	63	64
F-22	802789	278496	306	203	141	103	165	62	NA	108	118	119
F-23	803405	278617	300	215	179	85	120	35	NA	90	100	101
F-24	803509	277877	301	211	157	90	145	55	NA	95	105	106
F-25	806226	277670	302	234	221	69	81	13	NA	74	84	85
F-27	803760	276721	301	205	150	95	151	55	NA	100	110	111
F-28	804690	275342	289	205	187	84	102	19	NA	89	99	100
F-29	805661	275543	275	209	189	67	86	19	NA	72	82	82.5
F-30	805326	278350	300	234	210	66	90	24	NA	71	81	82
I-1	801231	279461	286	173	218	113	68	NA	76	111	121	122
I-5	803640	277068	302	206	140	96	162	NA	NA[5]	150	160	162
F-21-NW	803182	278360	302	211	148	91	155	64	NA	TBD[4]	154	160
F-26-NW	803284	277354	303	208	132	96	171	75	NA	TBD[4]	170	176

Note:
1) Depths and elevations for Phase 4 wells are estimated based on elevation contour maps for ground surface, groundwater and top of clay.
2) All monitoring wells will have 10-foot screens; nested wells will have 2.5-foot screens.
3) Estimated groundwater depths are for the Fluvial Aquifer wells 'F' wells and the Intermediate Aquifer at wells 'I' wells.
4) Nested wells will have up to 4 screened intervals at depths to be determined by vertical profiling at these locations prior to well installation.
5) Well I-5 will not have surface casing because there was no clay between Fluvial and Upper Claiborne sands in adjacent well MW-290.
NA: Not applicable
ft: feet
bgs: below ground surface
btoc: below top of casing
NAVD: North American Vertical Datum of 1988

TABLE 6
EXISTING LTM WELLS
SRI PHASE 4 QAPP
Main Installation - Defense Depot Memphis, Tennessee

Well	Aquifer	Area	Northing (ft)	Easting (ft)	Top of Casing Elevation (ft, NAVD)	Ground Elevation (ft, NAVD)	Depth to Top of Clay (ft, bgs)	Surface Casing Depth (ft, bgs)	Riser Length (ft)	Screen Length (ft)	Total Well Depth (ft, btoc)
DR1-1	Fluvial	TTA-1S	276300	800856	293.14	293.42	141.5	NA	121.7	20	141.7
DR1-1A	Fluvial	TTA-1S	276307	800863	293.00	293.37	-	NA	89.2	20	109.2
DR1-2	Fluvial	TTA-1N	276537	801153	290.00	291.39	115.0	NA	97.7	20	117.7
DR1-3	Fluvial	TTA-1S	276527	801416	290.93	291.11	126.5	NA	109.7	20	129.7
DR1-4	Fluvial	TTA-1S	276231	801400	292.78	293.00	126.0	NA	106.3	20	126.3
DR1-5	Fluvial	TTA-1S	276080	800828	294.46	294.86	144.0	NA	124.7	20	144.7
DR1-5A	Fluvial	TTA-1S	276087	800835	294.51	294.87	-	NA	90.0	20	110.0
DR1-6	Fluvial	TTA-1S	276044	801103	293.17	293.50	136.0	NA	114.4	20	134.4
DR1-6A	Fluvial	TTA-1S	276035	801104	293.28	293.58	-	NA	90.9	20	110.9
DR1-7	Fluvial	TTA-1N	276791	801441	289.15	289.46	129.5	NA	108.3	20	128.3
DR1-8	Fluvial	TTA-1N	276752	800875	290.09	290.47	111.0	NA	92.7	20	112.7
DR2-1	Fluvial	TTA-2	276772	806498	304.90	305.08	94.0	NA	73.9	20	93.9
DR2-2	Fluvial	TTA-2	276771	806659	304.30	304.67	92.0	NA	78.4	15	93.4
DR2-3	Fluvial	TTA-2	276539	806203	303.44	303.66	106.0	NA	93.0	20	113.0
DR2-4	Fluvial	TTA-2	276456	806633	303.55	303.96	106.5	NA	88.1	20	108.1
DR2-5	Fluvial	TTA-2	276831	806180	305.41	305.72	99.0	NA	84.5	15	99.5
DR2-6	Fluvial	TTA-2	276644	805861	304.70	304.92	116.0	NA	94.6	20	114.6
MW-16	Fluvial	Background	278838	807100	299.86	300.19	75.0	NA	57.6	15	72.6
MW-19	Fluvial	Background	278946	800782	290.57	290.86	93.5	NA	83.1	10	93.1
MW-21	Fluvial	TTA-1N	276473	800602	295.00	295.30	-	NA	92.1	15	107.1
MW-22	Fluvial	TTA-1S	275912	800702	298.04	298.49	-	NA	95.4	10	105.4
MW-23	Fluvial	Background	275791	801817	298.99	299.24	-	NA	101.2	10	111.2
MW-24	Fluvial	Background	275616	803539	299.51	299.81	114.7	NA	97.3	15	112.3
MW-25A	Fluvial	TTA-2	275975	805521	269.88	270.13	-	NA	73.0	10	83.0
MW-26	Fluvial	TTA-2	276508	805962	303.69	303.89	110.0	NA	97.6	10	107.6
MW-34	Intermediate	Window	279411	801918	299.97	300.80	158.3	NA	136.6	20	156.6
MW-38	Intermediate	Window	279141	802450	307.45	308.45	155.0	NA	139.9	15	154.9
MW-39	Fluvial	W-C	277281	802598	296.28	296.58	-	NA	95.5	20	115.5
MW-39A	Upper Claiborne	W-C	277278	802608	298.61	298.70	165.0	NA	148.1	20	168.1
MW-50	Fluvial	TTA-2	276456	807065	298.82	299.32	126.0	NA	115.0	10	125.0
MW-52	Fluvial	SE	275372	805897	279.26	279.71	104.0	NA	94.0	10	104.0
MW-53	Fluvial	Background	279177	805136	306.38	305.58	83.0	NA	72.5	10	82.5
MW-55	Fluvial	Background	279301	801205	292.08	292.48	74.0	NA	64.0	10	74.0
MW-62	Fluvial	B-835	278290	801858	293.71	293.90	97.0	NA	86.1	10	96.1
MW-63A	Fluvial	N-C	278200	803573	305.96	306.33	140.0	NA	130.0	10	140.0
MW-63B	Fluvial	N-C	278201	803558	305.78	306.22	-	NA	115.0	10	125.0
MW-64	Fluvial	TTA-2	276952	805006	304.21	304.46	113.0	NA	102.0	10	112.0

TABLE 6
EXISTING LTM WELLS
SRI PHASE 4 QAPP
Main Installation - Defense Depot Memphis, Tennessee

Well	Aquifer	Area	Northing (ft)	Easting (ft)	Top of Casing Elevation (ft, NAVD)	Ground Elevation (ft, NAVD)	Depth to Top of Clay (ft, bgs)	Surface Casing Depth (ft, bgs)	Riser Length (ft)	Screen Length (ft)	Total Well Depth (ft, btoc)
MW-66A	Fluvial	TTA-1N	276626	799793	284.22	284.34	94.0	NA	74.6	20	94.6
MW-85	Fluvial	TTA-2	276704	806065	304.13	304.50	111.5	NA	95.9	15	110.9
MW-88	Fluvial	TTA-2	276879	806513	305.15	305.47	97.0	NA	82.0	15	97.0
MW-89	Intermediate	Window	278287	802555	303.98	304.38	94.5	NA	147.0	30	177.0
MW-90	Intermediate	Window	278284	802540	304.19	304.64	-	NA	115.0	30	145.0
MW-92	Fluvial	TTA-2	276614	806490	304.41	304.78	107.9	NA	93.0	15	108.0
MW-93	Fluvial	Background	275542	804440	294.08	294.31	107.0	NA	92.0	15	107.0
MW-94A	Fluvial	W-C	276806	803086	303.00	303.23	117.5	NA	109.6	10	119.6
MW-96	Fluvial	TTA-2	276310	806320	289.02	289.67	95.5	NA	75.5	20	95.5
MW-97	Fluvial	S-C	276074	802139	297.44	297.70	117.5	NA	97.5	20	117.5
MW-98	Fluvial	W-C	276891	802573	294.43	294.93	147.0	NA	137.0	10	147.0
MW-99	Fluvial	Background	277443	801115	285.33	285.69	111.5	NA	91.5	20	111.5
MW-100B	Fluvial	TTA-1N	276601	800854	290.92	291.47	127.5	NA	107.4	20	127.4
MW-101[1]	Fluvial	TTA-1S	276204	801110	291.74	291.98	134.0	NA	89.0	15	104.0
MW-102B	Fluvial	Background	275761	800708	311.40	312.07	140.5	NA	120.5	20	140.5
MW-103	Fluvial	N-C	278691	805160	301.37	301.89	90.0	NA	70.0	20	90.5
MW-104	Fluvial	N-C	278676	805417	291.98	292.15	90.5	NA	66.7	20	87.2
MW-107[1]	Upper Claiborne	Window	278419	803010	304.92	305.18	158.0	NA	128.0	15	143.0
MW-108	Upper Claiborne	W-C	277658	802986	303.07	303.25	170.0	NA	160.0	10	170.0
MW-113	Fluvial	TTA-2	276685	806279	304.81	304.92	105.0	NA	96.0	10	106.0
MW-140	Memphis	Window	279061	801716	298.12	298.16	76.0	NA	224.6	20	244.6
MW-141	Intermediate	Window	278019	802571	303.71	303.70	110.0	NA	148.7	20	168.7
MW-142	Fluvial	B-835	278056	801629	291.18	291.49	98.5	NA	85.0	20	105.0
MW-143	Fluvial	B-835	278301	801201	290.66	290.90	92.5	NA	78.6	20	98.6
MW-197A	Upper Claiborne	W-C	276975	802042	291.64	291.54	176.0	NA	161.7	15	176.7
MW-197B	Fluvial	W-C	276973	802037	291.43	291.43	-	NA	93.8	15	108.8
MW-198	Fluvial	B-835	277776	802142	291.78	292.20	105.0	NA	90.3	15	105.3
MW-199A	Intermediate	B835	277756	802574	301.90	301.84	117.0	NA	146.1	15	161.1
MW-199B	Fluvial	B-835	277752	802576	302.06	302.07	-	NA	104.6	15	119.6
MW-200	Fluvial	W-C	277006	802859	300.18	300.51	117.0	NA	103.2	15	118.4
MW-202A	Intermediate	Window	278686	802111	299.67	299.69	86.0	NA	176.2	15	191.2
MW-202B	Intermediate	Window	278693	802112	299.92	299.74	88.0	NA	118.8	15	133.8
MW-203A	Upper Claiborne	W-C	276842	801740	290.70	290.80	167.0	NA	142.9	20	162.9
MW-203B	Fluvial	W-C	276821	801742	290.87	291.10	-	NA	93.0	20	113.0
MW-204A	Fluvial	W-C	276725	802168	292.59	292.49	149.0	NA	133.3	15	148.3
MW-204B	Fluvial	W-C	276708	802167	292.71	293.00	-	NA	94.9	15	109.9

TABLE 6
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SRI PHASE 4 QAPP
Main Installation - Defense Depot Memphis, Tennessee

Well	Aquifer	Area	Northing (ft)	Easting (ft)	Top of Casing Elevation (ft, NAVD)	Ground Elevation (ft, NAVD)	Depth to Top of Clay (ft, bgs)	Surface Casing Depth (ft, bgs)	Riser Length (ft)	Screen Length (ft)	Total Well Depth (ft, btoc)
MW-205A	Upper Claiborne	W-C	277157	802277	292.30	292.40	158.0	NA	141.3	15	156.3
MW-205B	Fluvial	W-C	277173	802278	292.16	292.30	-	NA	97.3	15	112.3
MW-206A	Fluvial	W-C	277219	802792	300.32	300.35	144.5	NA	127.3	15	142.4
MW-206B	Fluvial	W-C	277201	802795	300.30	300.12	-	NA	96.7	15	111.7
MW-207A	Upper Claiborne	W-C	277653	803192	304.05	304.45	167.0	NA	149.9	15	164.9
MW-207B	Fluvial	W-C	277665	803193	304.06	304.42	-	NA	108.5	15	123.5
MW-208A	Upper Claiborne	W-C	277382	802799	302.21	302.40	198.0	NA	183.4	15	198.5
MW-208B	Fluvial	W-C	277397	802815	302.13	302.08	-	NA	106.7	15	121.7
MW-209A	Intermediate	B-835	277574	802507	298.45	298.36	205.0	NA	189.0	15	204.0
MW-209B	Fluvial	B-835	277582	802520	298.89	298.72	-	NA	102.3	15	117.3
MW-210A	Intermediate	W-C	277239	801958	289.61	289.70	139.0	NA	177.0	15	192.0
MW-210B	Fluvial	W-C	277228	801952	289.54	289.83	-	NA	97.0	15	112.0
MW-211	Intermediate	Window	278001	802974	304.14	304.09	99.0	NA	166.3	15	181.3
MW-212	Fluvial	B-835	278028	802225	295.74	295.68	100.0	NA	85.3	15	100.3
MW-213	Fluvial	B-835	278427	801669	294.22	294.20	92.0	NA	77.3	15	92.3
MW-214A	Upper Claiborne	N-C	277878	803907	304.01	303.96	137.0	NA	119.1	15	134.1
MW-214B	Upper Claiborne	N-C	277876	803922	304.10	303.96	-	NA	101.6	15	116.6
MW-215A	Upper Claiborne	N-C	277298	804164	304.97	304.86	147.0	NA	128.8	15	143.8
MW-215B	Fluvial	N-C	277298	804177	305.03	304.98	-	NA	105.4	15	120.4
MW-216	Fluvial	S-C	276025	801996	297.72	297.63	119.0	NA	99.9	15	115.0
MW-217	Fluvial	TTA-2	276671	805214	304.65	304.51	116.0	NA	101.8	15	116.8
MW-218	Fluvial	TTA-2	276937	805628	306.07	306.00	114.0	NA	98.9	15	114.0
MW-219	Fluvial	TTA-1N	276429	800461	295.13	295.00	110.0	NA	98.0	15	113.0
MW-229	Intermediate	Window	279294	802837	311.78	312.09	93.0	NA	188.4	20	208.4
MW-252	Intermediate	Window	278789	801365	294.16	294.40	87.0	97.0	126.1	20	146.1
MW-253	Intermediate	Window	278287	801191	290.47	290.80	107.0	117.0	118.3	20	138.3
MW-254	Memphis	Window	279334	800858	292.84	293.28	75.0	85.0	285.8	20	305.8
MW-255	Memphis	Window	279305	801227	291.84	292.38	72.0	82.0	284.7	20	304.7
MW-256	Intermediate	Window	279302	801244	292.68	293.40	69.0	79.0	127.1	20	147.1
MW-258	Fluvial	N-C	278126	804427	304.37	304.83	105.0	NA	79.3	20	99.3
MW-259	Fluvial	TTA-2	276279	804451	290.77	291.44	136.0	NA	98.6	20	118.6
MW-260	Fluvial	N-C	278398	804376	304.16	304.45	96.0	NA	68.0	20	88.3
MW-261	Fluvial	S-C	276391	802592	293.52	293.79	135.0	NA	90.0	20	110.3
MW-262	Intermediate	Window	279334	800833	293.22	293.50	82.0	87.0	154.4	10	164.6
MW-263	Fluvial	N-C	278945	805817	291.40	291.78	79.0	NA	69.1	10	79.3
MW-264	Upper Claiborne	N-C	278411	804590	303.72	304.00	117.0	NA	104.8	10	115.0
MW-265	Fluvial	N-C	278112	804710	305.15	305.61	95.0	NA	85.8	10	96.0

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Main Installation - Defense Depot Memphis, Tennessee

Well	Aquifer	Area	Northing (ft)	Easting (ft)	Top of Casing Elevation (ft, NAVD)	Ground Elevation (ft, NAVD)	Depth to Top of Clay (ft, bgs)	Surface Casing Depth (ft, bgs)	Riser Length (ft)	Screen Length (ft)	Total Well Depth (ft, btoc)
MW-266	Fluvial	TTA-2	277092	806686	304.68	305.10	87.0	NA	77.1	10	87.3
MW-267	Fluvial	TTA-2	277161	806001	303.84	304.30	90.0	NA	71.9	10	82.1
MW-268	Upper Claiborne	TTA-2	277204	805284	304.59	304.92	120.0	NA	109.5	10	119.7
MW-269	Fluvial	TTA-1N	276369	800127	290.05	290.50	102.0	NA	92.2	10	102.4
MW-270	Fluvial	SE	275483	805042	281.74	282.20	88.0	NA	78.4	10	88.6
MW-271	Fluvial	S-C	276315	803774	294.91	295.50	145.0	NA	134.7	10	144.9
MW-272	Fluvial	Background	275880	804037	293.27	293.70	122.0	NA	112.8	10	123.0
MW-273	Intermediate	Window	279713	800122	284.73	285.00	85.0	91.0	128.1	10	138.3
MW-274	Fluvial	Background	275726	806543	294.30	294.60	100.0	NA	89.3	10	99.5
MW-275	Fluvial	Background	275232	805306	272.31	272.59	89.0	NA	80.5	10	90.7
MW-276	Fluvial	Background	275564	804697	288.68	288.91	97.0	NA	87.5	10	97.7
MW-277	Fluvial	Background	275532	803998	301.67	301.96	113.0	NA	102.3	10	112.5
MW-278	Fluvial	TTA-1N	276294	799814	292.18	292.46	102.0	NA	91.0	10	101.2
MW-279	Fluvial	TTA-1S	275982	800579	299.89	300.17	123.0	NA	112.0	10	122.2
MW-280	Fluvial	TTA-2	277390	806313	306.36	306.57	87.0	NA	76.0	10	86.2
MW-281	Fluvial	N-C	278155	804123	304.56	305.03	101.0	NA	81.7	10	91.9
MW-282	Fluvial	Background	278710	804033	307.81	308.14	87.0	NA	76.0	10	86.2
MW-283	Fluvial	Background	278176	806074	304.34	304.87	88.0	NA	77.0	10	87.2
MW-284	Fluvial	Background	277049	803765	303.99	304.35	-	NA	109.0	10	119.0
MW-285	Fluvial	W-C	278102	803184	304.61	304.98	-	NA	99.5	10	110.5
MW-286	Fluvial	Window	278427	803027	305.04	305.41	-	NA	102.0	10	112.0
MW-287	Fluvial	Window	278236	803971	304.67	305.01	-	NA	84.0	10	94.0
MW-288	Fluvial	N-C	277932	803895	304.69	305.07	-	NA	90.0	10	100.0
MW-289	Fluvial	N-C	277865	804526	305.41	305.85	-	NA	78.0	10	88.0
MW-290	Fluvial	N-C	277046	803795	304.22	304.49	135.5	180	214.0	10	224.0
MW-291	Memphis	Background	278371	804963	303.59	303.97	-	NA	74.0	10	84.0
MW-292	Fluvial	N-C	276981	806334	304.83	305.28	-	NA	73.0	10	83.0
MW-293	Fluvial	TTA-2	278143	803188	304.34	304.77	141.3	NA	152.5	10	162.5
MW-294	Upper Claiborne	Window	277351	805966	304.38	304.84	222.8	NA	70.0	10	80.0
MW-295	Fluvial	TTA-2	277222	805292	304.35	304.72	-	NA	73.0	10	83.5
MW-296	Fluvial	TTA-2	276362	803345	296.32	296.74	-	NA	100.0	10	110.0
MW-297	Fluvial	S-C	276351	802850	297.91	298.46	-	NA	100.0	10	110.0
MW-298	Fluvial	S-C	276100	802436	296.50	297.04	-	NA	100.0	10	110.0
MW-299	Fluvial	S-C	278329	801532	292.71	293.04	199.0	NA	86.0	10	96.0
MW-300	Fluvial	B-835	278451	801082	290.26	290.64	-	NA	85.0	10	95.0
MW-301	Fluvial	B-835	275494	805309	271.03	271.33	-	NA	74.0	10	84.0
MW-302	Fluvial	SE	276266	804423	291.60	291.92	156.9	146	160.0	10	170.0

TABLE 6
EXISTING LTM WELLS
SRI PHASE 4 QAPP
Main Installation - Defense Depot Memphis, Tennessee

Well	Aquifer	Area	Northing (ft)	Easting (ft)	Top of Casing Elevation (ft, NAVD)	Ground Elevation (ft, NAVD)	Depth to Top of Clay (ft, bgs)	Surface Casing Depth (ft, bgs)	Riser Length (ft)	Screen Length (ft)	Total Well Depth (ft, btoc)
PMW21-01	Intermediate	TTA-2	276533	800600	294.76	295.00	110.0	NA	88.4	20	108.4
PMW21-02	Fluvial	TTA-1N	276575	800701	292.98	293.19	108.0	NA	91.3	20	111.3
PMW21-03	Fluvial	TTA-1N	276573	800743	292.11	292.72	109.0	NA	90.3	20	110.3
PMW21-04	Fluvial	TTA-1N	276602	800772	291.87	292.20	109.0	NA	89.0	20	109.0
PMW21-05	Fluvial	TTA-1N	276628	801130	288.53	288.92	-	NA	94.3	20	114.3
PMW85-01	Fluvial	TTA-2	276802	806146	305.08	305.39	-	NA	93.2	10	103.2
PMW85-05	Fluvial	TTA-2	276752	806222	305.12	305.32	103.0	NA	93.2	10	103.2
PMW92-02	Fluvial	TTA-2	276667	806476	304.17	304.35	99.0	NA	94.8	10	104.8
PMW92-03	Fluvial	TTA-2	276679	806439	303.91	304.17	103.0	NA	92.5	10	102.5
PMW101-02A	Fluvial	TTA-1S	276282	801145	292.00	292.29	138.0	NA	117.7	20	137.7
PMW101-02B	Fluvial	TTA-1S	276286	801145	291.98	292.24	-	NA	97.8	20	117.8
PMW101-03A	Fluvial	TTA-1S	276348	801198	291.61	291.99	141.0	NA	119.2	20	139.2
PMW101-03B	Fluvial	TTA-1S	276353	801194	291.55	291.82	-	NA	99.3	20	119.3
PMW101-04A	Fluvial	TTA-1S	276299	801182	291.07	291.43	138.0	NA	117.9	20	137.9
PMW101-04B	Fluvial	TTA-1S	276296	801187	291.47	291.75	-	NA	98.6	20	118.6
PMW101-06A	Fluvial	TTA-1S	276192	801187	292.13	292.72	139.0	NA	120.0	20	140.0
PMW101-06B	Fluvial	TTA-1S	276195	801184	292.17	292.40	-	NA	99.3	20	119.3
PMW101-07A	Fluvial	TTA-1S	276143	801172	292.20	292.52	138.0	NA	117.9	20	137.9
PMW101-07B	Fluvial	TTA-1S	276142	801177	292.36	292.70	-	NA	98.0	20	118.0

Notes:
1: MW-101 has three screened sections at the following depths (ft, btoc): 89-104, 109-119 and 124-134.
2: MW-107 has two screened sections at the following depths (ft, btoc): 128-143 and 148-158.
ft: feet
bgs: below ground surface
btoc: below top of casing
NAVD: North American Vertical Datum of 1988

Figures

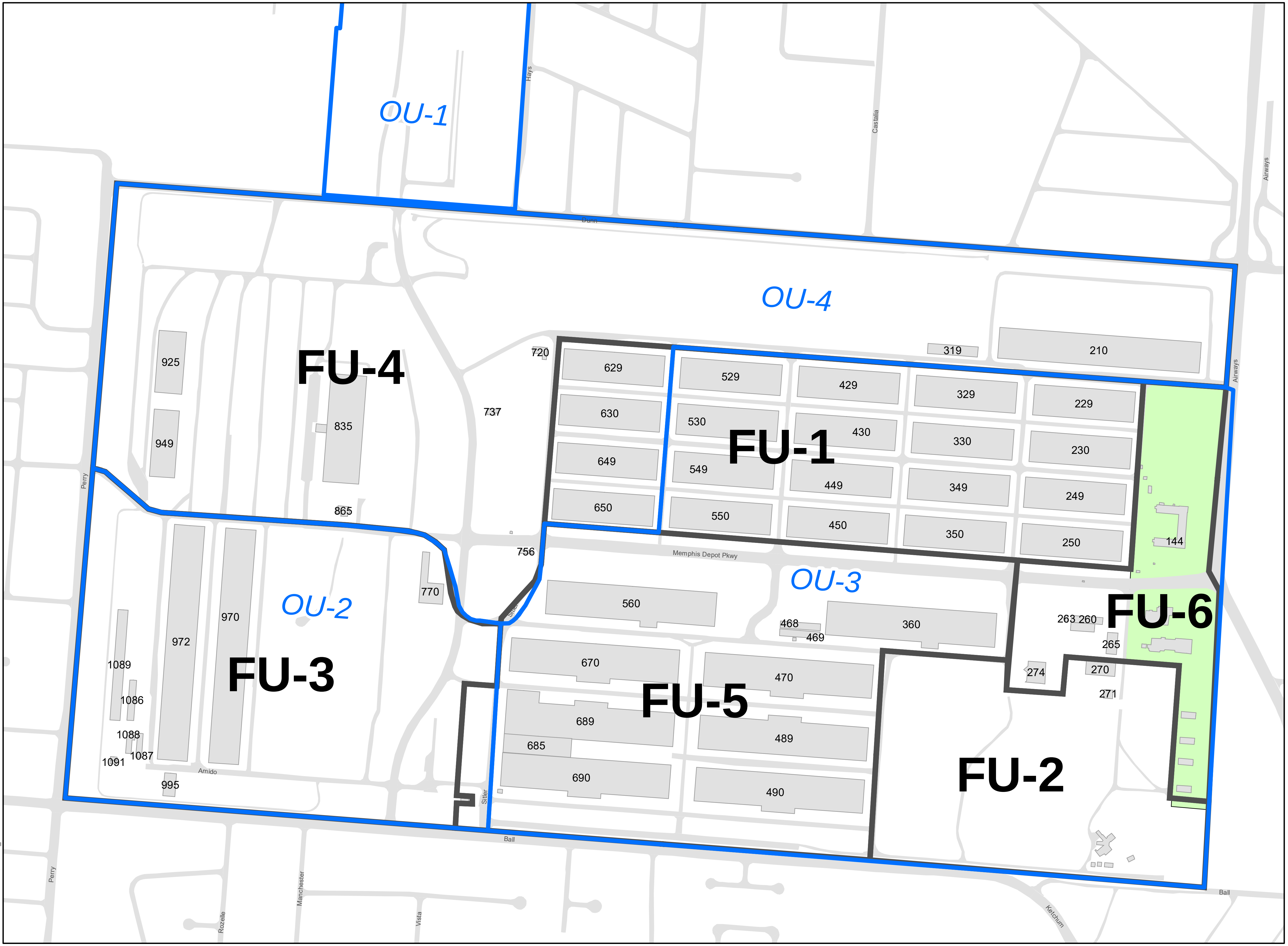

Figure 1

Main Installation Unit Boundaries

SRI Phase 4 QAPP

Main Installation
Defense Depot
Memphis, Tennessee

Legend

▬	Operable Units (OU-#)
▭	Functional Unit Boundary (FU-#)
🟩	Area Available for Unrestricted Use
▭	Buildings *490 - DDMT Assigned Number*
▭	Roads

Projection: NAD 1927 StatePlane Tennessee
Units: Feet, Elevation Units: Feet, NAVD88

Date: 1/17/2019
Edition: Rev 0

Path: W:\SRI Phase 4\QAPP\01_MIBoundariesAndActions.mxd

Figure 2

SRI Phase 3 and LTM Wells

SRI Phase 4 QAPP

Main Installation
Defense Depot
Memphis, Tennessee

Projection: NAD 1927 StatePlane Tennessee
Units: Feet, Elevation Units: Feet, NAVD88

Date: 1/17/2019
Edition: Rev 0

Path: W:\SRI Phase 4\QAPP\02_MI_LTM_Wells.mxd

Path: W:\LTM\LB28\07_FAQ_GWeleOct18.mxd

Note
1. Groundwater elevations for IAQ wells MW-107 and MW-169 are shown and included to aid interpretation of elevation contours at the entrance to the window and northwest of Dunn Field. Both wells are screened in Upper Claiborne sand where a clay layer is not present below the Fluvial sand.

Legend

- ● Fluvial Aquifer Well
- 🟧 Intermediate/Upper Claiborne Well
- ◀ Groundwater Flow Direction
- – – Potentiometric surface of the Fluvial Aquifer 1-ft. contour
- — — Potentiometric surface of the Fluvial Aquifer 5-ft. contour
- · · Potentiometric surface extrapolation
- — Property Boundary
- ▭ Roads
- ▭ Buildings
- ▨ Clay Elevation Exceeds Groundwater Elevation
- MW-03 230.52 Fluvial Aquifer, used for groundwater contours (10/3-9/18)
- MW-169 201.70 Intermediate/ Upper Claiborne Aquifer, used for groundwater contours (10/3-9/18)

Groundwater elevations are in ft, NAVD.

Figure 3

Fluvial Aquifer Groundwater Elevations, October 2018

SRI Phase 4 QAPP

Main Installation
Defense Depot
Memphis, Tennessee

0 250 500
Feet

Projection: NAD 1927 StatePlane Tennessee
Units: Feet, Elevation Units: Feet , NAVD88

Date: 2/1/2019
Edition: Rev 0

Legend

- ■ Intermediate/Upper Claiborne Well
- ◀ Groundwater Flow Direction (Intermediate)
- -·-·- Intermediate Aquifer Contours
- ▬ Property Boundary
- ▭ Roads
- ▭ Buildings
- ▨ Clay Elevation Exceeds Groundwater Elevation

MW-273
177.91 Intermediate Aquifer, used for groundwater contours (10/3-9/18)

Groundwater elevations are in ft, NAVD.

Figure 4

Intermediate Aquifer Groundwater Elevations, October 2018

SRI Phase 4 QAPP

Main Installation
Defense Depot
Memphis, Tennessee

Projection: NAD 1927 StatePlane Tennessee
Units: Feet, Elevation Units: Feet, NAVD88

Date: 2/1/2019
Edition: Rev 0

Path: W:\LTM\LB28\09_IUC_GWeleOct18.mxd

Legend

- ● Groundwater Elevations (Fluvail)
- Potentiometric surface of the Fluvial Aquifer 1-ft. contour
- Potentiometric surface of the Fluvial Aquifer 5-ft. contour
- Divide for flow into the window (north of line) or into the sink (south of line).
- Flow Direction
- Property Boundary
- Buildings *490 - DDMT Assigned Number*
- Roads
- ▨ Clay Elevation Exceeds Groundwater Elevation

Figure 5

Fluvial Aquifer Flow Direction

SRI Phase 4 QAPP

Main Installation
Defense Depot
Memphis, Tennessee

0 250 500
Feet

Projection: NAD 1927 StatePlane Tennessee
Units: Feet, Elevation Units: Feet, NAVD88

Date: 8/22/2019
Edition: Rev 0

HDR

Note
1. Contour data includes August 2018 water levels.

Path: W:\SRI Phase 4\QAPP\05_SRI4 FAQ Flow Directons.mxd

Legend

● Fluvial

■ Intermediate/Upper Claiborne

▲ Memphis/ Upper Claiborne (Deep)

Well Symbols (µg/L)

- ● 0 - 5
- ● 5 - 10
- ● 10 - 50
- ● 50 - 100
- ● >100

Contour Shading FAQ (µg/L)

- 🟩 5-10
- 🟨 10-50
- 🟧 50-100
- 🟥 >100

Contour Shading IUC/MAQ (µg/L)

- ▨ 5-10
- ▨ >10

Potentiometric surface of the Fluvial Aquifer 5-ft. contour

Potentiometric surface of the Fluvial Aquifer 1-ft. contour

Potentiometric surface of the Intermediate Aquifer 5-ft. contour

Property Boundary

Groundwater Flow Direction (Fluvial)

Groundwater Flow Direction (Intermediate)

Clay Elevation Exceeds Groundwater Elevation

Figure 6

PCE Concentrations, October 2018

SRI Phase 4 QAPP

Main Installation
Defense Depot
Memphis, Tennessee

0 250 500
Feet

Projection: NAD 1927 StatePlane Tennessee
Units: Feet, Elevation Units: Feet, NAVD88

Date: 1/17/2019
Edition: Rev 0

HDR

Note:
1. Color-coded wells symbols are based on analytical result at each well. Results are from the October 2018 LTM event.
2. Groundwater contours are from the October 2018 LTM event.

Path: W:\SRI Phase 4\QAPP\03_PCEOct2018.mxd

Note:
1. Color-coded wells symbols are based on analytical result at each well. Results are from the October 2018 LTM event.
2. Groundwater contours are from the October 2018 LTM event.

Figure 7

TCE Concentrations, October 2018

SRI Phase 4 QAPP

Main Installation
Defense Depot
Memphis, Tennessee

Path: W:\SRI Phase 4\QAPP\04_TCEOct2018.mxd

Legend

- ● Fluvial
- ■ Intermediate/Upper Claiborne
- ▲ Memphis/ Upper Claiborne (Deep)

Well Symbols (µg/L)

- ● 0 - 5
- ● 5 - 10
- ● 10 - 50
- ● 50 - 100
- ● >100

Contour Shading FAQ (µg/L)

- 🟩 5-10
- 🟨 10-50
- 🟧 50-100
- 🟥 >100

Contour Shading IUC/MAQ (µg/L)

- ▨ 5-10
- ▨ >10

- ● Proposed Fluvial Aquifer Phase 4 Well
- ■ Proposed Intermediate Aquifer Phase 4 Well
- ☒ Proposed Phase 4 Nested Well
- Flow Divide
- Potentiometric surface of the Fluvial Aquifer 5-ft. contour
- Potentiometric surface of the Fluvial Aquifer 1-ft. contour
- Potentiometric surface of the Intermediate Aquifer 5-ft. contour
- Property Boundary
- ◀ Groundwater Flow Direction (Fluvial)
- ◀ Groundwater Flow Direction (Intermediate)
- ▨ Clay Elevation Exceeds Groundwater Elevation

Note:
1. Color-coded wells symbols are based on analytical result at each well. Results are from the October 2018 LTM event.
2. Groundwater contours are from the October 2018 LTM event.

Figure 8

Phase 4 Well Locations
PCE Concentrations

SRI Phase 4 QAPP

Main Installation
Defense Depot
Memphis, Tennessee

N W E S

0 250 500
Feet

Projection: NAD 1927 StatePlane Tennessee
Units: Feet, Elevation Units: Feet, NAVD88

Date: 8/28/2019
Edition: Rev 0

Path: W:\SRI Phase 4\QAPP\08_PCEOct2018.mxd

Note:
1. Color-coded wells symbols are based on analytical result at each well. Results are from the October 2018 LTM event.
2. Groundwater contours are from the October 2018 LTM event.

Path: W:\SRI Phase 4\QAPP\09_TCEOct2018.mxd

Figure 9

Phase 4 Well Locations TCE Concentrations

SRI Phase 4 QAPP

Main Installation
Defense Depot
Memphis, Tennessee

Projection: NAD 1927 StatePlane Tennessee
Units: Feet, Elevation Units: Feet, NAVD88

Date: 8/28/2019
Edition: Rev 0

Appendix A
Field Standard Operating Procedures

STANDARD OPERATING PROCEDURE 1 - GENERAL PROCEDURES FOR FIELD PERSONNEL

Lead Organization: Department of the Army (DA)
Preparing Organization: HDR
SOP Approved by: Field Team Leader: Clayton Mokri
Project QA Officer: Lynn Lutz
Project Manager: Tom Holmes

1 Purpose

This Standard Operating Procedure (SOP) provides guidance for the general field practices to be followed during field activities at Defense Depot Memphis, Tennessee (DDMT); review is mandatory prior to the start of each field event. This SOP provides general guidance; the project-specific work plan must be reviewed for specific project requirements.

2 Health and Safety

Each individual assigned to field work must participate in the HDR Medical Monitoring Program, must have taken the Occupational Safety and Health Administration (OSHA) 40-Hour course (updated with the 8-Hour OSHA Refresher, when necessary), and must be certified as able to wear respiratory protection.

Each individual is required to have read and understood the project Site Safety and Health Plan (SSHP) for the specific project activity. Upon arrival at the site, each person shall sign the acknowledgement sheet confirming their review of the SSHP. Personal protective equipment (PPE) and other provisions for site safety requirements are discussed in the project specific Health and Safety plan.

All equipment will only be used by properly trained personnel. Only personnel that have received forklift operator safety training are permitted to use the forklift. Proper tools will be made available to each employee as necessary. Any questions should be addressed to the Field Team Leader (FTL).

3 Personnel Qualifications and Responsibilities

Field activities will be directed by the FTL, an environmental professional (engineer, geologist or scientist) with experience in performing and directing the planned activities. Field staff will be junior to mid-level environmental professionals or environmental technicians. Field work will be conducted by persons with experience in performing the planned activities. At least one person on each team will have a current certification in first aid and CPR.

The FTL will provide direction to field staff to ensure work is performed in accordance with the project documents (Quality Assurance Project Plan [QAPP], project work plan and SOPs). The field staff will carefully review the project documents, conduct the work as planned, seek direction from the FTL when questions or problems arise, and carefully complete field documentation.

4 Equipment and Supplies

The required equipment and supplies will be identified in the SOPs for the specific field activities to be performed and in the project work plan. Field activities should not proceed until the proper tools and equipment are available and in good working order.

Each team will have use of a truck/van during field activities. An initial safety check should be performed at the start of each shift to confirm the vehicle is in good working condition. The vehicle should then be checked daily for damage or required maintenance. For each HDR owned vehicle, mileage will be recorded on the vehicle mileage log at the start and end of each field event.

5 Procedure

5.1 Start-Up Activities

5.1.1 Office

Prior to leaving the office for field work, personnel will perform the following actions:

1. The Project Manager (PM) will assign an FTL to direct field activities and coordinate with project personnel. Task specific responsibilities of the FTL will be addressed in the appropriate SOP; general responsibilities include:
    a. Review project work plan, SSHP, and QAPP.
    b. Work with PM to properly staff the field activity.
    c. Coordinate sampling activities with the project chemist and analytical laboratory.
    d. Confirm availability and condition of DDMT-owned equipment and order additional equipment/supplies for delivery prior to the start of each event.
    e. Prepare field forms and other documentation for the planned event.
    f. If work is to be subcontracted, review the subcontract agreement, work plan, and SSHP.
    g. Confirm that field staff have Driver's License (or other picture identification) and current OSHA Certification in their possession prior to leaving the office.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the following activities will be performed:

- Complete equipment and supply checklists and verify that required documentation and equipment for field activities are on site.
- Review condition of DDMT-owned and rental equipment; inventory field supplies and laboratory-provided sampling supplies.

- Review locations for planned field activities for hazards, determine requirements for site preparation and clearance, and select location for the storage of purge and decontamination waters.
- Conduct team safety meetings as required by the SSHP.
- Conduct team review of the project documents including SOPs to be utilized.
- Complete the Field Event Startup Report and submit to PM (Attachment 1-1).

5.2 Field Operations

Field staff responsibilities are project-specific. At a minimum, field personnel will perform the following activities:

1. Document field activities in a log book for each team and/or field records as required by the work plan or SOPs.
2. Record the following additional information for field measurements:
   a. The identification number and calibration results for each field instrument
   b. The numerical value and units of each measurement
   c. A description of any unexpected delays or problems observed during purging or sampling activities
3. Complete required data collection/sample control forms (e.g., Chain-of-Custody, Field Sampling Report, etc.).
4. Communicate with the PM regarding site conditions and out of scope work to be performed.
5. Perform following activities daily before leaving the site:
   a. Decontaminate and check condition of field equipment.
   b. Provide log books and other field documentation to FTL for review and scanning.
   c. Properly dispose of trash, debris and used PPE.
   d. Safely store purge and decontamination water, or transfer to large storage tanks at Dunn Field.
   e. Make arrangements for shipment of samples (if applicable) and follow-up with the analytical laboratory to confirm samples arrived in good condition.
   f. Complete activity-specific field reports as required by applicable SOPs.
   g. Complete the Daily Field Report and submit to PM (Attachment 1-2).

5.3 Field Log Books and Documentation

Dedicated log books will be used by each field team in addition to documentation required by activity-specific SOPs.

- The first page of each log book will list the following information:
  - Site Name: Former Defense Depot Memphis Tennessee

  - EPA ID (TN4210020570)
  - Project Location: 2241 Truitt Street, Memphis, TN 38114
- The first entry for each field event will list the following information: log books:
  - Project Name and Number
  - FTL (full name) and initials
  - Sample team leader and members (full names) and initials
- At minimum, the log book will describe general activities performed, date and time, personnel and weather conditions. All field equipment calibration and maintenance records will be documented in the logbook. Communications with the FTL, PM or project chemist regarding field activities will be documented. Additional field data will be recorded in the log book if other field records are not used.
- Any deviations from the QAPP or work plan will be noted in the log books.
- Errors will be crossed out with a single line, the correction added and the entry initialed.
- Each page will be numbered and dated. A diagonal line will be drawn through any unused portion of a page containing an entry. To indicate the end of an entry, personnel are required to initial and date the page at the conclusion of each day.

5.4 Closeout

Upon the completion of field activities, the FTL will view each site to verify the area has been cleared and restored as closely as possible to its prior condition. Trash will be removed from the site, and surface damage, including ruts caused by vehicles, will be repaired.

Confirm all equipment is accounted for and properly decontaminated and in good working condition. Notify PM if repairs are needed. Properly package and ship all rental equipment to the vendor. When shipping equipment, use the proper HDR FedEx number and insure the package for the cost of the equipment. Follow manufacturer’s instructions on long and short term storage when storing government and/or HDR equipment.

Rental trucks should be fueled and returned to the rental company as soon as possible. HDR leased trucks should also be fueled and cleaned prior to storing at the shop.

Work areas should be cleaned with tools and equipment properly stored.

The FTL will make a final check of all logbooks and other field records to ensure there are no blanks or missing data and the entries are legible. FTL will organize scanned forms in proper order and transmit to PM.

The FTL will complete Field Event Closeout Report and submit to PM (Attachment 1-3).

6 Data and Records Management

All field forms and log book entries will be scanned and copied to the project folder on the HDR network file share drive within one week of the field event completion. All photographs taken during the field event will be uploaded along with a typed photograph log (date, project and subject) to the HDR network file share drive. The photographs will then be erased from the camera. All original forms will be stored on site in Memphis in the filing cabinet in the proper folder labeled for the project. The PM, project chemist and project administrator will be sent a link for the data.

7 Quality Control and Quality Assurance

All work will be performed in accordance with the QAPP, the specific work plan, and applicable SOPs. All field activities will be recorded in the log books in sufficient detail to reconstruct the events. No erasures or mark outs will be made on field forms or log books. A single line will be used to strike out errors and will be annotated with the initials and date of the editor.

8 References

HDR, 2017a. *2017 Uniform Federal Policy-Quality Assurance Project Plan, Environmental Restoration Support at Former Defense Depot Memphis, Tennessee, Revision 0*. Prepared for the U.S. Army Corps of Engineers, Mobile District. May 2017.

USEPA Region 4 SESD Guidance, *Soil Sampling* (SESDPROC-010-4). October, 2010.

Field Event Startup Report

Prepared by: Date:

Event Name:

Project-Activity Number:

Summary of Planned Event:

Planned Performance Period: _______to___________

Project Documents - Title, Date

Work Plan:

Health and Safety Plan:

Other SOPs – List number/revision and title:

Field Event Staffing

Position	Name	OSHA Cert. (Y/N)	First Aid/ CPR (Y/N)	Driver's License (Y/N)	Proj. Plans reviewed (Y/N)	Experience (Hi-Med-Low-None)
Field Team Leader						

DDMT Field Equipment

Name/Use	Mfr./Model No.	Condition	Calibration Req'd.(Y/N)	Calibration supplies	Other supplies (batteries, etc.)

Rental Equipment

Name/Use	Mfr./Model No.	Condition	Calibration Req'd.(Y/N)	Calibration supplies	Other supplies (batteries, etc.)

Lab-provided Sampling Supplies

Sample Type	Number	Supplies

Additional Tools/Supplies

Camera
Field forms (list):
Sample supplies (list):
Water/Ice cooler
Sample cooler

Final Check

1. All required equipment/tools received and condition checked

Yes ___ No ___ Comment:

2. Initial equipment calibration completed

Yes ___ No ___ Comment:

3. Vehicles inspected

Yes ___ No ___ Comment:

4. Field locations reviewed

Yes ___ No ___ Comment:

5. Weather forecast checked

Yes ___ No ___ Comment:

6. Staff documents (OSHA, DL) checked

Yes ___ No ___ Comment:

7. Review of project plans confirmed and activities discussed

Yes ___ No ___ Comment:

8. Initial Safety Meeting held and SSHP signed

Yes ___ No ___ Comment:

Daily Field Report

Project Number/Activity:	**Date:**
Project Name:	**Field Team Leader:**
Brief Work Description:	

Weather:	**Temp:**

Previous Day's Samples received at laboratory – Y / N Comment:

Time	**Description**

Name/Organization of Field Staff, Subcontractors and Site Visitors	

Samples Collected

Problems or Deviations from Work Plan

Tasks to be completed next workday

____________________ ______________________________ _____________

Name **Signature** **Date**

Field Event Close-Out Report

Prepared by: Date:

Event Name:

Project-Activity Number:

Performance Period: ________to__________

Field Team Leader:

Field Staff:

Summary of Completed Event:

Field problems and/or changes from planned activities:

Change in number/type of samples collected:

Health and Safety problems/Injuries:

Close-out Checklist

1. Log book and field forms scanned and originals placed in project file

Yes ___ No ___ Comment:

2. Equipment/tools decontaminated

Yes ___ No ___ Comment:

3. Rental equipment shipped to supplier

Yes ___ No ___ Comment:

4. Rental vehicles returned

Yes ___ No ___ Comment:

5. DDMT equipment and tools properly stored

Yes ___ No ___ Comment:

6. List damaged equipment

Yes ___ No ___ Comment:

7. Replacement supplies ordered

Yes ___ No ___ Comment:

8. Field locations inspected and trash/debris removed

Yes ___ No ___ Comment:

9. Field shop/office cleaned

Yes ___ No ___ Comment:

STANDARD OPERATING PROCEDURE 2 – DRILLING AND SOIL SAMPLING

Lead Organization: Department of the Army (DA)
Preparing Organization: HDR
SOP Approved by: Field Team Leader: Clayton Mokri
Project QA Officer: Lynn Lutz
Project Manager: Tom Holmes

1 Purpose and Summary

This Standard Operating Procedure (SOP) provides guidance for drilling and soil sampling operations in support of investigative activities at Defense Depot Memphis, Tennessee (DDMT). Drilling activities will enable collection of subsurface soil samples and allow the installation of monitoring wells. This SOP provides general guidance; the project-specific work plan must be reviewed for specific project requirements.

2 Overview

There are several methods by which drilling operations may be conducted including, manual (hand) augering, power augering with hollow-stem augers, sonic drilling, and cable tool or mud rotary drilling with installation of surface casing. Generally, hand augering is useful only for surficial soil sampling while the other methods are used for deeper, subsurface investigations, sampling and installation of monitoring wells. Sonic drilling is the recommended drilling method for well installation at DDMT; it has proven to be the most effective method for boring advancement and well installation based on the depth to water (i.e. 75-105 feet below ground surface [ft bgs]) and geologic characteristics of the fluvial aquifer (i.e. tight sands mixed with gravel up to cobble size).

Drilling activities that require the use of a truck-mounted drill rig will be conducted by a Tennessee-licensed subcontractor with experience on similar projects. The drilling subcontractor will advance boring to the target depth using the selected drilling technology and provide equipment sufficient to carry out the work as specified. Drilling and soil sampling will be overseen by the field team leader (FTL), an environmental professional (engineer, geologist or scientist), with support staff if required. HDR personnel will prepare soil boring logs with lithologic descriptions and observations relevant to investigative activities, collect soil samples for field or laboratory analysis and monitor compliance with the project Site Safety and Health Plan (SSHP).

3 Health and Safety

Proper safety precautions must be observed during drilling activities and when collecting soil samples in accordance with the SSHP. Each individual assigned to field work must: (1) participate in the HDR Medical Monitoring Program, or subcontractor medical surveillance program, as applicable, (2) must have taken the Occupational Safety and Health Administration (OSHA) 40-Hour course (updated with the 8-Hour OSHA Refresher, when necessary), and (3) must be certified as able to wear respiratory protection.

Each individual is required to have read and understood the SSHP for the specific project activity. Upon arrival at the site, each person shall sign the acknowledgement sheet confirming their review of the SSHP. Personal protective equipment (PPE) and other provisions for site safety requirements are discussed in the SSHP. At a minimum for drilling all personnel will wear a hard hat, steel toe shoes, safety glasses, hearing protection, and a high visibility outer garment.

All equipment will only be used by properly trained personnel. In particular, the use of a photoionization detector (PID) will only be performed by personnel familiar with the equipment. Proper tools will be made available to each employee as necessary. Any questions should be addressed to the FTL.

All drilling locations will be cleared for underground and above ground utilities prior to beginning drilling activities. Prior to setting up on the drilling location, the FTL will confirm the location has been cleared with the appropriate utility companies and the property owner/tenant. Drilling will only proceed where no aboveground or subsurface obstructions exist. Locations will be offset if these obstructions are identified prior to drilling, or encountered after drilling has begun. The new locations will be as close as possible to the originally proposed locations; utility clearance will be performed again as necessary.

If drilling is to occur in the vicinity of overhead utilities, HDR personnel will measure utility line height from the ground surface using a clinometer (or similar device) to ensure a minimum safe clearance distance is maintained between on-site equipment and overhead utility lines. As needed, the appropriate utility company will be contacted in order to determine a recommended safe clearance distance from all aboveground or underground on-site utilities.

Prior to the start of drilling activities, the drilling subcontractor will hand auger at each drilling location to a depth of 4 ft bgs, in order to verify that no underground utilities or objects are present.

4 Personnel Qualifications and Responsibilities

Field activities will be directed by the FTL, an engineer/geologist with experience in the planned drilling activities; junior to mid-level geologists will assist, if necessary. Field activities will be overseen by a Tennessee-licensed geologist or engineer. Drilling will be conducted by a licensed driller and crew familiar with planned activities, the project-specific work plan and SSHP. At least one person on each team will have a current certification in first aid and CPR. Operation of fork lifts on site will be limited to personnel that have documentation for forklift operator safety training.

The FTL will provide direction to field staff to ensure work is performed in accordance with the project documents (Quality Assurance Project Plan [QAPP], project-specific work plan, SSHP, and SOPs). The field staff will carefully review the project documents, conduct the work as planned, seek direction from the FTL when questions or problems arise, and carefully complete field documentation.

5 Equipment and Supplies

The required equipment and supplies will be identified in the project-specific work plan. Field activities should not proceed until the proper tools and equipment are available and in good working order. Usual equipment/supplies for a drilling project will include: a PID, tape measure, Munsell color chart, knife, nitrile gloves, field drill log forms, camera, and work table.

Each team will have use of a truck/van during field activities. An initial safety check should be performed at the start of each shift to confirm the vehicle is in good working condition. The vehicle should then be checked daily for damage or required maintenance.

6 Procedures

6.1 Start-Up Activities

6.1.1 Office

Prior to leaving the office for field work, personnel will perform the following actions:

1. The Project Manager (PM) will assign a FTL to direct field activities and coordinate with project personnel. Task specific responsibilities of the FTL will be addressed in the appropriate SOP; general responsibilities include:
    a. Review project-specific work plan, SSHP, QAPP, and for subcontracted work, review of the subcontract agreement.
    b. Work with PM to properly staff the field activity.
    c. Arrange site access with the property manager (Colliers International-Memphis Depot Industrial Park), tenants and/or property owners.
    d. Have a surveyor locate the proposed drilling locations, and mark each location with a wooden stake and white flagging or white paint.
    e. Notify the Tennessee One Call underground utility location and, if necessary, a private utility location service.
    f. Provide drilling subcontractor with proposed boring location and depth for well permits from Shelby County Health Department (SCHD); confirm receipt of permits.
    g. Coordinate sampling activities and supplies with the project chemist and analytical laboratory.
    h. Confirm availability and condition of DDMT-owned equipment and order additional equipment/supplies for delivery prior to the start of each event.
    i. Prepare field forms and other documentation for the planned event.
    j. Provide all HDR and subcontracted field personnel with time and location for personnel to meet prior to beginning field activities.
    k. Confirm that field staff have a valid Driver's License (or other picture identification) and current OSHA Certification in their possession prior to leaving the office.

6.1.2 Field

After arrival on site, but prior to commencement of operations, the following activities will be performed:

- Complete equipment and supply checklists and verify that required documentation and equipment for drilling and soil sampling activities are on site.
- Notify SCHD prior to start of drilling activities in accordance with permit requirements.
- Review condition of DDMT-owned and rental equipment; inventory field supplies and laboratory-provided sampling supplies.
- Confirm drilling and soil sampling locations are clearly marked and review locations for hazards; determine if the utility locators have adequately marked utilities on the site. Check for overhead dangers such as power lines, and make necessary height measurements to ensure safe clearance distances are maintained.
- Determine requirements for site preparation and clearance, and select location for the placement of the decontamination area, storage of decontamination waters, and soil cuttings.
- Confirm locations and requirements for each sample to be collected.
- Conduct site set up activities to include posting of signage (if applicable) and delineation of work zones as required in the SSHP.
- Calibrate field equipment.
- Conduct team safety meetings as required by the SSHP.
- Conduct team review of the project documents including SOPs to be utilized.
- Complete the Field Event Startup Report and submit to PM.

6.2 Field Operations

Field staff responsibilities are project-specific. At a minimum, field personnel are required to ensure the following items are completed as part of field operations during drilling and soil sampling activities.

6.2.1 Field Documentation

Field activities will be documented in a bound logbook for each team and in field records as required by the project-specific work plan or SOPs. At minimum, the logbook will describe general activities performed, date and time, personnel performing the activity, and weather conditions.

For field measurements, the following additional information will be required:

- The numerical value and units of each measurement
- The identity of and calibration results for each field instrument

For sampling activities, the following additional information will be required:

- Sampling type and method

- The identity of each sample and the depth(s) from which it was obtained
- The amount of each sample
- Sample description (e.g., color, odor, clarity)
- Identification of sampling devices
- Identification of conditions that might reflect representativeness of a sample (e.g., refueling operations, damaged well casings)

Field personnel will complete required data collection/sample control forms (e.g., Chain-of-Custody [COC], Drill logs, Field Sampling Report, etc.).

6.2.2 Drilling Logs

The geologist/engineer will log the subsurface conditions encountered in the boring, and record the information on the drilling log and the logbook. Additional pertinent information will be recorded on the drilling log, including, but not limited to, the following:

- Drilling date
- Drilling method
- Geologist name
- Location of boring/Boring identification
- Driller’s name/Drilling subcontractor name/Type of drill rig
- Diameter of inner and outer sonic drill casings
- Diameter of surface casing, casing type and method of installation
- Types of drilling fluids and depths at which they were used
- Weather conditions
- Start and completion time for each boring
- Standard Penetration Test blow counts per six inch advance, if applicable
- Recovery length of each sample
- Visual description of soil using the Unified Soil Classification system (ASTM-D-2488-00)
- Depths at which each soil sample was collected for chemical or physical analysis
- Total number of samples taken
- Total depth of boring
- Boring refusal
- Water losses (if applicable)
- Water bearing strata (depth and thickness)
- Depth at which saturated conditions were first encountered

- Lithologic descriptions and depths of lithologic boundaries
- Zones of caving or heaving
- Depths at which drilling fluid was lost and amount lost
- Drilling rate
- Drill rig reactions such as chatter, rod drops, or bouncing
- Location of the boring relative to an easily identifiable landmark.

6.2.3 Drilling Procedures

Generally, drilling activities will be completed in accordance with the planned activities presented in project work plan. Additionally, the following requirements will apply to drilling activities at DDMT:

- Drilling will conform to Shelby County rules and regulations, and Rules of Tennessee Department of Environment and Conservation (TDEC), Division of Water Supply, Chapter 12-4-10.
- All necessary precautions will be taken to prevent leakage of hydraulic oil or other contaminants from the drilling rig into the borehole or onto equipment that is placed in the hole.
- The only acceptable drilling fluid to be used while advancing the borehole is water. However, water will be used only when necessary as approved by the FTL, and will be from an approved potable water source. If the onsite subcontractor and HDR personnel determine drilling fluid additives (e.g. sodium bentonite) are necessary for drilling operations, PM authorization must be obtained prior to their use.
- During drilling of boreholes with a sonic rig, soil will be collected continuously as 10-foot sections of soil core. These cores will be deposited from the drill casing into 10-foot polyethylene liners; the liners will be laid out for visual logging and sampling for headspace readings and laboratory analysis.
- The drilling subcontractor will place all soil cores on the ground near the drill rig in order for the HDR geologist/engineer to safely examine, log, and collect samples from the recovered soil core.
- The HDR geologist/engineer will maintain visual and verbal communication with the onsite subcontracted driller in order to maintain awareness of any changes in subsurface conditions, amount of water used (if any) during drilling, quantities of materials used during drilling and well installation, or any mechanical problems with the drill rig or support equipment.
- The HDR geologist/engineer will carefully and thoroughly complete all required field documentation in order to provide a complete record of drilling activities, including drill rig maintenance and repairs, subcontractor down time, subsurface conditions and geologic materials encountered.
- The HDR geologist/engineer will determine and record the depth to groundwater observed during drilling.

- When the HDR geologist/engineer is finished with visual logging and sampling of a given 10 foot section of soil core, the drilling subcontractor will place the core in an approved soil cutting disposal container.
- During drilling activities, the drilling subcontractor will notify the onsite HDR geologist/engineer of any significant changes in lithology encountered, significant changes in amount of water being used, and any mechanical problems with the drill rig.
- The HDR geologist/engineer will monitor the breathing zone for organic vapors in accordance with the procedures contained in the SSHP. The tops of the boreholes will be monitored for organic vapors using a PID.
- The HDR geologist/engineer collect soil samples at specified intervals in borings for soil classification and/or chemical analysis or field screening as specified in the project-specific work plan.
- All drilling equipment will be decontaminated prior to drilling activities in accordance with SOP 9 *Equipment Decontamination*.
- Any investigative-derived waste (i.e., drill cuttings, drilling fluid) that is contaminated will be disposed as specified in the project work plan.
- Soil cuttings will be examined for contamination. If contamination is suspected, they will be noted on the boring log form and the suspect soil cuttings will be segregated.
- The HDR geologist/engineer will communicate with the PM regarding site conditions and out of scope work to be performed.

6.2.4 Boring Diameter

The boring diameter is based on a minimum of 2 inches of annular space between the outside diameter of the well casing and the borehole wall. The majority of borings and wells at DDMT are completed in the fluvial aquifer, which is underlain by the uppermost clay of the Jackson Formation/Upper Claiborne Group. For these borings, a 6-inch diameter borehole is advanced 5-10 feet into the clay; after the depth to the clay is confirmed, the boring is back-filled to just below the top of clay or to the target well depth. A borehole diameter of 6 inches allows proper installation of a nominal 2-inch outside diameter well casing.

For wells to be installed in the deeper intermediate or Memphis aquifer, a surface casing is typically installed into the uppermost clay of the Jackson Formation/Upper Claiborne Group in order to prevent cross contamination between formations. For the deeper borings, a 12-inch borehole will be advanced 10 feet into the uppermost clay and an 8-inch diameter surface casing will be installed, either welded sections of carbon steel or threaded Schedule 80 polyvinyl chloride (PVC). After placing the surface casing, the driller will lower a galvanized or PVC tremie pipe connected to a grout pumping unit through the inner annulus of the casing. The driller will pump grout through the injection pipe until the grout returns to the ground surface. The grout will cure for 24 hours before continuing to advance the borehole. Water present in the inner annulus of the casing will be pumped to a holding tank before the borehole is advanced to the target depth. A 6-inch diameter borehole will then be advanced to the target depth for installation of a 2-inch diameter well.

6.2.5 Soil Sampling Procedures

During drilling of boreholes with a sonic rig, soil samples will be collected continuously as 10-foot sections of soil cores. These cores are deposited from the drill casing into 10-foot polyethylene liners, and the liners laid out for visual logging, and to obtain samples for headspace readings and laboratory analysis, if required by the project work plan.

During advancement of the soil borings, the following sampling devices may also be used:

- Chemical Sample Collection: 2 or 3-inch diameter carbon steel split-barrel sampler lined with California brass rings (CBRs)
- Geotechnical Sample (disturbed) Collection: 2-inch diameter carbon steel split-barrel sampler
- Geotechnical Sample (undisturbed) Collection: 3-inch diameter “Shelby Tube” or thin-walled tube sampler

6.2.5.1 Soil Description

Soils will generally be described in accordance with the 1990 ASTM D-2488-90, *Standard Practice for Description and Identification of Soils* (Visual-Manual Procedure). Descriptive information to be recorded in the field will include:

- Identification of the predominant particle size and range of particle sizes
- Percent of gravel, sand, fines, or all three
- Description of grading and sorting of coarse particles
- Particle angularity and shape
- Maximum particle size or dimension

The plasticity of fines description will include:

- Color using Munsell Color System
- Moisture (dry, wet, or moist)
- Consistency of fine grained soils
- Structure of consolidated materials
- Cementation (weak, moderate, or strong)

The Unified Soil Classification System (USCS) group symbols will be used for identification. Additional information to be recorded includes: depth to the water table, caving or sloughing of the borehole, changes in drilling rate, depths of laboratory sample collection, presence of organic materials, presence of fractures or voids in consolidated materials, and other noteworthy observations or conditions, such as the locations of geologic boundaries.

6.2.5.2 Headspace Sampling

At five-foot intervals within the soil cores, the headspace will be screened with a PID. The headspace samples will be collected and analyzed using the following procedure:

- From the sampling location within the soil core, remove the top 1 to 2 inches of soil using a decontaminated stainless steel spoon.
- Partially fill two decontaminated 16-ounce containers with soil using the stainless steel spoon.
- Cover the jars immediately with aluminum foil and fasten the jar lids.
- Allow the sample vapors to equilibrate in the jars (approximately 5 minutes). If necessary, the headspace samples will be brought to a temperature of 20 degrees Celsius (°C) (68 degrees Fahrenheit [°F]) to 32°C (90°F)
- Collect a reading from the first sample jar by puncturing the aluminum foil with the tip of a calibrated PID and recording the highest reading.
- If the reading is > 10 parts per million, collect a reading with the activated charcoal filter on the calibrated FID for the second jar. Determine corrected hydrocarbon measurement of the sample by subtracting the filtered reading from the unfiltered reading.

6.2.5.3 Soil Sample Collection for Laboratory Analysis

Selected soil samples may be collected for laboratory analysis based upon the results of the headspace screening. At these selected locations, samples for volatile organic compound (VOC) analysis will be collected using an Encore or Terracore sampler, or acceptable equivalent. (Note: There is no difference in field criteria for the two samplers. Different laboratories supply different devices and there is a difference in cost.) Samples collected for VOC analysis should be collected from the soil cores in a manner that minimizes disturbance of the sample.

The following items should be considered when collecting soil samples:

- A clean pair of new, non-powdered, disposable gloves will be worn each time a sample is collected.
- Samplers must use new, verified/certified-clean disposable or non-disposable equipment cleaned in accordance with SOP 9 *Equipment Decontamination*.
- Document field sampling, including field conditions, any problems encountered during sampling and sample appearance, in the field logbook. Samples collected will also be noted on the drilling log sheet at the corresponding depth.
- Place any unused sample material into the approved transport/disposal containers along with other drill cuttings generated during sonic drilling activities.
- When soil sampling is completed or when time permits, transfer samples to site office for final packaging. Complete COC documentation and shipping procedures in accordance with relevant SOPs. The completed COC will remain with the samples until custody is relinquished.
- Note any problems encountered during sampling in the Field Sampling Report Form and Daily Quality Control Report Form.

- For borings where a monitoring well will be installed, a sample for total organic carbon (TOC) analysis may be collected from the interval to be screened. The TOC samples will be collected from the soil core using a pre-cleaned stainless steel spoon and placed in the appropriate laboratory supplied container.

6.2.5.3.1 Encore ™ Sampler Procedure

The procedure for collection of VOC samples using an Encore ™ Sampler are as follows:

- Remove sampler and cap from package and attach T-handle to the 5-gram sampler body.
- Quickly push the sampler into a freshly exposed surface of soil until the sampler is full.
- Carefully wipe the exterior of the sampler head with a clean disposable paper towel so that the cap can be tightly attached.
- Push cap on with a twisting motion to attach and seal the sampler.
- Attach the label onto the sampler body, place the sampler into a plastic Ziploc™ bag and place into a cooler with ice.
- Repeat steps a) through e) for the remaining 5-gram and 25-gram sampler.
- Collect a bulk soil sample for screening and moisture determination in a 2 or 4-ounce wide mouth glass jar. Fill the jar completely allowing no headspace. Place the sample in a cooler containing ice.
- Thoroughly mix remaining soil and place into specified labeled containers for remaining parameters.
- Place sample bottles into Ziploc™ or bubble bag and in an iced cooler.
- Complete COC documentation and shipping procedures in accordance with relevant SOPs.

6.2.5.3.2 Terracore Sampler Procedures

The procedure for collection of VOC samples using a Terracore Sampler are as follows:

- Label appropriate laboratory containers
- Quickly push the sampler (Terracore or equivalent) into a freshly exposed surface of soil to collect 5 grams (+ 0.5g) of sample. Also collect a bulk aliquot container for moisture content analysis in the laboratory supplied 4 ounce container.
- Carefully wipe the exterior of the sampler head with a clean disposable paper towel.
- Empty sampler into appropriate laboratory container. The cored samples must be extruded from the selected coring tool to a volatile organic analysis (VOA) vial in accordance with collection and preservation methods described in EPA method 5035A. The extruded core is transferred into a laboratory pre-weighed (tared) VOA vial with septum cap. Unpreserved VOA vials must be analyzed within 48 hours of collection, VOA vials preserved with sodium bisulfate or methanol must be analyzed within 14 days of collection.
- Place the sample into a plastic Ziploc™ bag and place into a cooler with ice.
- Complete COC documentation and shipping procedures in accordance with relevant SOPs.

6.2.6 Post Run Tubing Boring Construction

The post run tubing (PRT) drill rod will be advanced into the subsurface to 5.5 feet bgs by a direct-push drill rig. After reaching 5.5 feet bgs, the PRT rod will be retracted approximately 6 inches exposing the soil interval (5 feet bgs to 5.5 feet bgs) to be sampled. Teflon® tubing will be threaded into the PRT adaptor through the center of the PRT rod and capped to prevent soil gas venting. The annulus around the PRT rod where it penetrates ground surface will be packed with bentonite crumbles and hydrated. The boring will not be disturbed or sampled for a minimum of 2 hours to allow the bentonite crumbles to seal the annulus and allow soil gas to equilibrate. After the soil gas sample has been collected, the PRT drill rod and tubing will be removed from the boring and the boring will be filled to ground surface with neat cement.

6.3 Closeout

6.3.1 Daily Closeout

Perform following activities daily before leaving the site:

- Decontaminate and check condition of field equipment.
- Provide logbooks and other field documentation to FTL for review.
- Properly dispose of trash, debris and used PPE.
- Make arrangements for shipment of samples (if applicable) and follow-up with the analytical laboratory to confirm samples arrived in good condition.
- Secure the site for the night and/or weekend.
- Prepare the daily field report as required by the project-specific work plan or SOPs and submit report to the PM. Note any problems or deficiencies in field activities.

6.3.2 Field Event Closeout

Upon completion of field activities, the FTL will view each site to verify the area has been cleared and restored as closely as possible to its prior condition. The following activities will be performed prior to the completion of each field event:

- All trash will be removed from site and disposed of appropriately
- Any damage to the ground surface, including ruts, will be repaired
- All equipment is accounted for, properly decontaminated, and in good working condition. The FTL will be notified if repairs are needed
- Rental equipment has been properly cleaned, packaged, and shipped to the appropriate vendor
- Shipments are made using the correct HDR FedEx number and packages insured for the cost of the rental item
- Manufacturer’s instructions are followed regarding long and short term storage for all equipment

- Rental vehicles are refueled and returned to the rental company
- HDR leased vehicles are cleaned and refueled
- All work areas have been cleaned, and tools and equipment have been stored properly

The FTL will make a final check of all drilling logs, logbooks and other field records to ensure there are no blanks or missing data and the entries are legible. The FTL will complete Field Event Closeout Report and submit to PM.

7 Data and Records Management

All field forms and logbook entries will be scanned and copied to the project folder on the network file share drive within one week of the field event completion. All photographs taken during the field event will also be uploaded along with a typed photograph log (date, project and subject) to the network file share. All uploaded photographs will then be erased from the camera. All original forms will be stored on site at the field office in Memphis in the appropriate project-specific filing cabinet and task-specific labeled folder.

8 Quality Control and Quality Assurance

All work will be performed in accordance with the QAPP, the project-specific work plan, and applicable SOPs. All field activities will be recorded in the logbooks in sufficient detail to reconstruct the events. No erasures or mark outs will be made on field forms or logbooks. A single line will be used to strike out errors and will be annotated with the initials and date of the editor. Boring logs will be typed into a spreadsheet provided by the CAD operator for the inclusion into computerized drill logs.

9 References

HDR, 2018a. DDMT Uniform Federal Policy-Quality Assurance Project Plan, Environmental Restoration Support at Former Defense Depot Memphis, Tennessee, Revision 1. Prepared for the U.S. Army Corps of Engineers, Mobile District. March 2018.

Shelby County Health Department, Pollution Control Section, Water Quality Branch, <http://www.shelbycountytn.gov/DocumentCenter/Home/View/767>.

USEPA Region 4 SESD Guidance, *Design and Installation of Monitoring Wells* (SESDGUID-101-R1), January, 2013.

USEPA Region 4 SESD Guidance, *Field Equipment Cleaning and Decontamination* (SESDPROC-205-R2), December, 2011.

USEPA Region 4 SESD Guidance, *Soil Sampling* (SESDPROC-300-R3), August, 2014.

STANDARD OPERATING PROCEDURE 3 – WELL INSTALLATION, DEVELOPMENT AND ABANDONMENT

Lead Organization: Department of the Army (DA)
Preparing Organization: HDR
SOP Approved by: Field Team Leader: Clayton Mokri
Project QA Officer: Lynn Lutz
Project Manager: Tom Holmes

1 Purpose and Summary

This Standard Operating Procedure (SOP) provides guidance for installation, development and abandonment of monitoring wells at Defense Depot Memphis, Tennessee (DDMT). This SOP provides general guidance; the project-specific work plan must be reviewed for specific project requirements.

2 Overview

Monitoring wells will be installed, developed and abandoned by a Tennessee-licensed subcontractor and supervised by an HDR geologist/engineer. Well installation and development will occur immediately after drilling and preparations should be made prior to beginning drilling operations, which are described in SOP 2 *Drilling and Soil Sampling*. This SOP incorporates past practice at DDMT as described in work and test procedures (WTPs) from the RA SAP (MACTEC, 1995) and SOPs prepared by United States Environmental Protection Agency (USEPA) Region 4.

3 Health and Safety

Proper safety precautions must be observed during drilling activities and when collecting soil samples in accordance with the site-specific Health and Safety Plans (HASPs). Each individual assigned to field work must: (1) participate in the HDR Medical Monitoring Program, or subcontractor medical surveillance program, as applicable, (2) must have taken the OSHA 40-Hour course (updated with the 8-Hour OSHA Refresher, when necessary), and (3) must be certified as able to wear respiratory protection.

Each individual is required to have read and understood the HASP for the specific project activity. Upon arrival at the site, each person shall sign the acknowledgement sheet confirming their review of the HASP. Personal protective equipment (PPE) and other provisions for site safety requirements are discussed in the HASP. At a minimum for drilling all personnel will wear a hard hat, steel toe shoes, safety glasses, hearing protection, and a high visibility outer garment.

All equipment will only be used by properly trained personnel. In particular, the use of a photoionization detector (PID) will only be performed by personnel familiar with the equipment. Proper tools will be made available to each employee as necessary. Any questions should be addressed to the Field Team Leader (FTL).

4 Personnel Qualifications and Responsibilities

Field activities will be directed by the FTL, a mid- or senior level engineer/geologist with experience in monitoring well installation, development and abandonment; junior to mid-level geologists will assist, if necessary. The well installation, development and/or abandonment will be conducted by a TN-licensed driller and crew familiar with planned activities, the project-specific work plan and HASP. At least one person on each team will have a current certification in first aid and CPR. If a fork lift is used on site the person driving the fork lift will have the proper Occupational Safety and Health Administration (OSHA) training.

The FTL will provide direction to field staff to ensure work is performed in accordance with the project documents (Quality Assurance Project Plan [QAPP], project-specific work plan HASP, and SOPs). The field staff will carefully review the project documents, conduct the work as planned, seek direction from the FTL when questions or problems arise, and carefully complete field documentation.

5 Equipment and Supplies

The required equipment and supplies will be identified in the project-specific work plan or quality assurance project plan (QAPP). Field activities should not proceed until the proper tools and equipment are available and in good working order. Usual equipment/supplies for a monitoring well installation, well development, and well abandonment will include: a PID, tape measure, knife, nitrile gloves, well pump, compressor, grout mixer, grout pump, bleach, sand, bentonite, Portland cement, well construction forms, well abandonment forms, camera, and development water containers.

Each team will have use of a truck/van during field activities. An initial safety check should be performed at the start of each shift to confirm the vehicle is in good working condition. The vehicle should then be checked daily for damage or required maintenance.

6 Procedures

6.1 Start-Up Activities

6.1.1 Office

Prior to leaving the office for field work, personnel will perform the following actions:

1. The Project Manager (PM) will assign a FTL to direct field activities and coordinate with project personnel. Task specific responsibilities of the FTL will be addressed in the appropriate SOP; general responsibilities include;
    a. Review project project-specific work plan, HASP, and QAPP and for subcontracted work, review of the subcontract agreement.
    b. Work with PM to properly staff the field activity.

c. Arrange site access with the Memphis Depot Associates, tenants and/or property owners.

d. Confirm availability and condition of on-site equipment and order additional equipment/supplies for delivery prior to the start of each event.

e. Prepare field forms and other documentation for the planned event.

f. Prepare the required Shelby County Health Department (SCHD) well installation and abandonment forms.

g. Provide all HDR and subcontracted field personnel with time and location for personnel to meet prior to beginning field activities.

h. Confirm that field staff have a valid Driver's License (or other picture identification) and current OSHA Certification in their possession prior to leaving the office.

6.1.2 Field

After arrival on site, but prior to commencement of operations, the following activities will be performed:

- Complete equipment and supply checklists and verify that required documentation and equipment for field activities are on site.
- Review condition of DDMT-owned and rental equipment, and inventory field supplies.
- Review locations for planned field activities for hazards, including overhead dangers such as power lines, and select location for the placement of the decontamination area, storage of decontamination and development waters.
- Confirm the exact locations of the wells to be abandoned and that the correct well is being abandoned.
- Confirm the location and length of the screened interval and the total depth of the well to be installed and developed.
- Conduct site set up activities to include posting of signage (if applicable) and delineation of work zones as required in the HASP.
- Calibrate field equipment.
- Conduct team safety meetings as required by the HASP.
- Conduct team review of the project documents including SOPs to be utilized.
- Complete the Field Event Startup Report and submit to PM.

6.2 Field Operations

Field activities will be documented in a logbook for each team and in field records as required by the project-specific work plan or SOPs. At minimum, the logbook will describe general activities performed, date and time, personnel and weather conditions. Additional information will be recorded in the log book if other field records are not used.

The following information will be required as part of the field documentation.

- The length of risers, screens, and end caps for each monitoring well including adjustments to riser sections during installation.
- The type, manufacturer, and gradation of the filter sand, and the volume used for each well.
- The type and manufacturer of the Portland cement and bentonite and the volume used for the bentonite seal and grout at each well.
- Surface completion details including: completion type, number of bollards installed, and a description of surface completion materials.

6.2.1 Monitoring Well Installation and Materials

Monitoring well installation will be completed in a manner consistent with relevant sections of USEPA Region 4 SESD Guidance, *Design and Installation of Monitoring Wells* (SESDGUID-101-R1), and applicable state/local requirements. Monitoring well installation will be conducted by a licensed driller and well installation subcontractor. A qualified geologist/engineer will oversee well installation activities.

Borings for monitoring wells will be advanced using sonic drilling. The following procedure will be used to install the well casing and screen:

- If the boring is drilled deeper than the total depth of the well, backfill the boring to approximately 1 foot below the planned well depth in accordance with the work plan, either with bentonite or by allowing the formation material to collapse as the casing is raised.
- Remove the new, polyvinyl chloride (PVC) or stainless steel screen and riser from manufacturer packaging.
- Install a section of minimum 2-inch (I.D.), threaded, flush jointed, pre-manufactured PVC or stainless steel screen inside the steel drill casing; screen length will be 10 feet unless a different length is specified in the work plan..
- Install solid riser to ground surface, plus stick-up (if required).
- Install the filter pack using the gravity method through the annular opening between drill casing and well screen as the drill casing is removed. Continue removing drill casing and installing filter pack until at least 5 feet above the top of the well screen. Use the sonic drilling head to vibrate the steel casing as it is slowly withdrawn to distribute and compact the filter pack around the screen and to prevent bridging. Measure the thickness of the filter pack as it is placed.
- Install a minimum 5-foot bentonite seal. If bentonite is gravity fed in dry form, the seal will be hydrated with potable water. Allow the bentonite seal a minimum of 1 hour of hydration time before grouting the annulus. If the seal is in the saturated section of if potential for bridging is an issue, a bentonite slurry can be installed using a side-discharge tremie pipe.
- The remaining annulus will be filled with bentonite grout via tremie pipe to within 6-inches of the ground surface. Once the boring has been filled, the casing is removed and additional grout added as necessary.

- Wait at least 24 hours after grout installation to develop the well.

Well Construction Materials

Well risers will consist of material durable enough to retain their long-term stability and structural integrity and be relatively inert to minimize alteration of groundwater samples. Selection of PVC or stainless steel for the monitoring wells is based on the primary purpose of the well, which is the detection of potential contaminants, and site-specific conditions, such as planned remedial actions.

Well materials will consist of new, threaded, flush joint PVC or stainless steel pipe, with a minimum inside diameter of 2 inches. If PVC is used, the riser pipe will conform to ASTM D 1785, Standards for Schedule 40 Pipe; deeper wells installed in the intermediate or Memphis aquifers require Schedule 80 Pipe. Materials will be new, unused and joined with compatible welds or couplings that do not interfere with the primary purpose of the well. Use of solvent or glue will not be permitted.

Monitoring well screens will consist of new, commercially fabricated, threaded, flush joint, minimum 2-inch inside diameter (ID), factory slotted or continuous wrap PVC or stainless steel screen. Screen slot size will be based on previously available soil information, but will be generally sized to prevent 90 percent of the filter pack from entering the well. The screen slot size will be adjusted if site geologic conditions significantly differ from the expected conditions. Previous well installation at DDMT have generally used factory-slotted or wire-wrapped screens with 0.010-inch openings,

Silt traps will not be used in monitoring wells. A notch will be cut in the top of the casing to be used as a measuring point for water levels.

6.2.1.1 Well Design

Monitoring wells will be designed and installed in a manner to accomplish the following objectives: to collect representative water levels and groundwater samples; to prevent contamination of the aquifer by the drilling equipment; to prevent vertical seepage of surface water or inter-aquifer contamination.

Well design includes placement of the screen and the type and amount of filter pack, bentonite seal, and grout seal. The FTL and PM will collectively make decisions on well depths, locations, screened intervals, etc. If the borings are advanced into the clay unit at the base of the aquifer, bentonite chips will be used to backfill the boring to the top of the clay and allowed to hydrate for one hour prior to placing the filter pack or screen.

The well pipe assembly will be hung in the borehole, prior to placement of the filter pack, and will not be allowed to rest on the bottom of the hole in order to keep the well assembly straight and plumb. Centralizers will be installed at the top of the screened section and at 30-foot intervals.

6.2.1.1.1 Screen Location

The screened intervals will be selected for each proposed well, based on visual observations of aquifer materials encountered and objectives in the project work plan.

6.2.1.1.2 Filter Pack

A filter pack will be installed in the annular space between the boring and the well screen. The filter pack will consist of clean, inert, well rounded silica sand and contain less than 2 percent flat particles. The filter pack will be certified as free of contaminants by the supplier and have a grain size distribution compatible with the formation materials and the screen.

A filter pack size of 15-18 or 10-20 grade is typically used for Fluvial Aquifer monitoring wells and 10-20 grade for Intermediate Aquifer monitoring wells at DDMT. If the site conditions show significant change (i.e. more gravelly, or more fine-grained soil) from those previously encountered, a grain-size analysis will be completed and the filter pack selected based on those results.

The filter pack will be placed from the bottom of the hole to a minimum of 5 feet above the top of the well screen. The filter pack will not extend across more than one water-bearing unit.

Prior to installation of the well screen and casing, the total depth of the borehole depth will be measured from the top of the 6-inch steel drill casing by the drilling contractor to verify that the target depth has been reached. The sand filter pack will be gravity-placed through the 6-inch steel casing in lifts of approximately 1 foot. Care will be taken to prevent bridging by frequently measuring the thickness of the filter pack as it is placed. As the steel casing is slowly withdrawn between lifts, it will be vibrated with the sonic drilling head to compact the sand filter pack.

6.2.1.1.3 Bentonite Seal

A minimum 5-foot thick bentonite seal will be installed above the filter pack in the annular space of the well. Only 100 percent sodium bentonite (pellets or chips) will be used and care will be taken to prevent bridging by frequently measuring the thickness of the bentonite as it is gravity placed. When the seal is installed above the water table, the bentonite will be hydrated with water from an approved water source. At least 5 gallons of water will be added after each 24 to 30 inches of bentonite is placed. The bentonite seal will be allowed to hydrate for a minimum of one hour prior to placement of the grout collar around the wells. When the seal is placed below the water table, a bentonite slurry may be installed using a side-discharge tremie pipe.

6.2.1.1.4 Grout Seal

A non-shrinking cement-bentonite grout mixture will be placed in the annular space from the top of the bentonite seal to approximately 6-inches below the ground surface. Concrete will be added in the remaining annular space during installation of the protective casing and concrete pad.

The cement-bentonite mixture will consist of 94 pounds of neat Type I Portland or American Petroleum Institute (API) Class A Cement, not more than four pounds of 100 percent sodium bentonite powder, and not more than 8 gallons potable water. The cement-bentonite mixture may be modified to reduce the heat generated during curing. A side discharge tremie pipe will be used to place the grout mixture into the annular space. The tremie pipe will be located a maximum of 10 feet from the top of the bentonite seal in deep wells to ensure even placement of grout in the annular space. Pumping will continue until undiluted grout is visible at the surface.

6.2.2 Nested Monitoring Well Construction and Materials

Nested monitoring well installation will be conducted by a TN-licensed driller overseen by a qualified geologist/engineer. Borings will be advanced via sonic drilling utilizing a 6-inch diameter inner casing and an 8-inch diameter outer casing. After reaching the desired depth, the 6-inch diameter casing will be removed and the nested well will be constructed.

Each nested well will consist of up to four 1-inch inside diameter (ID) wells constructed within a single boring. The 1-inch ID wells will be constructed with Schedule 80 PVC well casing and screen for increased rigidity and strength, and will have one 2.5-feet long, pre-packed screen with a 2-inch diameter centralizer placed approximately one foot above the screen. The 8-inch diameter boring will be filled with filter sand around the pre-packed screen; the screened intervals will be separated by a minimum 5-foot thick bentonite seal. Schedule 80 PVC well casing will extend from each screen interval to the ground surface. The annulus will be filled with a neat cement grout mixture from the uppermost bentonite seal to the surface. A diagram of a nested well is included as Attachment 1, at the end of this SOP.

The well construction steps are listed below:

- After reaching the desired depth with the 8-inch diameter casing, place one foot of filter sand in the base of the boring; confirm the depth to the top of the sand by tape measure.
- Insert a PVC plug in the bottom of the pre-packed well screen, connect Schedule 80 PVC casing to the top of the screen and attach a 2-inch diameter centralizer approximately one foot above the well screen.
- Lower the screen and casing to the sand at the bottom of the boring; suspend the well casing and maintain tension on the casing throughout construction in order to minimize bowing.
- Place filter sand through the 8-inch diameter casing in lifts while measuring the depth to the top of the sand. Sand should extend two feet above the top of the screen interval.
- Raise the 8-inch sonic casing to the top of the filter pack while vibrating. Measure the depth to the top of the filter pack and add additional filter sand as necessary.
- Slowly pour bentonite chips and raise the 8-inch diameter casing while vibrating until bentonite is at least 5-feet thick and two feet below the next screen interval. Allow the bentonite to hydrate for at least one hour.
- Place two feet of filter sand on top of the bentonite seal. Confirm the thickness of the sand by tape measure and install the next 1-inch ID well following the steps listed above.
- Continue this process until each of the nested wells has been constructed.
- After a 5-foot thick bentonite seal has been placed and hydrated above the shallowest screened interval, place a neat cement/bentonite grout mixture in the annulus via tremie pipe to within 6-inches of the ground surface.
- Develop the well at least 24 hours after grout installation.

6.2.2.1 Well Construction Materials

Well materials will consist of new, threaded, flush joint schedule 80 PVC, with an ID of approximately 1-inch and conform to ASTM D 1785, where applicable. Casing will only be joined with compatible welds or couplings that do not interfere with the primary purpose of the well. Use of solvent or glue will not be permitted.

To ensure well screen separation from the borehole wall and adjacent well casings, Geoprobe pre-packed well screens will be utilized. The Geoprobe screens are constructed from PVC, slotted to 0.010 inch, measure 2.5-feet in length and include 20-40 mesh sand enclosed within a stainless steel screen.

A notch will be cut in the top of the casing to be used as a measuring point for water levels.

6.2.2.1.1 Screen Location

The screened intervals will be selected for each proposed well, based on visual observations of aquifer materials encountered and objectives in the project work plan.

6.2.2.1.2 Filter Pack

A filter pack will be installed in the annular space between the borehole wall and the Geoprobe pre-packed well screen. The filter pack will consist of clean, inert, well rounded silica sand and contain less than 2 percent flat particles. The filter pack will be certified as free of contaminants by the supplier and have a grain size distribution compatible with the formation materials and the screen.

A filter pack size of 10-20 grade sand will be used based on past practice at DDMT. If the site conditions show significant change (i.e. more gravelly, or more fine-grained soil) from those previously encountered a grain-size analysis will be completed and the filter pack selected based on those results. The filter pack will be placed from two feet below to two feet above the well screen, except at the deepest well screen where the filter pack will extend 1 foot below the well screen.

Prior to installation of the well casing, the total depth of the borehole depth will be measured from the top of the 8-inch steel drill casing by the drilling contractor to verify that the target depth has been reached. Care will be taken to prevent bridging by frequently measuring the thickness of the filter pack as it is placed. As the steel casing is slowly withdrawn between lifts, it will be vibrated with the sonic drilling head to compact the sand filter pack.

6.2.2.1.3 Bentonite Seal

A minimum 5-foot thick bentonite seal will be installed in the annular space of the well above each filter pack to separate the nested well screens. Only 100 percent sodium bentonite (pellets or chips) will be used and care will be taken to prevent bridging by frequently measuring the thickness of the bentonite as it is gravity placed. When the seal is installed above the water table, the bentonite will be hydrated with water from an approved water source. At least 5 gallons of water will be added after each 24 to 30 inches of bentonite is placed. The bentonite seal will be allowed to hydrate for a minimum of one hour prior to construction of overlying filter pack or placement of the grout collar around the wells.

6.2.2.1.4 Grout Seal

A non-shrinking cement-bentonite grout mixture will be placed in the annular space from the top of the uppermost bentonite seal to approximately 6-inches below the ground surface. Concrete will be added in the remaining annular space during installation of the protective casing and concrete pad.

The cement-bentonite mixture will consist of 94 pounds of neat Type I Portland or American Petroleum Institute (API) Class A Cement, not more than four pounds of 100 percent sodium bentonite powder, and not more than 8 gallons potable water. A side discharge tremie pipe will be used to place the grout mixture into the annular space. The tremie pipe will be located a maximum of 10 feet from the top of the bentonite seal in deep wells to ensure even placement of grout in the annular space. Pumping will continue until undiluted grout is visible at the surface.

6.2.3 Surface Completion

Surface completion (flush-mount or stick-up) will be selected by the PM based on well location and planned land use. For flush-mount completions, the well casing(s) will be cut approximately 3 inches below ground surface and secured with a water-tight locking cap to prevent surface water from entering the well. The casing will be covered by a bolted manhole cover set in a 3-foot by 3-foot by 4-inch thick concrete pad that slopes away from the manhole.

If an aboveground surface completion is used, the well casing will be extended 2 or 3 feet above ground surface and secured with a water-tight cap. The protective casing will be a steel sleeve placed over the casing and cap; the steel sleeve diameter will be at least 4 inches greater than the casing diameter or at least 8-inches diameter for nested wells. The protective casing will be set in a 3-foot by 3-foot by 4-inch concrete surface pad. A vent hole will be drilled in the steel sleeve about 1 inch above the top of the well pad. The pad will be sloped away from the well sleeve and a lockable cap or lid will also be installed. Three 3-inch diameter concrete-filled steel guard posts will be installed around each well unless the well is located in an area receiving vehicular traffic. These guard posts will be 5 feet in total length and installed radially from the well head. The guard posts will be installed approximately 2 feet into the ground and set in concrete just outside the concrete pad. The protective sleeve and guard posts will be brush-painted yellow or orange.

Wells will be secured immediately after well completion. Corrosion-resistant locks will be provided for both flush and aboveground surface completions. A brass survey marker will be installed in each concrete pad and the well ID will be stamped in the marker. A reference point will be marked on the well casing for use in groundwater level and well depth measurements. This reference point will marked by the HDR geologist/engineer using a permanent marker for PVC wells, or by notching the top of casing for stainless steel wells. By convention, this marking is usually placed on the north side of the top of casing.

6.2.4 Location Survey

Following installation of the surface completion for each well, the wells will be surveyed for horizontal locations and elevations at top of casing, ground surface and well pad by a Tennessee-licensed surveyor. The top of casing elevation will be made at the reference point on the north side of the top of casing and permanently marked or notched. Vertical coordinates will be based on the North American Datum, 1927 used for all survey data at DDMT. Horizontal coordinates will be provided in the Tennessee State Plane coordinate system. Accuracy for well locations will be within 0.01 foot for elevations and within 0.1 feet for horizontal coordinates.

6.2.5 Well Installation Diagrams

The HDR geologist/engineer will maintain suitable logs detailing drilling and well construction practices. Well dimensions, amount, type and manufacture of materials used to construct each well will be recorded in the logbook. Additional information to be recorded in the field for the well installation diagram will include:

- Well identification.
- Drilling method.
- Installation date(s).
- Total boring depth.
- Lengths and descriptions of the screen(s) and riser(s).
- Thickness and descriptions of filter pack, bentonite seal, annular grout, and any backfilled material.
- Quantities of all well construction materials used.

6.2.6 Well Development

The purpose of well development is to create good hydraulic contact between the well and the aquifer and to remove accumulated sediments from the well. Each newly installed monitoring well will be developed no sooner than 24 hours after installation to allow for adequate grout curing time. The water volume purged during development will exceed the volume of potable water or other drilling fluids used during drilling and well installation.

The wells will be developed with a surge block in conjunction with a pump sized to effectively develop the well. No detergents, soaps, acids, bleaches, or additives will be used during well development. Development will continue until clear, sand-free formation water is produced from the well and water quality parameters have stabilized.

The monitoring well development protocol is as follows:

- Measure the static water level (SWL) and the depth to the top of sediment in the well.
- Record the total depth of the well (from the Well Installation Diagram).
- Calculate the volume of water in the well and saturated annulus.
- Begin developing the well using a combination of surging and pumping. Continue pumping and periodically surging until each the following criteria have been met:
  - Fluids lost to the formation during drilling and well installation have been removed (this is a minimum requirement where conditions permit).
  - Record water quality parameters and continue development until stabilization criteria have been met. Stabilization of water quality parameters is achieved after three successive readings are within ± 0.1 for pH, ± 3% for specific conductance, ± 10% for dissolved oxygen (DO) values greater than 0.5 milligrams per liter (mg/L) or three successive DO values less than 0.5 mg/L, ± 10 millivolts for oxidation reduction potential

  (ORP), 3% for temperature, and 10% for turbidity values greater than 5 nephelometric turbidity units (NTU) or three successive values less than 5 NTU (USEPA, 2017).
  - If feasible, monitor the SWL during purging. Adjust the purge rate to keep the SWL from dropping more than 0.3 meter from the initial SWL.
  - No sediment remains in the bottom of the well. However, it can be accepted if the sediment thickness remaining within the well is less than 1 percent of the screen length.
- In the event that the above criteria have not been met after six hours of pumping, surging, and bailing (including recharge time for poorly recharging wells), development activities will be temporarily discontinued at that well. The FTL and PM will decide whether or not to continue development.
- In the event of slowly recharging wells that will not sustain pumping or bailing, the field staff will advise the FTL as soon as a determination of estimated recharge time has been made.
- Physical characteristics of the water (suspended sediment, turbidity, temperature, pH, EC, purge rate, odor, etc.) will be recorded throughout the development operation. At a minimum, they will be recorded initially and after each well volume has been removed, or every 30 minutes, whichever comes first.
- The total quantity of water removed and final depth to the top of sediment (total depth of well) will be recorded.
- Well development equipment will be decontaminated prior to use in each newly-installed monitoring well.

6.2.6.1 Well Development Records

Well development data will be recorded on Well Development Data Sheets, which should include the following information:

- Method of development.
- The model number and type of water quality instruments.
- The model and type of water pump used for development.
- The flow rate of the pump.
- The type and technique used for surging of the well.
- Final water quality description (e.g., color, odor, clarity).
- Identification of conditions that might reflect the results of the development if it was successful or why it was not.
- Volume of water removed from the well.

6.2.6.2 Well Development Water

Development water will be drummed or stored in bulk containers. The containers will be clearly labeled with site name, well name, date, and contents. The development water will be properly disposed in accordance with investigation derived waste (IDW) procedures set forth in the project work plan.

6.2.7 Well Abandonment

Monitoring wells at DDMT are reviewed annually with regard to classification, sample frequency and utility. Wells are recommended for abandonment based on the following criteria:

1. The well is redundant: duplicates information; not in the flow pathway of on-coming plumes and not required to establish background; or analytical data will have no clear, reasonable use in future decision making.
2. The monitoring well (MW) has sustained damage and cannot be repaired, or an object that cannot be removed has become lodged in the MW.
3. The MW was installed for a specific reason that no longer applies.

Wells are scheduled for abandonment after recommendations are approved by USEPA and Tennessee Department of Environment and Conservation (TDEC).

Well abandonment will be completed in accordance with SCHD requirements following issuance of a fill and abandonment construction permit from SCHD. Well abandonment will be conducted by a TN-licensed well contractor. An HDR geologist/engineer will oversee well abandonment activities. The following procedure will be used for well abandonment:

- Total well depths will be measured and compared to depths recorded during well installation to determine if obstructions are present in the well.
- One-half gallon of bleach will be poured into the well as a disinfectant.
- The well screen and casing will be filled with grout (Portland type II cement with 5 percent bentonite) from the bottom up using a tremie pipe. After allowing the grout time to settle, additional grout will be added to fill the well casing to approximately 6 inches below ground surface (bgs).
- Surface completions including well pads and manholes will be removed at wells located in grassed or graveled areas. If necessary, the well casing will be cut off a few inches below the ground surface. The pad areas will be recovered with either topsoil/grass seed or gravel. At wells located in concrete or asphalt-paved areas, the manhole covers will be removed and the manholes filled with concrete. Bollards will be removed at all abandoned wells.
- Surface completion materials including manholes, bollards, well lids and wells casings will be placed in a roll-off and properly disposed.

The following information will be recorded to document the well abandonment:

- The total depth of the abandoned wells and whether obstructions had to be removed.
- The amount and type of Portland and bentonite used for grouting.
- The volume of grout used to fill the well casing and the volume of water recovered during grouting.
- Disposal of surface completion materials removed during well abandonment.

6.3 Closeout

6.3.1 Daily Closeout

Perform following activities daily before leaving the site:

- Decontaminate and check condition of field equipment.
- Provide log books and other field documentation to FTL for review.
- Properly dispose of trash, debris and used PPE.
- Secure the site for the night and/or weekend.
- Prepare daily report as required by the project-specific work plan or SOPs and submit report to the PM. Note any problems or deficiencies in field activities.

6.3.2 Field Event Closeout

Upon completion of field activities, the FTL will view each site to verify the area has been cleared and restored as closely as possible to its prior condition. Trash will be removed from the site, and surface damage including ruts caused by vehicles, will be repaired.

Confirm all equipment is accounted for and properly decontaminated and in good working condition. Notify FTL if repairs are needed. Properly package and ship all rental equipment to the vendor. When shipping equipment, use the proper HDR FedEx number and insure the package for the cost of the equipment. Follow manufacturer’s instructions on long and short term storage when storing government and/or HDR equipment.

Rental trucks should be fueled and returned to the rental company as soon as possible. HDR leased trucks should also be fueled and cleaned prior to storing at the shop.

Work areas should be cleaned with tools and equipment properly stored.

The FTL will make a final check of all logbooks and other field records to ensure there are no blanks or missing data and the entries are legible.

The FTL will complete Field Event Closeout Report and submit to PM.

7 Data and Records Management

All field forms and logbook entries will be scanned and copied to the project folder on the network file share drive within one week of the field event completion. All photographs taken during the field event will also be uploaded along with a typed photograph log (date, project and subject) to the network file share. All uploaded photographs will then be erased from the camera. All original forms will be stored on site at the field office in Memphis in the appropriate project-specific filing cabinet and task-specific labeled folder.

Well logs and sample results for new wells will be submitted to the SCHD in accordance with permit requirements.

8 Quality Control and Quality Assurance

All work will be performed in accordance with the QAPP, the project-specific work plan, and applicable SOPs. All field activities will be recorded in the logbooks in sufficient detail to reconstruct the events. No erasures or mark outs will be made on field forms or logbooks. A single line will be used to strike out errors and will be annotated with the initials and date of the editor. Well completion diagrams will be typed into a spreadsheet provided by the CAD operator for the inclusion into computerized well diagrams.

9 References

HDR, 2018. DDMT Uniform Federal Policy-Quality Assurance Project Plan, Environmental Restoration Support at Former Defense Depot Memphis, Tennessee, Revision 1. Prepared for the U.S. Army Corps of Engineers, Mobile District. March 2018.

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USEPA Region 4 Science and Ecosystem Support Division (SESD) 2013. SESDGUID-101-R1, *Design and Installation of Monitoring Wells*. January, 2013.

USEPA, 2017. *Low Stress Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells*. September 2017.

STANDARD OPERATING PROCEDURE 4 – GROUNDWATER SAMPLE COLLECTION

Lead Organization: Department of the Army (DA)
Preparing Organization: HDR
SOP Approved by: Field Team Leader: Clayton Mokri
Project QA Officer: Lynn Lutz
Project Manager: Tom Holmes

1 Purpose and Summary

This Standard Operating Procedure (SOP) provides guidance for groundwater sample collection at Defense Depot Memphis, Tennessee (DDMT). The project work plan must be reviewed for specific requirements.

2 Health and Safety

General Information on Health and Safety requirements are provided in SOP 1. Each individual is required to have read and understood the Health and Safety Plan (HASP) for the specific project activity and signed the acknowledgement sheet confirming their review.

Health and safety concerns for groundwater sampling include the use of lead-acid batteries with bladder pumps, contact with contaminated groundwater, and contact with sample container preservatives. Material safety data sheets (MSDS) will be available on site for each chemical to be utilized during sampling activities. Staff will wear appropriate personal protective equipment (PPE), as outlined in the site safety health plan. Many of the wells are located in or near streets and parking lots with traffic; field staff should wear vests with reflective stripes or other high visibility clothing while sampling. Some wells may be located in areas with biological threats such as spiders, fire ants, snakes, and wasp nests; the wells should be checked for hazards before starting sampling activities.

3 Personnel Qualifications and Responsibilities

Groundwater sampling will be directed by a Field Team Leader (FTL), a mid- or senior level environmental professional (engineer, geologist or scientist) with appropriate experience. Field staff will be junior to mid-level environmental professionals or environmental technicians overseen by the FTL. Sampling will be performed by two-person teams and at least one person on each team will have a current certification in first aid and CPR.

4 Equipment and Supplies

The required equipment and supplies will be identified in the work plan for the specific field activities to be performed. Field activities should not proceed until the proper tools and equipment are available and in good working order. Usual equipment/supplies for groundwater sampling will include: a photoionization detector (PID), nitrile gloves, pump controller, portable bladder pump, compressor, water quality meter, water level indicator tape, camera, and purge water containers.

Each team will have use of a truck/van during field activities. An initial safety check should be performed at the start of each shift to confirm the vehicle is in good working condition. The vehicle should then be checked daily for damage or required maintenance.

5 Procedure

5.1 Start-Up Activities

5.1.1 Office

The Project Manager (PM) will assign a FTL to direct field activities and coordinate with project personnel. General responsibilities are described in SOP 1. Task specific responsibilities include:

- Coordinate sampling activities with the PM, project chemist (PC) and analytical laboratory.
- PC will prepare the sampling plan detail (SPD) listing the wells and sample bottles for planned analyses. FTL will review the SPD, discuss any questions with PC and confirm shipment of laboratory-supplied sample containers and equipment for arrival prior to the start of sampling.
- The FTL will update the list of wells to be included in the water level sweep. An example list is provided in Attachment 4-1.
- Confirm availability and condition of DDMT-owned equipment and order additional equipment/supplies for delivery prior to the start of sampling event.
- Obtain well location maps and prepare tables showing screened interval and previous water level measurements to confirm planned sample depths.
- Prepare field forms and other documentation for the planned event.
- Schedule time and location for the initial meeting with field staff to review project information and begin work.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the following activities will be performed:

- Complete equipment and supply checklists and verify that required documentation and equipment for field activities are on site.
- Review condition of DDMT-owned and rental equipment; inventory field supplies.
- View well locations and confirm the wells are accessible and well IDs are clearly marked.
- Review locations for planned field activities for hazards. Determine requirements for site preparation and clearance, and select location for storage of decontamination and purge waters. Confirm sufficient storage capacity for wastewater.

- Confirm the location and length of the screened interval and the total depth of the well to be sampled if not equipped with a diffusion bag.
- Conduct site set up activities to include posting of signage (if applicable) and delineation of work zones as required in the HASP.
- Review sampling activities and assignments with field staff.
- Prior to groundwater sampling, HDR will visually inspect laboratory supplied trip blanks (TBs) for headspace. TBs without headspace will be placed into the refrigerator at DDMT and chilled overnight. HDR will visually inspect TBs for headspace the following day and discard TBs with headspace. The laboratory will replace discarded TBs with new TBs as necessary.

5.2 Field Operations

Field records will be prepared in accordance with SOP 7 – Sample Control and Documentation. Each sampling site will be characterized by the following factors:

- Location of work
- Weather conditions: rainfall, temperature, and wind direction
- Ongoing activities that may influence or disrupt sampling efforts
- Accessibility to the sampling locations (e.g., rough terrain, fallen trees, flooding, etc.)

5.2.1 Water Level Sweep and Monitoring Well Inventory

Prior to sampling, a water level sweep will be made at listed monitoring wells to produce an accurate potentiometric map.

1. Determine if the water level probes are working properly by using two or more in one well to confirm the same depth is measured. If the depths differ by more than 0.1 feet, determine which one is malfunctioning and replace it for the project.
2. Arrive at the monitoring wells and inspect the surroundings for hazards (e.g. traffic, wasps, trip hazards)
3. Using the water level sweep list proceed to the wells requiring water level readings. Confirm the well location by checking the well ID on the pad.
4. Assess the well condition and note cracks in the pad, missing bolts, missing caps, etc. on the well inventory (Attachment 4-2).
5. Caution shall be used when opening each well to avoid fumes which may have accumulated and to prevent foreign materials from entering the well. If a persistent odor is observed, air monitoring with a PID will conducted in accordance with the HASP.
6. Remove water or debris from the well box as necessary and remove the monitoring well cap. Note appearance of positive or negative pressure in casing when cap is removed (air pressure lifting cap or suction on cap). Multiple wells within an area can be inspected and opened to make efficient use of field time, but each open well must be within clear sight of field staff or within a secured area.

7. Locate the permanent mark or notch on the monitoring well top of casing, normally on the north side. If the mark has faded, reapply permanent marker so that the mark is conspicuous.
8. Allow the water level at to equilibrate for at least 3 minutes after removing the well cap prior to measurement. If pressure is noted, re-measure water level at least 3 minutes after the initial measurement; if the two measurements vary by more than 0.05 feet, make a third measurement.
9. Turn the water level indicator on and slowly lower it into the well until it alerts to the water level.
10. Bring up the probe slowly until the beeping stops and slowly lower it again until it beeps; do this three times and record the average level recorded. All readings should be taken at the location marked on top of the casing; if no mark is present, use the north side of the casing.
11. Record the depth measurement to the nearest 0.01 feet.
12. Securely fasten the well cap, lock, and cover.
13. Decontaminate the water level probe before proceeding to the next well. The decontamination procedure for the water level indicator is: Hand wash the calibrated tape and probe with Alconox solution (or equivalent) and rinse with deionized (Reagent Grade II) water in accordance with SOP 9.

5.2.2 Monitoring Well Sampling

Field measurements of groundwater parameters are used for groundwater sampling and for independent measurements during remedial actions. At the beginning of each day, field equipment will be properly calibrated per manufacturer’s instructions; calibration shall be repeated throughout the day as necessary if abnormal readings are observed. Calibration activities will be recorded on Attachment 4-3. Monitoring well sampling will be conducted per the methods listed below.

5.2.2.1 Sampling Using a Passive Diffusion Bag Sampler

Groundwater samples will be collected for VOC analyses using PDB sampling from most monitoring wells. A typical PDB sampler consists of a low-density polyethylene tube closed at both ends and filled with deionized water. The PDB is positioned in the well screen interval at the desired target depth by attaching it to weighted tether. The water within the PDB is allowed to equilibrate with the ambient groundwater for at least 28 days before retrieval. The PDB water is decanted into 40-mL volatile organic analysis (VOA) vials and sent to the lab for analysis. Detailed procedures for using PDB samplers in wells can be found in “User’s Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells” (USGS, 2001). The following is a generalized summary of PDB sampling:

1. The top and bottom of the PDB sampler will be attached to 3/16” polyester or similar non-buoyant rope strong enough to support the weight of the sampler and subject to minimal stretch. The PDB will be suspended within the well screen at selected depths based on the depth to water, location of the screen and total depth of the well. Weights will be attached to the bottom of the sampler to keep it in place in the well.

2. The PDBs will carefully be withdrawn from the well and inspected. Evidence of algae or other coatings on the bag or tears in the membrane will be noted in the field book. If there are tears, the sample will be rejected.
3. The contents of the intact bag will then be transferred to pre-preserved VOA vials causing as little agitation of the sample as possible.
4. A new PDB will be filled with deionized water, attached to the tether with zip ties, and carefully lowered into the well. Once the PDB is in place, securely fasten the well cap, lock, and cover.

5.2.2.2 Sampling Using a Bladder Pump

The sampling protocol will be as follows for the collection of groundwater samples using low-flow sampling with a portable bladder pump (USEPA, 2017):

1. Wells should be sampled in order of increasing contamination (i.e. - samples that are expected to be least contaminated will be collected before those that are more highly contaminated).
2. The bladder pump will be decontaminated per SOP 9 prior to use in each well.
3. Check well casing for a reference mark. Measure the water level (initial) to 0.01 ft. and record this information on Attachment 4-4.
4. Slowly and carefully lower the pump inlet to the mid-point of the screened interval. In cases where the entire screen is not saturated, place the pump inlet near the middle of the saturated screen, keeping in mind the limitations stated below. Record the pump depth on Attachment 4-4.
5. Do not place pump inlet less than 2 feet above the bottom of the well, as this may cause the mobilization of bottom sediments. If saturated screen length is 3 feet or less, collect sample using disposable bailer.
6. Place pump inlet at least 1-foot below the water level so there is little risk of entrainment or air in the sample.
7. Measure water level and record this information on Attachment 4-4.
8. Turn-on the pump and discharge the groundwater into a graduated waste bucket. Slowly increase the flow rate until the water level starts to drop. Reduce the flow rate slightly so the water level stabilizes. Record the pump's settings. Calculate the flow rate using a graduated container and a stop watch. Record the flow rate. Do not let the water level drop below the top of the well screen. If the groundwater is highly turbid or discolored, continue to discharge the water into the bucket until the water clears (visual observation); this usually takes a few minutes. The turbid or discolored water is usually from the well-being disturbed during the pump installation.
9. If the water level drops to the top of the well screen during the purging of the well, stop purging the well and contact the FTL.
10. If the water level has dropped 0.3 feet or less from the initial water level (water level measure before the pump was installed); proceed to Step 11. If the water level has dropped more than 0.3 feet, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump's tubing to this calculation. This

combined volume of water needs to be purged from the well after the water level has stabilized before samples are be collected.

11. Attach the pump's tubing to the "T" connector with a valve (or a three-way stop cock). The pump's tubing from the well casing to the "T" connector must be as short as possible to prevent the groundwater in the tubing from heating up from the sun light or from the ambient air. Attach a short piece of tubing to the other end of the end of the "T" connector to serve as a sampling port for the turbidity samples. Attach the remaining end of the "T" connector to a short piece of tubing and connect the tubing to the flow-through-cell bottom port. To the top port, attach a small piece of tubing to direct the water into a calibrated waste bucket. Fill the cell with the groundwater and remove all gas bubbles from the cell. Position the flow-through-cell in such a way that if gas bubbles enter the cell they can easily exit the cell. If the ports are on the same side of the cell and the cell is cylindrical shape, the cell can be placed at a 45-degree angle with the ports facing upwards; this position should keep any gas bubbles entering the cell away from the monitoring probes
12. Turn-on the monitoring probes and turbidity meter.
13. Record the temperature, pH, dissolved oxygen (DO), specific conductance, and oxidation reduction potential (ORP) measurements. During the pump discharge cycle, open the valve on the "T" connector to collect a sample for the turbidity measurement, close the valve, measure and record the turbidity. Calculate the pump's flow rate from the water exiting the flow through- cell using a graduated container and a stop watch, and record the measurement. Measure and record the water level. Check flow-through-cell for gas bubbles and sediment; if present, remove them. Record these measurements on Attachment 4-4.
14. Repeat Step 13 every 5 minutes or as appropriate until monitoring parameters stabilized. Note: at least one flow-through-cell volume must be exchanged between readings. If not, the time interval between readings will need to be increased. Stabilization is achieved when three consecutive measurements are within ± 0.1 for pH, ± 3% for specific conductance, ± 10% for DO values greater than 0.5 milligrams per liter (mg/L) or three successive DO values less than 0.5 mg/L, ± 10 millivolts for ORP, 3% for temperature, and 10% for turbidity values greater than 5 nephelometric turbidity units (NTU) or three successive values less than 5 NTU (USEPA, 2017). A minimum of 5 sets of water quality indicator parameters should be recorded.
15. Specific conductance and DO usually take the longest to stabilize. Up to 2 hours of purging may be required to reach stabilization. Stabilized purge indicator trends are generally obvious and follow either an exponential or asymptotic change to stable parameter values during purging. If stabilization does not occur within 2 hours the FTL should be contacted for direction.
16. When it is time to collect the groundwater samples, turn-off the monitoring probes, and disconnect the pump's tubing from the "T" connector. The pump will not be turned off between the purging and sampling processes. Lower the flow rate to 100 mL/min and fill sample containers as described in Section 5.2.2.4.

5.2.2.3 Sampling using a Disposable Bailer

Wells will be sampled with bailers where necessary due to small diameter casing in piezometers, or to slow groundwater recharge and/or a thin saturated layer in wells. A new disposable Teflon bailer will be used for sampling at each well. Purging and sampling will be conducted in a manner that minimizes the agitation of sediments in the well and formation; the bailer will not be allowed to free fall into a well.

The sampling protocol will be as follows for the collection of groundwater samples using a disposable Teflon bailer:

1. Measure the static water level prior to purging using a decontaminated electronic water level indicator. The probe of the water level indicator will be lowered into the well casing and the water level will be recorded.
2. Calculate the saturated well volume.
3. Lower the bailer into the well using new nylon twine, until it contacts the water surface. Allow the bailer to sink and fill with a minimum of water surface disturbance. Slowly withdraw the bailer from the well, preventing the bailer and bailing line from touching the ground.
4. The well should be purged until a minimum of three well volumes is removed. DO, pH. ORP, temperature, turbidity, and specific conductance readings will be taken after each half of a well volume is removed, at a minimum, and recorded on the Sample Collection Data sheet (Attachment 4-4). The well should be sampled after water quality parameters have stabilized (Section 5.2.2.2) or five casing volumes have been removed.
5. If the well is purged dry, a sample will be collected as soon as sufficient recharge has occurred and within 24 hours. Temperature, specific conductance, turbidity, pH, and DO will also be measured and recorded; however, stabilization of these parameters is not required.
6. After water quality indicators stabilize or the well recharges, collect samples by pouring the water from the bailer into the appropriate sample containers. This process will be repeated as necessary to fill each container.
7. After samples have been collected, replace the well cap and lock the security casing.

5.2.2.4 Sample Collection

Groundwater samples will be collected by gently filling the sample bottles with minimum turbulence. Fill the sample bottles in the following order, as needed for the required analyses:

- Volatile organic compounds (VOCs) (no headspace)
- Carbon Dioxide, Methane, Ethane, Ethene (no headspace)
- Metabolic fatty acids (MFAs) (no headspace)
- Total organic carbon (TOC) (no headspace)

Collect the samples to be analyzed for volatile organics first, leaving zero headspace. Once the VOC sample vial is filled, carefully secure the cap to the vial. Turn the vial upside down, tap the vial against the palm of a hand, and look for any bubbles inside the vial. If bubbles are observed, gently remove the cap and carefully add a small amount of sample water to the container until a meniscus forms at the rim of the vial. Gently place the cap over the meniscus and secure to the vial. Re-inspect the container for any air bubbles. If air bubbles are observed again, repeat the sample process using a new VOC vial containing acid as a preservative. Proceed with the collection of samples for the remaining analyses, collecting the more volatile parameters first.

At the end of each day, as sample containers are placed into the refrigerator or cooler for shipment to the laboratory, containers will be inspected for headspace. Samples with excessive headspace may be discarded after discussion with the project manager, laboratory, and project chemist and the samples recollected.

5.3 Closeout

Perform following activities daily before leaving the site:

- Decontaminate and check condition of field equipment.
- Provide log books and other field documentation to FTL for review.
- Properly dispose of trash, debris and used PPE.
- Store purge water in the designated area.
- Make arrangements for shipment of samples (if applicable) and follow-up with the analytical laboratory to confirm samples arrived in good condition in accordance with SOPs 7 and 8.
- Complete the Daily Field Report (SOP 1, Attachment 1-2) and submit to PM.

Upon the completion of groundwater sampling activities, the FTL will perform closeout activities per SOP 1 and complete Closeout Report (SOP 1, Attachment 1-3) and submit to PM.

6 Data and Records Management

All field forms and log book entries will be scanned and copied project folder on the “Z” drive within one week of the field event completion. All photographs taken during the field event will be uploaded along with a typed photograph log (date, project and subject) to the “Z” drive.

7 Quality Control and Quality Assurance

All work will be performed in accordance with the QAPP, the specific work plan, and applicable SOPs.

8 References

HDR, 2018. DDMT Uniform Federal Policy-Quality Assurance Project Plan, Environmental Restoration Support at Former Defense Depot Memphis, Tennessee, Revision 1. Prepared for the U.S. Army Corps of Engineers, Mobile District. March 2018

United States Environmental Protection Agency (USEPA) Region 1 2017. Low Stress Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells. September 2017.

USEPA Region 4 Science and Ecosystem Support Division (SESD) 2013. SESDPROC-301-R3, *Operating Procedure: Groundwater Sampling*. January 2013.

USEPA Region 4 SESD 2013. SESDPROC-105-R2, *Operating Procedure: Groundwater Level and Well Depth Measurement*. January 2013.

United States Geological Survey, 2001. *User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells*. Water-Resources Investigations Report 2001-4060.

Attachment 4-1

Water Level Measurement Form

Well ID	Aquifer	Area	Measurement Date	Depth to Water (ft, btoc)	Northing (ft)	Easting (ft)	Screen Length (ft)	Total Well Depth (ft, btoc)	April 2018 Depth to Water (ft, btoc)	Oct. 2018 Depth to Water (ft, btoc)
DR1-1	Fluvial	TTA-1S			276300	800856	20	141.7	84.34	83.08
DR1-1A	Fluvial	TTA-1S			276307	800863	20	109.2	84.09	82.81
DR1-2	Fluvial	TTA-1N			276537	801153	20	117.7	81.91	80.58
DR1-3	Fluvial	TTA-1S			276527	801416	20	129.7	83.78	82.50
DR1-4	Fluvial	TTA-1S			276231	801400	20	126.3	84.51	83.14
DR1-5	Fluvial	TTA-1S			276080	800828	20	144.7	85.50	84.18
DR1-5A	Fluvial	TTA-1S			276087	800835	20	110.0	85.39	84.21
DR1-6	Fluvial	TTA-1S			276044	801103	20	134.4	84.35	82.85
DR1-6A	Fluvial	TTA-1S			276035	801104	20	110.9	84.50	82.94
DR1-7	Fluvial	TTA-1N			276791	801441	20	128.3	82.20	80.96
DR1-8	Fluvial	TTA-1N			276752	800875	20	112.7	81.48	80.21
DR2-1	Fluvial	TTA-2			276772	806498	20	93.9	86.23	85.82
DR2-2	Fluvial	TTA-2			276771	806659	15	93.4	75.81	75.76
DR2-3	Fluvial	TTA-2			276539	806203	20	113.0	91.52	90.66
DR2-4	Fluvial	TTA-2			276456	806633	20	108.1	89.10	88.59
DR2-5	Fluvial	TTA-2			276831	806180	15	99.5	92.45	91.89
DR2-6	Fluvial	TTA-2			276644	805861	20	114.6	94.56	93.51
MW-16	Fluvial	Background			278838	807100	15	72.6	55.74	55.42
MW-19	Fluvial	Background			278946	800782	10	93.1	79.12	78.32
MW-21	Fluvial	TTA-1N			276473	800602	15	107.1	84.84	84.08
MW-22	Fluvial	TTA-1S			275912	800702	10	105.4	87.77	87.06
MW-23	Fluvial	Background			275791	801817	10	111.2	89.78	89.25
MW-24	Fluvial	Background			275616	803539	15	112.3	94.42	94.00
MW-25A	Fluvial	TTA-2			275975	805521	10	83.0	62.96	62.01
MW-26	Fluvial	TTA-2			276508	805962	10	107.6	93.07	92.02
MW-34	Intermediate	Window			279411	801918	20	156.6	117.97	119.47
MW-38	Intermediate	Window			279141	802450	15	154.9	115.80	115.29
MW-39	Fluvial	W-C			277281	802598	20	115.5	92.40	92.01
MW-39A	Upper Claiborne	W-C			277278	802608	20	168.1	92.74	92.33
MW-50	Fluvial	TTA-2			276456	807065	10	125.0	81.14	80.26
MW-52	Fluvial	SE			275372	805897	10	104.0	71.57	70.55
MW-53	Fluvial	Background			279177	805136	10	82.5	72.94	72.21
MW-55	Fluvial	Background			279301	801205	10	74.0	69.15	69.52
MW-62	Fluvial	B-835			278290	801858	10	96.1	86.12	85.38
MW-63A	Fluvial	N-C			278200	803573	10	140.0	94.80	93.91
MW-63B	Fluvial	N-C			278201	803558	10	125.0	94.48	93.54
MW-64	Fluvial	TTA-2			276952	805006	10	112.0	98.60	97.64
MW-66A	Fluvial	TTA-1N			276626	799793	20	94.6	72.53	71.14
MW-85	Fluvial	TTA-2			276704	806065	15	110.9	92.46	92.99
MW-88	Fluvial	TTA-2			276879	806513	15	97.0	77.11	76.89
MW-89	Intermediate	Window			278287	802555	30	177.0	102.60	102.68
MW-90	Intermediate	Window			278284	802540	30	145.0	103.22	103.33
MW-92	Fluvial	TTA-2			276614	806490	15	108.0	90.81	90.32
MW-93	Fluvial	Background			275542	804440	15	107.0	89.68	89.31
MW-94A	Fluvial	W-C			276806	803086	10	119.6	97.61	97.31
MW-96	Fluvial	TTA-2			276310	806320	20	95.5	76.58	75.62

Notes:

ft, btoc:	feet below top of casing
ft, NAVD:	feet above North American Vertical Datum of 1988
NM:	Not measured
--:	Well not installed

Attachment 4-2

Well Inspection Form

Site:

Date:

Client:

Technician:

Page: of

		Entry Indicates Deficiency													
Inspection Point	Well Inspected - No Corrective Action Required	Cap non-functional	Lock Non Functional	Lock Missing	Bolts Missing (# missing / # total tabs)	Tabs Stripped (# stripped / # total tabs)	Tabs Broken (# broken / # total tabs)	Annular seal incomplete	Apron damaged	Rim / Lid broken	Trip Hazard	Below grade	Survey Mark/Notch not Visible	Well not inspected (explain in notes)	**Notes** (Note repairs made onsite)
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Attachment 4-3

Meter Calibration Log

EQUIPMENT MAKE	EQUIPMENT MODEL	SERIAL NUMBER	DATE	TIME	TEMP OF CALIBRATION STANDARD (°C or °F)	pH STANDARD	pH STANDARD	pH STANDARD	SPECIFIC CONDUCTANCE	ORP	DISSOLVED OXYGEN
						4	7	10	____ µs/cm	____ mV	____ mg/L or %

Attachment 4-4

Purging and Sampling Data Sheet

Job#:	**Sampler(s):**	**Site:**
Well ID:	**Date:**	**Sample Event:**
Well diam: 1/4" 1" 2" 4" 6" Other:	**Static DTW:**	**Total Depth:**
Purge equip (circle): Bladder-pump Peri-pump DC-pump PE bailer Teflon bailer Other: ____________ **Tubing (circle):** New Dedicated **Tubing Type (circle):** Teflon lined HDPE Other:_______________		
Purge Method (Circle): 3-5 Case Volume Micro/Low-Flow Extraction Well Other:____________________		
Pump intake depth (ft):	**Multipliers:** 1"=0.04 2"=0.16 3"=0.37 4"=0.65 5"=1.02 6"=1.47 Radius^2 x 0.163	
{TD-DTW X Multiplier = 1 Volume	1 Volume =_________ X 3 =______________gallons (total Purge)	

Time	**Temp (°C)**	**pH**	**Cond (mS/cm)**	**Turb. (NTU)**	**DO (mg/L)**	**ORP (mv)**	**DTW (feet)**	**Vol. Removed (gal / L)**	**Notes**

Did well dewater? YES NO	Total volume removed: _____________ (gal / L)	
Sample method: Disp Bailer Ded. Tubing New Tubing Ext. Port Other:		
Sample date:	Sample time:	DTW at sample:
Sample ID:	Number of bottles:	
QC Sample IDs:	Analysis:	

Stabilization Parameters: ± 0.1 for pH, ± 3% for specific conductance, ± 10% for DO > 0.5 mg/L or three readings < 0.5 mg/L, ± 10mv for ORP, ±3% for temperature, and 10% for turbidity > 5 NTU or three successive values < 5 NTU

Attachment 4-4

Purging And Sampling Data Sheet (continued)

Job#:		**Sampler(s):**							**Site:**
Well ID:		**Date:**		**Sample Event:**					
Time	**Temp (^oC)**	**pH**	**Cond (mS/cm)**	**Turb. (NTU)**	**DO (mg/L)**	**ORP (mv)**	**DTW (feet)**	**Vol. Removed (gal / L)**	**Notes**

Stabilization Parameters: ± 0.1 for pH, ± 3% for specific conductance, ± 10% for DO > 0.5 mg/L or three readings less than 0.5 mg/L, ± 10mv for ORP, ±3% for temperature, and 10% for turbidity greater than 5 NTU or three successive values less than 5 NTU

STANDARD OPERATING PROCEDURE 7 – SAMPLE CONTROL AND DOCUMENTATION

Lead Organization: Department of the Army (DA)
Preparing Organization: HDR
SOP Approved by: Field Team Leader: Clayton Mokri
Project QA Officer: Lynn Lutz
Project Manager: Tom Holmes

1 Purpose and Summary

This Standard Operating Procedure (SOP) provides guidance for sample control and identification, data recording, and proper completion of Chain-of-Custody (COC) forms.

2 Health and Safety

General Information on health and safety requirements are provided in SOP 1. Each individual is required to have read and understood the Site Safety and Health Plan for the specific project activity and signed the acknowledgement sheet confirming their review.

Health and safety concerns for sample handling include potential for exposure to contaminants, sample container preservatives, and injury from breakage of sample containers. Contamination levels at Defense Depot Memphis, Tennessee (DDMT) are relatively low but care should be taken to avoid exposure. Sample containers should be handled carefully; nitrile gloves and safety glasses should be used.

3 Personnel Qualifications and Responsibilities

Sample control activities will be directed by the Field Team Leader (FTL), an environmental professional (engineer, geologist or scientist) with experience in sampling activities. The field staff, environmental professionals or technicians, are responsible for proper sample handling and documentation of the sample collection.

4 Equipment and Supplies

The field staff will use a pen with blue or black waterproof ink to record field activities and document sample handling in a field logbook and on field data sheets. A laptop computer with laboratory-provided software may also be used for sample documentation.

5 Procedure

Proper field sampling and documentation help ensure sample authenticity and data integrity. These procedures describe sample collection documentation and sample handling, tracking, and custody procedures to ensure that sample integrity and custody are maintained.

If the computer is being used to scan the samples as they are collected the data recorded by the computer should be checked for correctness. The date and time on the computer should be checked prior to scanning of any samples. The sample label should be completed when the sample is collected. If a hand written COC will be used, all information should be recorded in a log book as to the type of sample, date and time collected and number of sample containers. The COC can then be filled out back at the field office in a quiet environment without disturbances to avoid errors.

Corrections to the COC, field logbook or field data forms will be made by a single line to strike out errors annotated with the initials and date of the editor; the correct information will be inserted as appropriate.

The number of sample containers on the COC should be physically checked against the number of containers collected. Once this is confirmed the sample crew can properly store the samples for shipment.

5.1 Start-Up Activities

5.1.1 Office

The FTL will work with the project chemist (PC) to:

- Prepare the sampling plan detail (Attachment 7-1).
- Coordinate with the analytical laboratory and ensure that sample forms including chain of custody forms and custody seals are shipped to the site.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the FTL will confirm that required documentation and equipment for field activities are on site.

5.2 Field Operations

5.2.1 Sample Identification

Individual samples will be identified by a unique alphanumeric code (also referred to as a sample ID number or field number) which will be written on the sample label and recorded on the COC form. The sample ID will include the location and sampling event as described in Worksheet #17 of the Quality Assurance Project Plan (QAPP). Additional information to be written on the label includes sample ID, time and date of sample, sampler's initials, and the analytical methods to be performed, as described in Section 5.2.3 of this SOP.

Field Quality Control (QC) samples to be collected at DDMT include trip blanks, rinsate blanks, field (ambient) blanks, and field duplicates. The ID for trip blanks, rinsate blanks and field blanks will consist of the prefix TB, RB or FB, respectively, followed by a number, followed by the sampling event, as shown below:

TB-1-ODPM-9	first Trip Blank for event ODPM-9
TB-2-ODPM-9	second Trip Blank for event ODPM-9
RB-1-ODPM-9	Rinsate Blank for event ODPM-9
FB-1-ODPM-9	Field Blank for event ODPM-9

Matrix spike and matrix spike duplicate samples will also be collected. The ID for these samples will consist of the location ID, followed by the sampling event, followed by the suffix matrix spike (MS) or matrix spike duplicate (MSD), as shown below:

MW-164-ODPM-9-MS	Matrix Spike sample for well MW-164
MW-164-ODPM-9-MSD	Matrix Spike Duplicate sample for well MW-164

The identity of field duplicate samples will be concealed from the laboratory by using a consecutively numbered duplicate identifier, followed by the sampling event, as shown below:

DUP-1-ODPM-9	first field duplicate for event ODPM-9
DUP-2-ODPM-9	second field duplicate for event ODPM-9

The location of field duplicates will be recorded on the sampling plan detail (SPD) and field notebook. The final SPDs will be maintained in the project file and copies will be kept at the on-site field office. At the end of the sampling event, the FTL will send the PM and PC the final SPD with changes to field duplicate or MS/MSD sample IDs, additional blanks collected, and any other changes.

5.2.2 Field Documentation

5.2.2.1 Logbook

The logbook is a written record of sampling activities to be completed in the field during sampling. The purpose is to document field conditions or procedural exceptions that may aid in the analysis of data generated from sampling activities. The log book will have with sequentially numbered pages and information will be recorded in blue or black waterproof ink. The recorder will sign and date each entry.

Information pertaining to environmental conditions at the site during the field investigation will be noted in the field log book for each day. The following information will be recorded for each activity:

1. Activity
2. Location
3. Date and time
4. Weather conditions

For field sampling activities, the following information will be recorded, if a sampling form is not used:

1. Sample type and sampling method

2. The identity of each sample and the depth(s) from which it was collected
3. Sample description (e.g., color, odor, clarity)
4. Identification of sampling devices used
5. Identification of sampling conditions that might affect the representativeness of a sample (i.e., refueling operations, damaged casings)

5.2.2.2 Daily Field Reports

Each day the FTL will prepare a Daily Field Report (SOP 1, Attachment 1-2). The report will include daily weather, time and description of field activities, samples collected, and any problems or changes in scope that occurred that day. The report also lists field staff, subcontractors and site visitors.

5.2.2.3 Photographs

Photographs taken for the purpose of project documentation will be noted in the field logbook. The sequential number of the photograph, photographer, date, time, location, description, and orientation of the photograph will be recorded in the logbook as the photographs are taken. The photographs and documentation will be loaded on the HDR network project file.

5.2.3 Sample Labels/Tags

Sample labels will be filled out for each sample with an indelible pen. The label will be protected from water and solvents with clear label protection tape. Any change in the pre-prepared label information will be initialed by the sampler.

5.2.3.1 Labels for Groundwater Samples

Pre-printed labels from the laboratory for groundwater sampling events contain the following information:

- Sample ID
- Preservative
- Date the bottle was prepared
- Matrix
- Tests
- Laboratory name
- Bar code

The sample collector will write in the following information:

- Date of collection
- Time of collection
- Name or initials of collector

5.2.3.2 Sample Tags for Air Samples

Sample tags from the laboratory for air sampling events contain the following information:

- Laboratory name, address, phone number and fax number

The sample collector will write in the following information:

- Client name (HDR)
- Sample ID
- Analysis (TO-15)
- Date and time of sample collection
- Sampler's initials
- Comments

5.2.4 Sample Custody

Sample custody is a part of a quality field or laboratory operation. Custody of a sample is defined as:

1. Having physical possession
2. Being in view, after being in possession
3. Having possession, then being placed in a secure area
4. Being maintained in a secure area by the person who had possession last

These custody practices will be observed in the field. They will be performed according to the procedures described in the following subsections.

5.2.4.1 COC Records

A hand-written three-part COC will be fully completed, in triplicate. The first two pages will accompany the cooler to the laboratory, and the bottom copy will be retained in the files at the field office after it is scanned into the computer file.

A computer-generated COC will have one copy printed that will accompany the cooler to the laboratory. The data used to generate the COC will be transmitted via E-mail to the laboratory and a PDF copy of the COC will be saved on the computer in the sampling file.

The information specified on the COC record will contain the same level of detail found in the site log book, with the exception that on-site measurement data will not be recorded. The custody record will include at least the following information:

- Name of person collecting the samples
- Date samples were collected
- Type of sampling conducted (composite/grab)
- Location of sampling station (including the site location)
- Number and type of containers used

- Signature of the HDR person relinquishing samples to a non-HDR person (such as a FedEx agent), with the date and time of transfer noted, and the cooler designation
- Airbill Number

If samples will require rapid turnaround in the laboratory because of project time constraints or analytical concerns such as extraction time or sample retention period limitations, these constraints will be noted in the remarks section of the custody record. The FTL or designee will contact the laboratory to confirm the turnaround time can be achieved. The computer generated COC is for use with Microbac Laboratories only. Other laboratories will provide COCs for use.

It is not practicable to seal the sample coolers or cartons at a FedEx office; they will be sealed beforehand. The custody record will, therefore, have the signature of the relinquishing field technician with the date and time, but the “relinquished to” box will not be completed.

The duplicate custody record will then be placed in a plastic bag, taped to the underside of the cooler lid, and the cooler closed. COCs for air samples will be included in the carton. The container will be tightly bound with filament tape. Finally, custody seals will be signed by the individual relinquishing custody and affixed in such a way that the cooler or carton cannot be opened without breaking the seals.

The original and duplicate custody records and the airway bill or delivery note together constitute a complete record. The FTL will email a copy of the airbill and the COC to the PC, who will maintain the custody records as part of the analytical data file.

Custody Seals: Custody seals will be preprinted, adhesive-backed seals designed to break if disturbed. For groundwater samples, affix custody seals on the sample shipping containers (coolers) in as many places as necessary to ensure security. For vapor samples affix a custody seal across the top, taped seam of the canister shipping carton and additional locations as necessary. Seals will be signed and dated before application.

Laboratory custody procedures are described in the laboratory sample handling and storage SOPs, included in Appendix B of this QAPP.

5.3 Closeout

Before leaving the site daily, the following procedures will be performed by on-site personnel:

- Maintain custody of samples, maintaining them as specified for the analyses to be performed.
- Prepare samples for shipment to the laboratory.
- Complete the COC forms.
- Contact the laboratory to inform them that samples will be shipped and also remind them of any special requirements for the sample analyses.
- Verify completion of logbook, ensuring that required information has been recorded.

Upon the completion of sample collection and shipment, copies of the COCs will be scanned and sent to interested parties to include the PM and PC. The FedEx tracking numbers will be checked each day to confirm the samples were delivered and the laboratory will be contacted to check on problems with the samples or COCs.

6 Data and Records Management

All field forms, COCs, and log book entries will be scanned and copied project folder on the HDR network project file within one week of the field event completion. All original forms will be stored on site in Memphis in the filing cabinet in the proper folder labeled for the project. The PM and PC will be sent a link for the data.

7 Quality Control and Quality Assurance

Work will be performed in accordance with the QAPP, the specific work plan, and applicable SOPs. Field activities will be recorded in the log books in sufficient detail to reconstruct the events and forms provided with the SOP will be completed. No erasures or mark outs will be made on field forms or log books. A single line will be used to strike out errors and will be annotated with the initials and date of the editor; the correct information will be inserted as appropriate.

8 References

HDR, 2018. DDMT Uniform Federal Policy-Quality Assurance Project Plan, Environmental Restoration Support at Former Defense Depot Memphis, Tennessee, Revision 1. Prepared for the U.S. Army Corps of Engineers, Mobile District. March 2018.

USEPA Region 4 Science and Ecosystem Support Division (SESD) 2011. SESDPROC-209-R2, *Operating Procedure: Packing, Marking, Labeling and Shipping of Environmental and Waste Samples*. April 2011.

Attachment 7-1

EXAMPLE: Sample Plan Detail

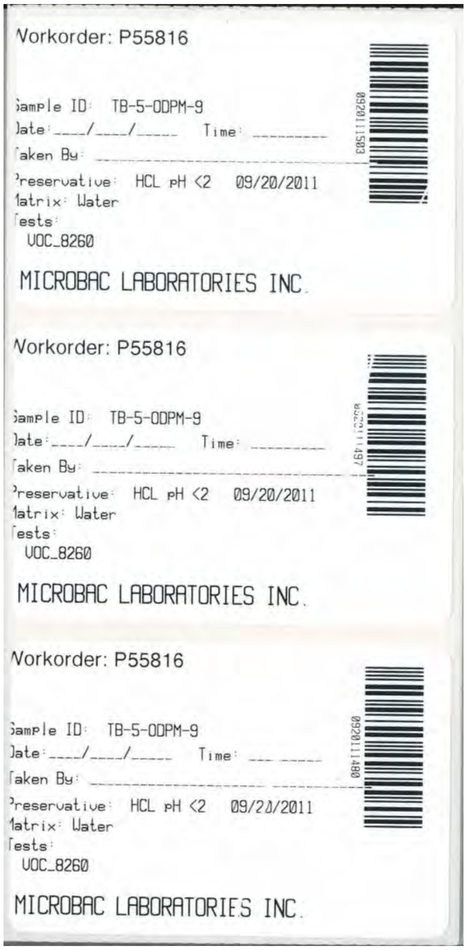
SAMPLING PLAN DETAIL (OFF DEPOT PM WELLS September 2011) - ODPM-9

Parameter	**VOCs**
Method	**8260B**
Container	**40 mL VOA**
Preservative	**HCl to pH<2** **Cool to 4°C**

#	Well ID	Sample ID	Additional	No. of Containers
1	MW-54	MW-54-ODPM-9		3
2	MW-70	MW-70-ODPM-9		3
3	MW-76	MW-76-ODPM-9		3
4	MW-77	MW-77-ODPM-9		3
5	MW-79	MW-79-ODPM-9	DUP-1	3
6	MW-148	MW-148-ODPM-9		3
7	MW-149	MW-149-ODPM-9		3
8	MW-150	MW-150-ODPM-9		3
9	MW-151	MW-151-ODPM-9		3
10	MW-152	MW-152-ODPM-9		3
11	MW-155	MW-155-ODPM-9		3
12	MW-157	MW-157-ODPM-9		3
13	MW-158	MW-158-ODPM-9		3
14	MW-158A	MW-158A-ODPM-9		3
15	MW-159	MW-159-ODPM-9	DUP-2	3
16	MW-160	MW-160-ODPM-9		3
17	MW-161	MW-161-ODPM-9		3
18	MW-162	MW-162-ODPM-9		3
19	MW-163	MW-163-ODPM-9		3
20	MW-164	MW-164-ODPM-9		3
20	MW-164	MW-164-ODPM-9-MS	MS	3
20	MW-164	MW-164-ODPM-9-MSD	MSD	3
21	MW-165	MW-165-ODPM-9		3
22	MW-165A	MW-165A-ODPM-9		3
23	MW-166	MW-166-ODPM-9		3
24	MW-166A	MW-166A-ODPM-9		3
25	MW-241	MW-241-ODPM-9		3
26	MW-242	MW-242-ODPM-9		3
27	MW-243	MW-243-ODPM-9		3
28	MW-244	MW-244-ODPM-9		3
29	MW-245	MW-245-ODPM-9		3
30	MW-246	MW-246-ODPM-9		3
31	RB	RB-ODPM-9		3
32	DUP-1	DUP-1-ODPM-9		3
33	DUP-2	DUP-2-ODPM-9		3
34	TB-1	TB-1-ODPM-9		3
35	TB-2	TB-2-ODPM-9		3

Attachment 7-2

EXAMPLE: Sample Labels for Groundwater Samples



Vorkorder: P55816

ample ID: TB-5-ODPM-9
ate: ____/____/_____ Time: __________
aken By: ________________________________
reservative: HCL pH <2 09/20/2011
atrix: Water
ests:
VOC_8260

MICROBAC LABORATORIES INC.

0920111503

Vorkorder: P55816

ample ID: TB-5-ODPM-9
ate: ____/____/_____ Time: __________
aken By: ________________________________
reservative: HCL pH <2 09/20/2011
atrix: Water
ests:
VOC_8260

MICROBAC LABORATORIES INC.

0920111497

Vorkorder: P55816

ample ID: TB-5-ODPM-9
ate: ____/____/_____ Time: __________
aken By: ________________________________
reservative: HCL pH <2 09/20/2011
atrix: Water
ests:
VOC_8260

MICROBAC LABORATORIES INC.

0920111480

Attachment 7-3

EXAMPLE: Sample Labels for Air Samples

ALS

2655 Park Center Drive, Ste. A
Simi Valley, CA 93065
+1 805 526 7161 | +1 805 526 7270 (fax)

Canister Sampling Information

DO NOT adhere any type of label to the canister. **DO NOT** over tighten the valve and remember to replace the brass cap.

Field Readings:

Pi__________ Pf__________

Initials:__________Date:__________

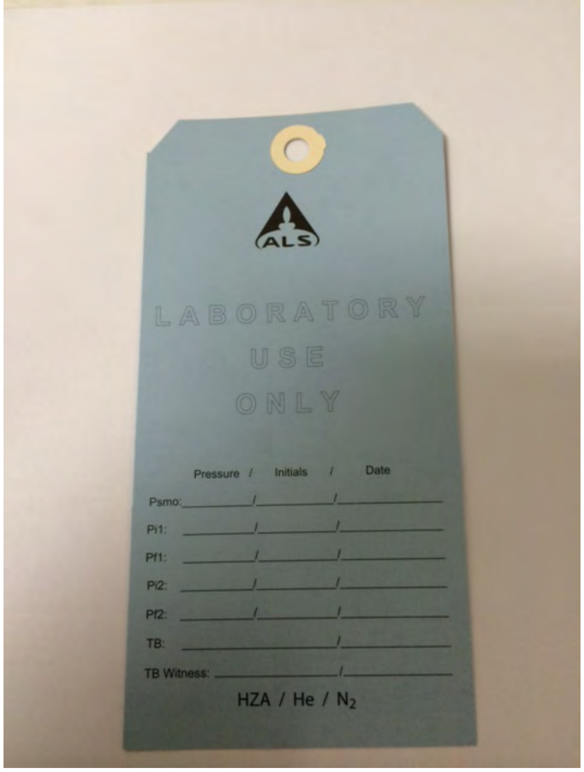
Client Name:

Sample ID:

Analysis:

Date / Time: Sampler's Int.:

Comments:



ALS

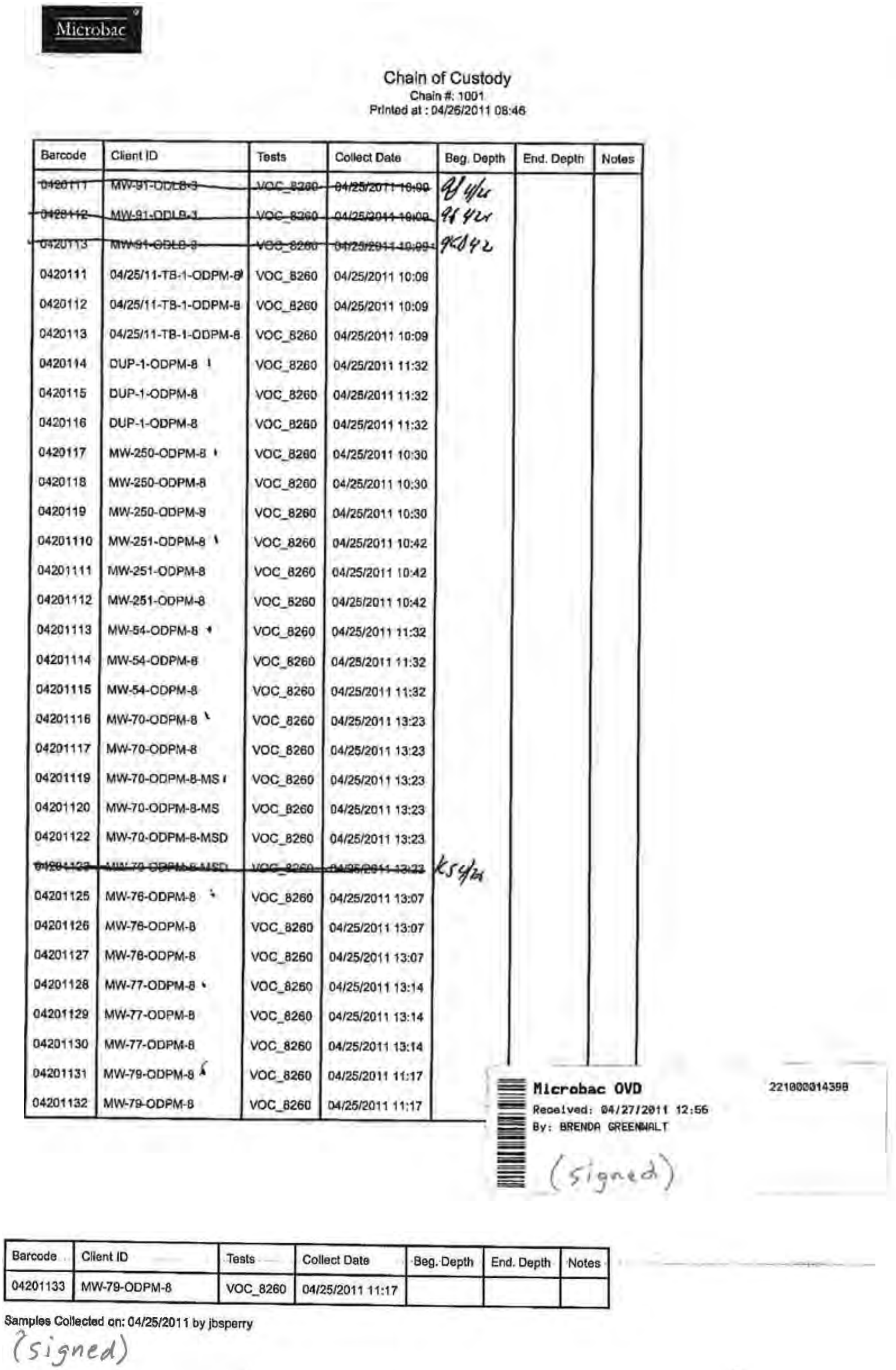
LABORATORY
USE
ONLY

	Pressure	Initials	Date
Psmo:			
Pi1:			
Pf1:			
Pi2:			
Pf2:			
TB:			
TB Witness:			

HZA / He / N_2

Attachment 7-4

EXAMPLE: Microbac Chain-of-Custody Form (Computer)



Microbac

Chain of Custody
Chain #: 1001
Printed at : 04/26/2011 08:46

Barcode	Client ID	Tests	Collect Date	Beg. Depth	End. Depth	Notes
~~0420111~~	~~MW-91-ODLB-3~~	~~VOC_8260~~	~~04/25/2011 10:09~~	[illegible]		
~~0420112~~	~~MW-91-ODLB-3~~	~~VOC_8260~~	~~04/25/2011 10:09~~	[illegible]		
~~0420113~~	~~MW-91-ODLB-3~~	~~VOC_8260~~	~~04/25/2011 10:09~~	[illegible]		
0420111	04/25/11-TB-1-ODPM-8	VOC_8260	04/25/2011 10:09			
0420112	04/25/11-TB-1-ODPM-8	VOC_8260	04/25/2011 10:09			
0420113	04/25/11-TB-1-ODPM-8	VOC_8260	04/25/2011 10:09			
0420114	DUP-1-ODPM-8	VOC_8260	04/25/2011 11:32			
0420115	DUP-1-ODPM-8	VOC_8260	04/25/2011 11:32			
0420116	DUP-1-ODPM-8	VOC_8260	04/25/2011 11:32			
0420117	MW-250-ODPM-8	VOC_8260	04/25/2011 10:30			
0420118	MW-250-ODPM-8	VOC_8260	04/25/2011 10:30			
0420119	MW-250-ODPM-8	VOC_8260	04/25/2011 10:30			
04201110	MW-251-ODPM-8	VOC_8260	04/25/2011 10:42			
04201111	MW-251-ODPM-8	VOC_8260	04/25/2011 10:42			
04201112	MW-251-ODPM-8	VOC_8260	04/25/2011 10:42			
04201113	MW-54-ODPM-8	VOC_8260	04/25/2011 11:32			
04201114	MW-54-ODPM-8	VOC_8260	04/25/2011 11:32			
04201115	MW-54-ODPM-8	VOC_8260	04/25/2011 11:32			
04201116	MW-70-ODPM-8	VOC_8260	04/25/2011 13:23			
04201117	MW-70-ODPM-8	VOC_8260	04/25/2011 13:23			
04201119	MW-70-ODPM-8-MS	VOC_8260	04/25/2011 13:23			
04201120	MW-70-ODPM-8-MS	VOC_8260	04/25/2011 13:23			
04201122	MW-70-ODPM-8-MSD	VOC_8260	04/25/2011 13:23			
~~04201123~~	~~MW-70-ODPM-8-MSD~~	~~VOC_8260~~	~~04/25/2011 13:23~~	KS 4/26		
04201125	MW-76-ODPM-8	VOC_8260	04/25/2011 13:07			
04201126	MW-76-ODPM-8	VOC_8260	04/25/2011 13:07			
04201127	MW-76-ODPM-8	VOC_8260	04/25/2011 13:07			
04201128	MW-77-ODPM-8	VOC_8260	04/25/2011 13:14			
04201129	MW-77-ODPM-8	VOC_8260	04/25/2011 13:14			
04201130	MW-77-ODPM-8	VOC_8260	04/25/2011 13:14			
04201131	MW-79-ODPM-8	VOC_8260	04/25/2011 11:17			
04201132	MW-79-ODPM-8	VOC_8260	04/25/2011 11:17			

Microbac OVD
Received: 04/27/2011 12:56
By: BRENDA GREENWALT
(signed)

221000014398

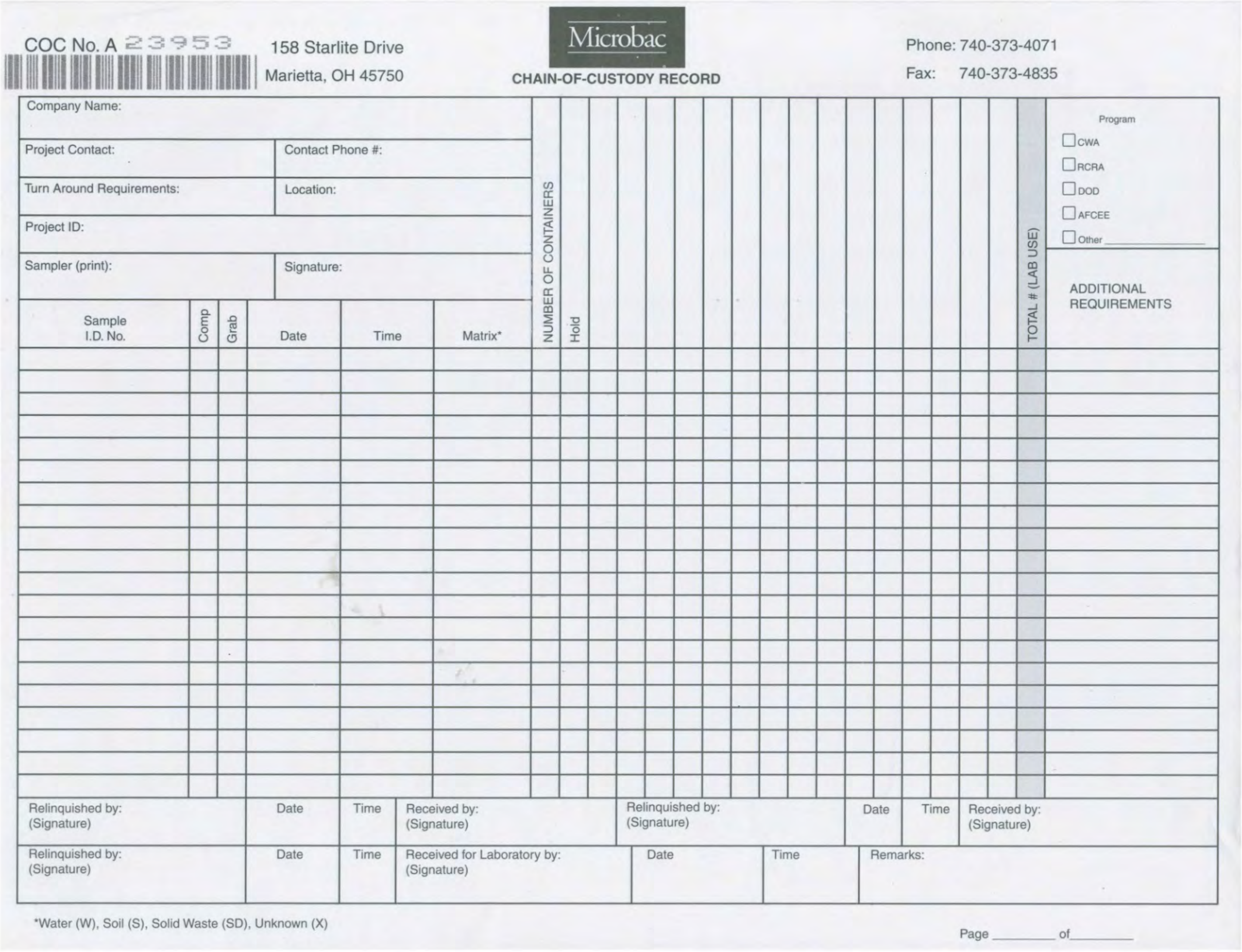
Barcode	Client ID	Tests	Collect Date	Beg. Depth	End. Depth	Notes
04201133	MW-79-ODPM-8	VOC_8260	04/25/2011 11:17			

Samples Collected on: 04/25/2011 by jbsperry

(signed)

Attachment 7-4

EXAMPLE: Microbac Chain-of-Custody Form (Hand)



COC No. A 23953

158 Starlite Drive
Marietta, OH 45750

Microbac

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name:

Project Contact:

Contact Phone #:

Turn Around Requirements:

Location:

Project ID:

Sampler (print):

Signature:

Program
☐ CWA
☐ RCRA
☐ DOD
☐ AFCEE
☐ Other ______________

Sample I.D. No.	Comp	Grab	Date	Time	Matrix*	NUMBER OF CONTAINERS	Hold																TOTAL # (LAB USE)	ADDITIONAL REQUIREMENTS

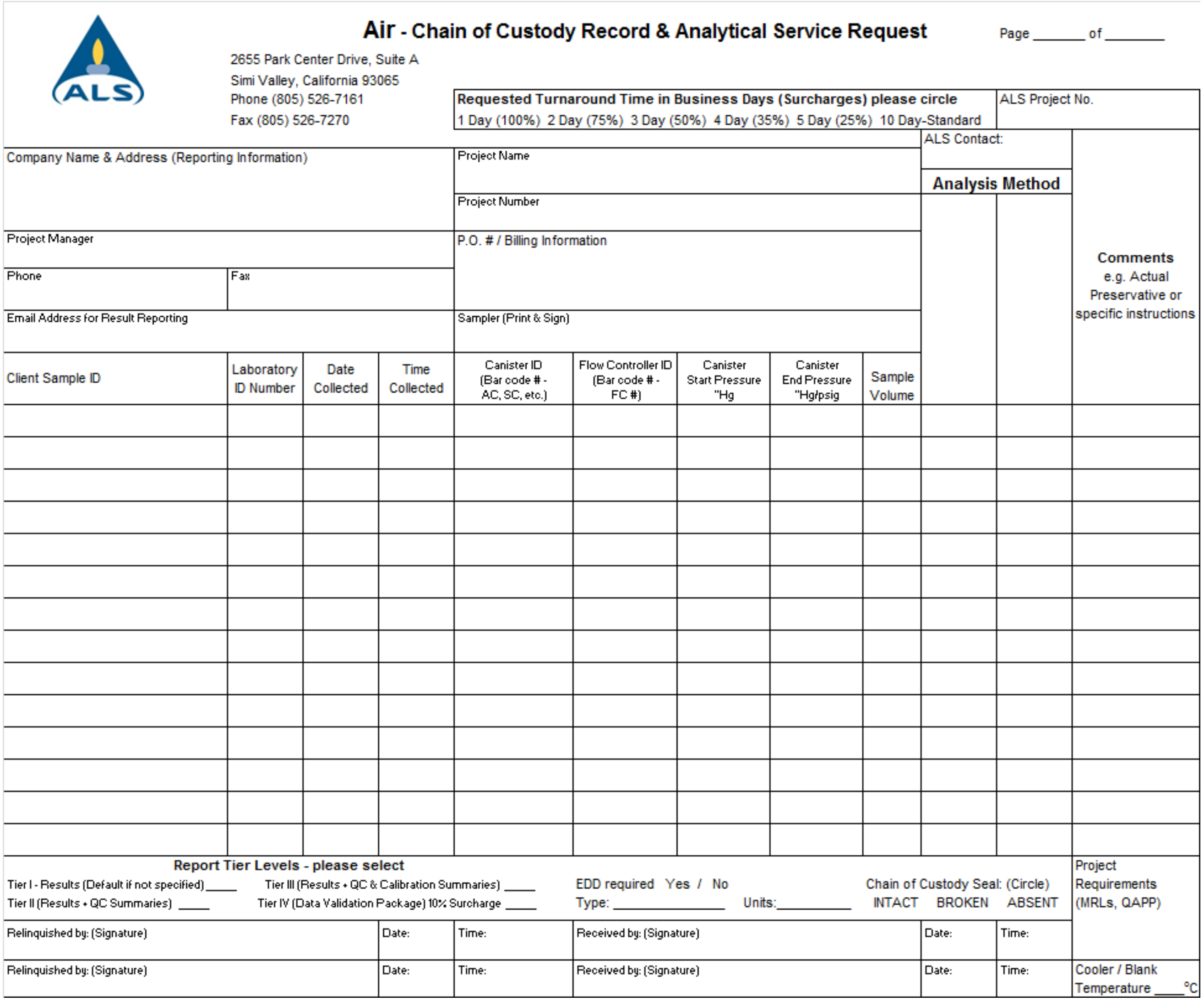
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:		

*Water (W), Soil (S), Solid Waste (SD), Unknown (X)

Page ________ of ________

Attachment 7-5

EXAMPLE: ALS Chain-of-Custody Form



Air - Chain of Custody Record & Analytical Service Request

Page _______ of ________

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

ALS Project No.

ALS Contact:

Company Name & Address (Reporting Information)

Project Name

Project Number

Project Manager

P.O. # / Billing Information

Phone

Fax

Email Address for Result Reporting

Sampler (Print & Sign)

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	**Analysis Method**		**Comments** e.g. Actual Preservative or specific instructions

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier III (Results + QC & Calibration Summaries) ____
Tier II (Results + QC Summaries) ____
Tier IV (Data Validation Package) 10% Surcharge ____

EDD required Yes / No
Type: ______________ Units:__________

Chain of Custody Seal: (Circle)
INTACT BROKEN ABSENT

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:	
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:	Cooler / Blank Temperature ____°C

STANDARD OPERATING PROCEDURE 8 – SAMPLE PACKING AND SHIPPING

Lead Organization: Department of the Army (DA)
Preparing Organization: HDR
SOP Approved by: Field Team Leader: Clayton Mokri
Project QA Officer: Lynn Lutz
Project Manager: Tom Holmes

1 Purpose and Summary

The purpose of this Standard Operating Procedure (SOP) is to provide guidance for packing and shipping environmental samples to the laboratory for analysis. The goals for sample packing and shipping are that: 1) the integrity of the sample is maintained, and 2) no exposure to the sample contents occurs during transit. These goals should be met regardless of the method by which the samples were shipped.

Samples will usually be shipped as either environmental samples or as hazardous materials based on the expected contaminant concentrations. While the concentration of constituents in the sample is not generally known prior to shipment of the sample, inferences can be made based on the site location and knowledge of past activities, observations during collection, and past sample results. Hazardous materials are generally considered to be samples of highly contaminated media collected at or near an observed release and can consist of pure product or a mixture. Environmental samples are generally media with low-level contamination.

Relevant regulations include Department of Transportation (DOT) regulations for ground transportation (49 Code of Federal Regulations [CFR]) and the International Air Transport Association (IATA) regulations for air transportation. Common carriers (e.g., FedEx, and UPS etc.) must abide by these regulations. This SOP provides specific guidance on how to package and ship samples to achieve the stated objectives and remain in compliance with shipping regulations. If field personnel are unsure regarding current shipping regulations, they will immediately contact the selected carrier (e.g., FedEx, UPS, etc.) for guidance.

2 Health and Safety

General Information on Health and Safety requirements are provided in SOP 1. Each individual is required to have read and understood the Health and Safety Plan (HASP) for the specific project activity and signed the acknowledgement sheet confirming their review.

Health and safety concerns for sample shipment include potential for exposure to contaminants, sample container preservatives, and injury from breakage of sample containers. Contamination levels at Defense Depot Memphis, Tennessee (DDMT) are relatively low but care should be taken to avoid exposure. Sample containers should be handled carefully; nitrile gloves and safety glasses should be used.

3 Personnel Qualifications and Responsibilities

Sample packing and shipping activities will be directed by the Field Team Leader (FTL), a mid- or senior level environmental professional (engineer, geologist or scientist) with experience in sampling activities. Field staff, environmental professionals or technicians, are responsible for proper sample handling and compliance with these guidelines.

4 Equipment and Supplies

The required equipment and supplies will consist of ice chests from the laboratory, clear tape, filament tape, gallon size Ziploc bags, trash bags, custody seals, bubble bags, cushion for bottom of cooler, and FedEx handle label hangers.

5 Procedure

5.1 Start-Up Activities

5.1.1 Office

The FTL will work with the project chemist (PC) to:

- Ensure that sufficient sample containers, shipping containers/coolers and packing material are shipped to the site based on the analytical parameters, total number of samples and average number of samples to be collected per day.
- Develop guidelines on the number/type of samples per shipper based on sample type and past analytical results (i.e. volatile organic compounds [VOCs] in one cooler to limit the number of trip blanks needed and samples from high concentration wells packed in separate cooler to prevent cross contamination)
- Coordinate sample shipments to ensure laboratory personnel will be available to receive the samples if weekend or holiday shipments are planned.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the FTL will confirm that the required sample containers, sample coolers, packing material and ice are available on-site.

5.2 Field Operations

On specific projects, protocols for sample shipment will be specified in the work plan. This SOP provides general guidelines for sample packing and shipping.

- Samples will be shipped to the laboratory by an overnight courier service.
- Samples will not remain on site for more than 24 hours after collection, unless samples were collected on a weekend or there were not enough samples to make a shipment. These

samples will be stored in the refrigerator at 4 degrees Celsius (°C) in a locked office until the next shipment.

- Glass sample containers will be placed inside sealed plastic bubble wrap bags or wrapped in bubble wrap and placed in plastic bags as a precaution against cross-contamination due to leakage or breakage.
- Sample bottles will be placed in coolers in a manner to limit the breakage and/or leakage during shipment. All coolers will have a bottom cushion/absorbent placed in prior to placing the samples in the cooler.
- Coolers will be lined with a heavy duty plastic garbage bag.
- Segregate highly contaminated samples, if known, by placement in a separate cooler or in separate plastic zip-lock bags.
- All coolers will have the drain plug taped closed, if present.
- Sufficient ice in plastic bags (double-bagged) will be placed in the coolers to keep the samples at 4°C throughout shipment.
- The top of the garbage bag, lining the cooler and containing the samples and ice, will be tied or adequately sealed as to prevent leakage.
- Chain-of-Custody (COC) documents will be placed in zip-lock bags and taped to the inside lid of each cooler.
- Cooler lids will be secured by wrapping with filament tape.
- The air bill will be secured to each handle of the cooler for the shipment label.
- Place Fragile and perishable stickers on all coolers. If shipping for Saturday delivery, place multiple Saturday Delivery stickers on each cooler and contact the laboratory to confirm receiving staff will be present.
- Confirm arrangements with the laboratory point-of-contact for Saturday delivery samples so that hold times and/or sample preservation are not compromised.

Custody seals will be used for sample shipments in accordance with SOP 7, Sample Control and Documentation. Custody seals are adhesive labels that are placed in such a manner that they will be visibly disturbed upon opening the shipping container or cooler. The seals will be initialed and dated upon placement. Upon receipt at the laboratory, the sample custodian will note the condition of custody seals and will also check the sample temperature, recording these items on the laboratory receipt form.

5.3 Closeout

Before leaving the site daily, the following procedures will be performed by the FTL or designated field staff:

- Ensure that the sample transport containers are properly packed and are in compliance with DOT and IATA regulations.
- Complete the Sample Handling, Packing & Shipping Checklist (Attachment 8-1).

6 Data and Records Management

All field forms and log book entries will be scanned and copied project folder on the “Z” drive within one week of the field event completion.

7 Quality Control and Quality Assurance

Work will be performed in accordance with the Quality Assurance Project Plan (QAPP), the specific work plan, and applicable SOPs. The Sample Handling, Packing & Shipping Checklist will be completed each day that samples are shipped. No erasures or mark outs will be made on the checklist. A single line will be used to strike out errors and will be annotated with the initials and date of the editor.

8 References

HDR, 2018a. DDMT Uniform Federal Policy-Quality Assurance Project Plan, Environmental Restoration Support at Former Defense Depot Memphis, Tennessee, Revision 1. Prepared for the U.S. Army Corps of Engineers, Mobile District. March 2018.

SESDPROC-209-R2, *Operating Procedure: Packing, Marking, Labeling and Shipping of Environmental and Waste Samples,* 2011.

Attachment 8-1

Sample Handling, Packing & Shipping Checklist

When preparing samples for shipment to the laboratory, complete this checklist to ensure that samples, documents, and materials are properly packed in the sample shipper.

Sample Event: ______________________

Date: ______________

PROJECT SAMPLES

☐ All samples, duplicates, MS/MSDs, equipment blanks, ambient blanks, and trip blanks should be included in the cooler that are listed on the COC.

☐ Verify that the proper number of bottles with appropriate preservative(s) were collected for each sample

☐ Verify that samples were checked for pH (except volatile samples)

DOCUMENTS

☐ **Chain-of-Custody (COC)** generated for *each* cooler

☐ COC reviewed for completeness, including appropriate signature(s) and date(s), and include the **courier tracking/shipping number** on the COC

☐ **COC** placed in a Ziploc bag and taped to the underside of the cooler lid

☐ **Custody seals** placed on the front and back of each cooler, or across the sealing tape for Summa canister cartons.

☐ Coolers for Saturday delivery have “Saturday Delivery” stickers and “Saturday Delivery” box checked on the airbill

☐ Shipments are insured

PACKING MATERIALS

☐ Ice is “double-bagged” and is sufficient to maintain a temperature of 4°C

☐ Glass bottles placed in a bubble bag to prevent breakage and leakage

☐ All coolers have a bottom cushion in place prior to placing samples in the cooler.

☐ Highly contaminated samples (if known) placed together

☐ **Trip blank** placed in each cooler that contains samples for VOC analyses at beginning of day

☐ All VOC samples placed in same cooler to minimize the number of trip blanks,

☐ Each cooler contains a **temperature blank**

Comments: (special handling or delivery requirements, highly contaminated samples, etc.)
____
____

Number of coolers shipped: ________________

Checklist Completed By: ______________________________ Date: ____________

Note: Place the completed checklist in the project file with the associated COCs and airbill.

STANDARD OPERATING PROCEDURE 9 – EQUIPMENT DECONTAMINATION

Lead Organization: Department of the Army (DA)
Preparing Organization: HDR
SOP Approved by: Field Team Leader: Clayton Mokri
Project QA Officer: Lynn Lutz
Project Manager: Tom Holmes

1 Purpose and Summary

This Standard Operation Procedure (SOP) provides guidance for proper decontamination of equipment used in sampling and collection of equipment rinsates to evaluate effectiveness of decontamination procedures.

2 Health and Safety

General Information on Health and Safety requirements is provided in SOP 1. Each individual is required to have read and understood the Site Safety and Health Plan for the project and signed the acknowledgement sheet confirming their review.

Health and safety concerns for equipment decontamination include exposure to contaminants from sampling equipment. Nitrile gloves and safety glasses should be used during decontamination.

3 Personnel Qualifications and Responsibilities

Sampling equipment decontamination and rinsate sample collection will be directed by the Field Team Leader (FTL), an environmental professional (engineer, geologist or scientist) with experience in equipment decontamination and sampling activities. The field staff, environmental professionals or technicians, are responsible for following these procedures and seeking direction from the FTL when questions or problems arise.

4 Equipment and Supplies

The required equipment and supplies will consist of Alconox soap, deionized water (DI), tap water, paper towels, foil, and sample containers.

5 Procedure

Proper equipment decontamination will prevent cross-contamination of samples due to residual contamination from previous sample locations and spread of contamination via sampling equipment. Proper decontamination also supports the legal defensibility of data generated during site activities.

Decontamination procedures will be evaluated by the collection of equipment rinsate samples. These samples consist of reagent water collected from final rinse of sampling equipment after the decontamination procedure has been performed. The samples are analyzed with the environmental sample to assess the adequacy of the decontamination performed.

5.1 Start-Up Activities

5.1.1 Office

The FTL will confirm that sufficient equipment and supplies are available at the site based on the number of samples and estimated field days.

5.1.2 Field

After arrival on site, but prior to commencement of operations, the FTL will confirm that decontamination supplies and equipment are available on site and review procedures with field staff.

5.2 Field Operations

5.2.1 Decontamination Area

The location of the decontamination area, used primarily for larger pieces of equipment, will be determined in consultation with subcontractor personnel. The decontamination pad will include a sump lined with 6-mil polyethylene sheeting to collect the decontamination water. The sump will be constructed by either excavating a small area to create a depression or by elevating the edges of the sheeting. Existing concrete pads with containment areas can be used for large equipment like drill rigs. Small handheld equipment will be decontaminated in 5-gallon buckets in order to contain the water.

5.2.2 Decontamination Water Source

Potable water from the municipal water system will be used as a rinse in the decontamination procedure. The FTL will be responsible for coordinating with the subcontractor personnel to secure an adequate supply of potable water for decontamination procedures. If large quantities of water are to be used, the subcontractor will rent a water meter from Memphis Light Gas and Water (MLGW). For smaller amounts, the field office water supply can be used.

5.2.3 Decontamination Procedures

The required decontamination procedure for large pieces of equipment such as drill rigs, auger flights, and drilling and well casing is:

1. Wash the external surface of equipment or materials with high pressure hot water and Alconox or equivalent, and scrub with brushes if necessary until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed from the equipment.
2. Air dry.
3. Decontamination waste water will be stored at the site and analyzed prior to disposal.

The required decontamination procedure for sampling equipment except the water level indicator probe is:

1. Wash and scrub with Alconox solution (or equivalent) and nylon brushes.
2. Double tap water rinse.
3. Rinse with American Society for Testing and Materials (ASTM) Type II Reagent - Grade Water
4. Wrap in oil free aluminum foil for transport.
5. Collect all decontamination rinse water in 5 gallon buckets. Rinse water will be combined with other wastewater generated during sampling activities and disposed of according to the work plan.

During water level sweeps and measurements in low-flow sampling, the water level tape and indicator in contact with groundwater will be decontaminated before initial use and before moving to a new location. The decontamination procedure for the water level indicator is:

1. Hand wash the calibrated tape and probe with Alconox solution (or equivalent).
2. Rinse with deionized (Reagent Grade II) water.

5.2.4 Equipment Rinsate Collection

When non-dedicated sampling equipment is used, the equipment will be decontaminated before initial use and after each sample is collected. An equipment rinsate sample will be collected for equipment type (bladder pump or bailer). At least one equipment rinsate will be collected for each sampling protocol (i.e. soil sampling, bladder pumps used for groundwater sampling) during each week of sampling. Equipment rinsate samples will be collected to be representative of field decontamination procedures.

Sampling Equipment: Equipment rinsate samples will be obtained from decontaminated bladder pumps, bailers, stainless steel split-spoons, hand augers, and stainless steel bowls with ASTM Type II water or better.

The equipment rinsate protocol will be as follows:

a. Label Sample Container - Label the sample container as outlined in SOP 7 – Sample Control and Documentation.

b. Collect Sample - After sample collection and equipment has been decontaminated as described above, an equipment rinsate will be collected. ASTM Type II water (or better) will be poured over and through the sampling equipment into a cleaned stainless steel bowl (preferably the equipment and bowl to be used on a specifically identifiable sample location). The collected water will be poured into the appropriate sample container. Repeat the process as necessary to fill each container to the required volume. Vials for volatile analysis and bottles for total organic carbon (TOC) analysis will be completely filled, leaving no air space above the liquid portion (to minimize volatilization). Check that the Teflon on the Teflon- lined silicone septum is toward the sample in the caps and secure the cap tightly. If semi-volatile compounds are to be sampled for, collect these samples next. Proceed to the collection of samples for the remaining analyses. Be careful of all pre-preserved bottles. If acids are present, open the bottle downwind and away from the body.

c. Custody, Handling and Shipping - Complete the procedures as outlined in SOP 7 – Sample Control and Documentation and SOP 8 - Sample Packing and Shipping.

5.3 Closeout

Before leaving the site daily, the following procedures will be performed by the FTL or designated field staff:

- Confirm all equipment is decontaminated and properly stored all equipment.
- Add decontamination rinse water to the wastewater storage tank
- Note equipment decontamination activities and rinsate sample collection on the Daily Field Report (SOP 1, Attachment 1-2).

6 Data and Records Management

All field forms and log book entries will be scanned and copied project folder on the “Z” drive within one week of the field event completion.

7 Quality Control and Quality Assurance

Work will be performed in accordance with the Quality Assurance Project Plan (QAPP), the specific work plan, and applicable SOPs.

8 References

HDR, 2018. DDMT Uniform Federal Policy-Quality Assurance Project Plan, Environmental Restoration Support at Former Defense Depot Memphis, Tennessee, Revision 1. Prepared for the U.S. Army Corps of Engineers, Mobile District. March 2018.

SESDPROC-205-R2, *Operating Procedure Field Equipment Cleaning and Decontamination,* 2011.

Appendix B
Analytical Standard Operating Procedures

CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

Chemtech
284 Sheffield Street
Mountainside, NJ 07092

has been assessed by ANAB
and meets the requirements of international standard

ISO/IEC 17025:2005

and DoD Quality Systems Manual for Environmental Laboratories (DoD QSM V 5.1.1)

while demonstrating technical competence in the fields of

TESTING

Refer to the accompanying Scope of Accreditation for information regarding the types of calibrations and/or tests to which this accreditation applies.

L2219
Certificate Number

ANAB Approval

Certificate Valid: 10/01/2018-10/20/2021
Version No. 004 Issued: 10/01/2018

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. 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).

ANSI-ASQ National Accreditation Board

ANAB

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005 AND DOD QUALITY SYSTEMS MAUAL FOR ENVIRONMENTAL LABORATORIES (DOD QSM V 5.1.1)

Chemtech

284 Sheffield Street
Mountainside, NJ 07092
Emanuel Hedvat
908-789-8900

TESTING

Valid to: **October 20, 2021** Certificate Number: **L2219**

Environmental

Air and Emissions

Technology	Method	Analyte
GC/MS	TO-15	1,1,1-Trichloroethane
GC/MS	TO-15	1,1,2,2-Tetrachloroethane
GC/MS	TO-15	1,1,2-Trichloroethane
GC/MS	TO-15	1,1,2-Trichlorotrifluoroethane
GC/MS	TO-15	1,1-Dichloroethane
GC/MS	TO-15	1,1-Dichloroethene
GC/MS	TO-15	1,2,4-Trichlorobenzene
GC/MS	TO-15	1,2,4-Trimethylbenzene
GC/MS	TO-15	1,2-Dibromoethane
GC/MS	TO-15	1,2-Dichlorobenzene
GC/MS	TO-15	1,2-Dichloroethane
GC/MS	TO-15	1,2-Dichloropropane
GC/MS	TO-15	1,3,5-Trimethylbenzene
GC/MS	TO-15	1,3-Butadiene
GC/MS	TO-15	1,3-Dichlorobenzene

Air and Emissions		
Technology	**Method**	**Analyte**
GC/MS	TO-15	1,4-Dichlorobenzene
GC/MS	TO-15	1,4-Dioxane
GC/MS	TO-15	2,2,4-Trimethylpentane
GC/MS	TO-15	2-Butanone
GC/MS	TO-15	2-Chlorotoluene
GC/MS	TO-15	2-Hexanone
GC/MS	TO-15	4-Ethyltoluene
GC/MS	TO-15	4-Methyl-2-Pentanone
GC/MS	TO-15	Acetone
GC/MS	TO-15	Allyl Chloride
GC/MS	TO-15	Benzene
GC/MS	TO-15	Benzyl Chloride
GC/MS	TO-15	Bromodichloromethane
GC/MS	TO-15	Bromoethene
GC/MS	TO-15	Bromoform
GC/MS	TO-15	Bromomethane
GC/MS	TO-15	Carbon Disulfide
GC/MS	TO-15	Carbon Tetrachloride
GC/MS	TO-15	Chlorobenzene
GC/MS	TO-15	Chloroethane
GC/MS	TO-15	Chloroform
GC/MS	TO-15	Chloromethane
GC/MS	TO-15	cis-1,2-Dichloroethene
GC/MS	TO-15	cis-1,3-Dichloropropene
GC/MS	TO-15	Cyclohexane
GC/MS	TO-15	Dibromochloromethane
GC/MS	TO-15	Dichlorodifluoromethane

Air and Emissions

Technology	Method	Analyte
GC/MS	TO-15	Dichlorotetrafluoroethane
GC/MS	TO-15	Ethanol
GC/MS	TO-15	Ethyl Acetate
GC/MS	TO-15	Ethyl Benzene
GC/MS	TO-15	Heptane
GC/MS	TO-15	Hexachloro-1,3-Butadiene
GC/MS	TO-15	Hexane
GC/MS	TO-15	Isopropyl Alcohol
GC/MS	TO-15	m/p-Xylene
GC/MS	TO-15	Methyl methacrylate
GC/MS	TO-15	Methyl tert-Butyl Ether
GC/MS	TO-15	Methylene Chloride
GC/MS	TO-15	Naphthalene
GC/MS	TO-15	o-Xylene
GC/MS	TO-15	Propene
GC/MS	TO-15	Styrene
GC/MS	TO-15	t-1,3-Dichloropropene
GC/MS	TO-15	tert-butyl alcohol
GC/MS	TO-15	Tetrachloroethene
GC/MS	TO-15	Tetrahydrofuran
GC/MS	TO-15	Toluene
GC/MS	TO-15	trans-1,2-Dichloroethene
GC/MS	TO-15	Trichloroethene
GC/MS	TO-15	Trichlorofluoromethane
GC/MS	TO-15	Vinyl Acetate
GC/MS	TO-15	Vinyl Chloride
GC/MS	TO-15	Isopropylbenzene

Air and Emissions

Technology	Method	Analyte
GC/MS	TO-15	n-Butylbenzene
GC/MS	TO-15	n-propylbenzene
GC/MS	TO-15	p-Isopropyltoluene
GC/MS	TO-15	sec-Butylbenzene
GC/MS	TO-15	tert-Butylbenzene

Drinking Water

Technology	Method	Analyte
GC/MS	EPA 524.2	1,1,1,2-Tetrachloroethane
GC/MS	EPA 524.2	Tetrachloroethene
GC/MS	EPA 524.2	1,1,1-Trichloroethane
GC/MS	EPA 524.2	1,1,2,2-Tetrachloroethane
GC/MS	EPA 524.2	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 524.2	1,1,2-Trichloroethane
GC/MS	EPA 524.2	1,1-Dichloroethane
GC/MS	EPA 524.2	1,1-Dichloroethene
GC/MS	EPA 524.2	1,1-Dichloropropene
GC/MS	EPA 524.2	1,2,3-Trichlorobenzene
GC/MS	EPA 524.2	1,2,3-Trichloropropane
GC/MS	EPA 524.2	1,2,4-Trichlorobenzene
GC/MS	EPA 524.2	1,2,4-Trimethylbenzene
GC/MS	EPA 524.2	1,2-Dibromo-3-Chloropropane
GC/MS	EPA 524.2	1,2-Dibromoethane
GC/MS	EPA 524.2	1,2-Dichlorobenzene
GC/MS	EPA 524.2	1,2-Dichloroethane
GC/MS	EPA 524.2	1,2-Dichloropropane
GC/MS	EPA 524.2	1,3,5-Trimethylbenzene

Drinking Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 524.2	1,3-Dichlorobenzene
GC/MS	EPA 524.2	1,3-Dichloropropane
GC/MS	EPA 524.2	1,4-Dichlorobenzene
GC/MS	EPA 524.2	1-Chlorobutane
GC/MS	EPA 524.2	2,2-Dichloropropane
GC/MS	EPA 524.2	2-Butanone
GC/MS	EPA 524.2	Bromoform
GC/MS	EPA 524.2	2-Chlorotoluene
GC/MS	EPA 524.2	2-Hexanone
GC/MS	EPA 524.2	4-Chlorotoluene
GC/MS	EPA 524.2	4-Methyl-2-Pentanone
GC/MS	EPA 524.2	Acetone
GC/MS	EPA 524.2	Acrylonitrile
GC/MS	EPA 524.2	Allyl Chloride
GC/MS	EPA 524.2	Benzene
GC/MS	EPA 524.2	Bromobenzene
GC/MS	EPA 524.2	Bromochloromethane
GC/MS	EPA 524.2	Bromodichloromethane
GC/MS	EPA 524.2	Bromomethane
GC/MS	EPA 524.2	Carbon Disulfide
GC/MS	EPA 524.2	Carbon Tetrachloride
GC/MS	EPA 524.2	Chlorobenzene
GC/MS	EPA 524.2	Chloroethane
GC/MS	EPA 524.2	Chloroform
GC/MS	EPA 524.2	Chloromethane
GC/MS	EPA 524.2	cis-1,2-Dichloroethene
GC/MS	EPA 524.2	cis-1,3-Dichloropropene

Drinking Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 524.2	Cyclohexane
GC/MS	EPA 524.2	Dibromochloromethane
GC/MS	EPA 524.2	Dibromomethane
GC/MS	EPA 524.2	Dichlorodifluoromethane
GC/MS	EPA 524.2	Diethyl Ether
GC/MS	EPA 524.2	Ethyl Benzene
GC/MS	EPA 524.2	Ethyl methacrylate
GC/MS	EPA 524.2	Ethyl-t-butyl ether
GC/MS	EPA 524.2	Hexachlorobutadiene
GC/MS	EPA 524.2	Hexachloroethane
GC/MS	EPA 524.2	Iodomethane
GC/MS	EPA 524.2	Isopropyl Ether
GC/MS	EPA 524.2	Isopropylbenzene
GC/MS	EPA 524.2	m/p-Xylenes
GC/MS	EPA 524.2	Methacrylonitrile
GC/MS	EPA 524.2	Methyl acrylate
GC/MS	EPA 524.2	Methyl methacrylate
GC/MS	EPA 524.2	Methyl tert-Butyl Ether
GC/MS	EPA 524.2	Methylcyclohexane
GC/MS	EPA 524.2	Methylene Chloride
GC/MS	EPA 524.2	Naphthalene
GC/MS	EPA 524.2	n-Butylbenzene
GC/MS	EPA 524.2	Nitrobenzene
GC/MS	EPA 524.2	n-propylbenzene
GC/MS	EPA 524.2	o-Xylene
GC/MS	EPA 524.2	Pentachloroethane
GC/MS	EPA 524.2	p-Isopropyltoluene

Drinking Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 524.2	Propionitrile
GC/MS	EPA 524.2	sec-Butylbenzene
GC/MS	EPA 524.2	Styrene
GC/MS	EPA 524.2	t-1,3-Dichloropropene
GC/MS	EPA 524.2	t-1,4-Dichloro-2-butene
GC/MS	EPA 524.2	Tert-Amyl methyl ether
GC/MS	EPA 524.2	tert-Butyl Alcohol
GC/MS	EPA 524.2	tert-Butylbenzene
GC/MS	EPA 524.2	Tetrahydrofuran
GC/MS	EPA 524.2	Toluene
GC/MS	EPA 524.2	trans-1,2-Dichloroethene
GC/MS	EPA 524.2	Trichloroethene
GC/MS	EPA 524.2	Trichlorofluoromethane
GC/MS	EPA 524.2	Vinyl Chloride
ICP	EPA 200.7	Aluminum
ICP	EPA 200.7	Antimony
ICP	EPA 200.7	Arsenic
ICP	EPA 200.7	Barium
ICP	EPA 200.7	Beryllium
ICP	EPA 200.7	Boron
ICP	EPA 200.7	Cadmium
ICP	EPA 200.7	Calcium
ICP	EPA 200.7	Chromium
ICP	EPA 200.7	Cobalt
ICP	EPA 200.7	Copper
ICP	EPA 200.7	Iron
ICP	EPA 200.7	Lead

Drinking Water		
Technology	**Method**	**Analyte**
ICP	EPA 200.7	Magnesium
ICP	EPA 200.7	Manganese
ICP	EPA 200.7	Molybdenum
ICP	EPA 200.7	Nickel
ICP	EPA 200.7	Potassium
ICP	EPA 200.7	Selenium
ICP	EPA 200.7	Silicon
ICP	EPA 200.7	Silver
ICP	EPA 200.7	Sodium
ICP	EPA 200.7	Sulfur
ICP	EPA 200.7	Tin
ICP	EPA 200.7	Titanium
ICP	EPA 200.7	Vanadium
ICP	EPA 200.7	Zinc
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lead

Drinking Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silicon
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Sulfur
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Zinc
CVAA	EPA 245.1	Mercury

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 608.3	4,4`-DDD
GC/ECD	EPA 608.3	4,4`-DDE
GC/ECD	EPA 608.3	4,4`-DDT
GC/ECD	EPA 608.3	Aldrin
GC/ECD	EPA 608.3	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 608.3	alpha Chlordane
GC/ECD	EPA 608.3	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 608.3	Chlordane (tech.)

Non-Potable Water

Technology	Method	Analyte
GC/ECD	EPA 608.3	delta-BHC
GC/ECD	EPA 608.3	Dieldrin
GC/ECD	EPA 608.3	Endosulfan I
GC/ECD	EPA 608.3	Endosulfan II
GC/ECD	EPA 608.3	Endosulfan sulfate
GC/ECD	EPA 608.3	Endrin aldehyde
GC/ECD	EPA 608.3	Endrin ketone
GC/ECD	EPA 608.3	Endrin
GC/ECD	EPA 608.3	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 608.3	gamma Chlordane
GC/ECD	EPA 608.3	Heptachlor epoxide
GC/ECD	EPA 608.3	Heptachlor
GC/ECD	EPA 608.3	Methoxychlor
GC/ECD	EPA 608.3	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 608.3	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 608.3	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 608.3	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 608.3	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 608.3	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 608.3	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 608.3	Aroclor-1260 (PCB-1260)
GC/MS	EPA 624.1	1,1,1,2-Tetrachloroethane
GC/MS	EPA 624.1	1,1,1-Trichloroethane
GC/MS	EPA 624.1	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624.1	1,1,2-Trichloroethane
GC/MS	EPA 624.1	1,1,2-Trichlorotrifluoroethane
GC/MS	EPA 624.1	1,1-Dichloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624.1	1,1-Dichloroethene
GC/MS	EPA 624.1	1,1-Dichloropropene
GC/MS	EPA 624.1	1,2,3-Trichlorobenzene
GC/MS	EPA 624.1	1,2,3-Trichloropropane
GC/MS	EPA 624.1	1,2,4-Trichlorobenzene
GC/MS	EPA 624.1	1,2,4-Trimethylbenzene
GC/MS	EPA 624.1	1,2-Dibromo-3-Chloropropane
GC/MS	EPA 624.1	1,2-Dibromoethane
GC/MS	EPA 624.1	1,2-Dichlorobenzene
GC/MS	EPA 624.1	1,2-Dichloroethane
GC/MS	EPA 624.1	1,2-Dichloropropane
GC/MS	EPA 624.1	1,3,5-Trimethylbenzene
GC/MS	EPA 624.1	1,3-Dichlorobenzene
GC/MS	EPA 624.1	1,3-Dichloropropane
GC/MS	EPA 624.1	1,4-Dichlorobenzene
GC/MS	EPA 624.1	1,4-Dioxane
GC/MS	EPA 624.1	2,2-Dichloropropane
GC/MS	EPA 624.1	2-Butanone
GC/MS	EPA 624.1	2-Chloroethyl vinyl ether
GC/MS	EPA 624.1	2-Chlorotoluene
GC/MS	EPA 624.1	2-Hexanone
GC/MS	EPA 624.1	4-Chlorotoluene
GC/MS	EPA 624.1	4-Methyl-2-Pentanone
GC/MS	EPA 624.1	Acetone
GC/MS	EPA 624.1	Acrolein
GC/MS	EPA 624.1	Acrylonitrile
GC/MS	EPA 624.1	Allyl chloride

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624.1	Benzene
GC/MS	EPA 624.1	Bromobenzene
GC/MS	EPA 624.1	Bromodichloromethane
GC/MS	EPA 624.1	Bromoform
GC/MS	EPA 624.1	Bromomethane
GC/MS	EPA 624.1	Carbon Disulfide
GC/MS	EPA 624.1	Carbon Tetrachloride
GC/MS	EPA 624.1	Chlorobenzene
GC/MS	EPA 624.1	Chloroethane
GC/MS	EPA 624.1	Chloroform
GC/MS	EPA 624.1	Chloromethane
GC/MS	EPA 624.1	cis-1,2-Dichloroethene
GC/MS	EPA 624.1	cis-1,3-Dichloropropene
GC/MS	EPA 624.1	Cyclohexane
GC/MS	EPA 624.1	Dibromochloromethane
GC/MS	EPA 624.1	Dibromomethane
GC/MS	EPA 624.1	Dichlorodifluoromethane
GC/MS	EPA 624.1	Diethyl Ether
GC/MS	EPA 624.1	Diisopropyl ether
GC/MS	EPA 624.1	Ethyl Acetate
GC/MS	EPA 624.1	Ethyl Benzene
GC/MS	EPA 624.1	Ethyl methacrylate
GC/MS	EPA 624.1	Hexachlorobutadiene
GC/MS	EPA 624.1	Hexachloroethane
GC/MS	EPA 624.1	Isopropyl Acetate
GC/MS	EPA 624.1	Isopropylbenzene
GC/MS	EPA 624.1	m/p-Xylenes

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624.1	Methacrylonitrile
GC/MS	EPA 624.1	Methyl Acetate
GC/MS	EPA 624.1	Methyl Iodide
GC/MS	EPA 624.1	Methyl methacrylate
GC/MS	EPA 624.1	Methyl tert-Butyl Ether
GC/MS	EPA 624.1	Methylcyclohexane
GC/MS	EPA 624.1	Methylene Chloride
GC/MS	EPA 624.1	n-amyl Acetate
GC/MS	EPA 624.1	Naphthalene
GC/MS	EPA 624.1	n-Butylbenzene
GC/MS	EPA 624.1	n-propylbenzene
GC/MS	EPA 624.1	o-Xylene
GC/MS	EPA 624.1	p-Isopropyltoluene
GC/MS	EPA 624.1	sec-Butylbenzene
GC/MS	EPA 624.1	Styrene
GC/MS	EPA 624.1	t-1,3-Dichloropropene
GC/MS	EPA 624.1	t-1,4-Dichloro-2-butene
GC/MS	EPA 624.1	tert-Butyl Alcohol
GC/MS	EPA 624.1	tert-butylbenzene
GC/MS	EPA 624.1	Tetrachloroethene
GC/MS	EPA 624.1	Toluene
GC/MS	EPA 624.1	Total 1,2-Dichloroethene
GC/MS	EPA 624.1	Total Xylenes
GC/MS	EPA 624.1	trans-1,2-Dichloroethene
GC/MS	EPA 624.1	Trichloroethene
GC/MS	EPA 624.1	Trichlorofluoromethane
GC/MS	EPA 624.1	Vinyl Acetate

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624.1	Vinyl Chloride
GC/MS	EPA 625.1	1,1-Biphenyl
GC/MS	EPA 625.1	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 625.1	1,2,4-Trichlorobenzene
GC/MS	EPA 625.1	1,2-Dichlorobenzene
GC/MS	EPA 625.1	1,3-Dichlorobenzene
GC/MS	EPA 625.1	1,4-Dichlorobenzene
GC/MS	EPA 625.1	1,4-Dioxane
GC/MS	EPA 625.1	2,2-oxybis(1-Chloropropane)
GC/MS	EPA 625.1	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 625.1	2,4,5-Trichlorophenol
GC/MS	EPA 625.1	2,4,6-Trichlorophenol
GC/MS	EPA 625.1	2,4-Dichlorophenol
GC/MS	EPA 625.1	2,4-Dimethylphenol
GC/MS	EPA 625.1	2,4-Dinitrophenol
GC/MS	EPA 625.1	2,4-Dinitrotoluene
GC/MS	EPA 625.1	2,6-Dinitrotoluene
GC/MS	EPA 625.1	2-Chloronaphthalene
GC/MS	EPA 625.1	2-Chlorophenol
GC/MS	EPA 625.1	2-Methylnaphthalene
GC/MS	EPA 625.1	2-Methylphenol
GC/MS	EPA 625.1	2-Nitroaniline
GC/MS	EPA 625.1	2-Nitrophenol
GC/MS	EPA 625.1	3,3-Dichlorobenzidine
GC/MS	EPA 625.1	3+4-Methylphenols
GC/MS	EPA 625.1	3-Nitroaniline
GC/MS	EPA 625.1	4,6-Dinitro-2-methylphenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625.1	4-Bromophenyl-phenylether
GC/MS	EPA 625.1	4-Chloro-3-methylphenol
GC/MS	EPA 625.1	4-Chloroaniline
GC/MS	EPA 625.1	4-Chlorophenyl-phenylether
GC/MS	EPA 625.1	4-Nitroaniline
GC/MS	EPA 625.1	4-Nitrophenol
GC/MS	EPA 625.1	Acenaphthene
GC/MS	EPA 625.1	Acenaphthylene
GC/MS	EPA 625.1	Acetophenone
GC/MS	EPA 625.1	Aniline
GC/MS	EPA 625.1	Anthracene
GC/MS	EPA 625.1	Atrazine
GC/MS	EPA 625.1	Azobenzene
GC/MS	EPA 625.1	Benzaldehyde
GC/MS	EPA 625.1	Benzidine
GC/MS	EPA 625.1	Benzo(a)anthracene
GC/MS	EPA 625.1	Benzo(a)pyrene
GC/MS	EPA 625.1	Benzo(b)fluoranthene
GC/MS	EPA 625.1	Benzo(g,h,i)perylene
GC/MS	EPA 625.1	Benzo(k)fluoranthene
GC/MS	EPA 625.1	Benzoic acid
GC/MS	EPA 625.1	Benzyl Alcohol
GC/MS	EPA 625.1	bis(2-Chloroethoxy)methane
GC/MS	EPA 625.1	bis(2-Chloroethyl)ether
GC/MS	EPA 625.1	Bis(2-ethylhexyl)phthalate
GC/MS	EPA 625.1	Butylbenzylphthalate
GC/MS	EPA 625.1	Caprolactam

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625.1	Carbazole
GC/MS	EPA 625.1	Chrysene
GC/MS	EPA 625.1	Dibenzo(a,h)anthracene
GC/MS	EPA 625.1	Dibenzofuran
GC/MS	EPA 625.1	Diethylphthalate
GC/MS	EPA 625.1	Dimethylphthalate
GC/MS	EPA 625.1	Di-n-butylphthalate
GC/MS	EPA 625.1	Di-n-octyl phthalate
GC/MS	EPA 625.1	Fluoranthene
GC/MS	EPA 625.1	Fluorene
GC/MS	EPA 625.1	Hexachlorobenzene
GC/MS	EPA 625.1	Hexachlorobutadiene
GC/MS	EPA 625.1	Hexachlorocyclopentadiene
GC/MS	EPA 625.1	Hexachloroethane
GC/MS	EPA 625.1	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 625.1	Isophorone
GC/MS	EPA 625.1	Naphthalene
GC/MS	EPA 625.1	Nitrobenzene
GC/MS	EPA 625.1	n-Nitrosodimethylamine
GC/MS	EPA 625.1	n-Nitroso-di-n-propylamine
GC/MS	EPA 625.1	n-Nitrosodiphenylamine
GC/MS	EPA 625.1	Pentachlorophenol
GC/MS	EPA 625.1	Phenanthrene
GC/MS	EPA 625.1	Phenol
GC/MS	EPA 625.1	Pyrene
GC/MS	EPA 625.1	Pyridine
GC/FID	NJDEP EPH 10/08, Rev.3	C9 to C12 Aliphatics

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/FID	NJDEP EPH 10/08, Rev.3	C12 to C16 Aliphatics
GC/FID	NJDEP EPH 10/08, Rev.3	C16 to C21 Aliphatics
GC/FID	NJDEP EPH 10/08, Rev.3	C21 to C40 Aliphatics
GC/FID	NJDEP EPH 10/08, Rev.3	Total Aliphatics
GC/FID	NJDEP EPH 10/08, Rev.3	C10 to C12 Aromatics
GC/FID	NJDEP EPH 10/08, Rev.3	C12 to C16 Aromatics
GC/FID	NJDEP EPH 10/08, Rev.3	C16 to C21 Aromatics
GC/FID	NJDEP EPH 10/08, Rev.3	C21 to C40 Aromatics
GC/FID	NJDEP EPH 10/08, Rev.3	Total Aromatics
GC/FID	NJDEP EPH 10/08, Rev.3	Total EPH
GC/ECD	EPA 8081B	4,4`-DDD
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	alpha Chlordane
GC/ECD	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 8081B	delta-BHC
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 aldehyde

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	gamma Chlordane
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Heptachlor
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 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	Picloram
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	DCPA (Dacthal)
GC/ECD	EPA 8151A	Dichlorobenzoic acid (3,5-)
GC/ECD	EPA 8151A	Dichlorprop
GC/ECD	EPA 8151A	MCPA

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Nitrophenol (4-)
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8011	EDB
GC/ECD	EPA 8011	DBCP
GC/ECD	EPA 504.1	EDB
GC/ECD	EPA 504.1	DBCP
GC/FID	RSK 175	Methane
GC/FID	RSK 175	Ethane
GC/FID	RSK 175	Ethene
GC/FID	EPA 8015D	Diesel range organics (DRO)
GC/FID	EPA 8015D	Gasoline range organics (GRO)
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,1-Dichloroethylene
GC/MS	EPA 8260C	1,1-Dichloropropene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,2-Dichloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	1,2-Dichloropropane
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	1,4-Dichlorobenzene
GC/MS	EPA 8260C	2,2-Dichloropropane
GC/MS	EPA 8260C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acrolein (Propenal)
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	1,1,2-Trichlorotrifluoroethane
GC/MS	EPA 8260C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	Chloroform

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	cis-1,2-Dichloroethylene
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	Ethyl acetate
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	m+p-Xylenes
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	p-Dioxane
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	Styrene
GS/MS	EPA 8260C	Tert-butyl alcohol
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Tetrachloroethylene (Perchloroethylene)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	trans-1,2-Dichloroethylene
GC/MS	EPA 8260C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	Xylene (total)
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Diethyl Ether
GC/MS	EPA 8260C	Diisopropyl ether
GC/MS	EPA 8260C	Hexachloroethane
GC/MS	EPA 8260C	Isopropyl Acetate
GC/MS	EPA 8260C	Methyl Acetate
GC/MS	EPA 8260C	Methyl Iodide
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,2-Diphenylhydrazine
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	2,4,5-Trichlorophenol

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methyl-4,6-dinitrophenol
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D	3+4-Methylphenol
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(g,h,i)perylene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	Diphenylamine
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	1,4-Dioxane
GC/MS	EPA 8270D	1,1’-Biphenyl
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D SIM	1,4-Dioxane
GC/MS	EPA 8270D SIM	2-Methylnaphthalene
GC/MS	EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D SIM	Benzo(b)fluoranthene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D SIM	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D SIM	Pyrene
Gravimetric	EPA 1664A	Oil & Grease
Gravimetric	EPA 1664A	Total Petroleum Hydrocarbons (TPH)
Colorimetric	HACH 8146	Ferrous Iron
Titrimetric	SM 2320B	Alkalinity
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	O-phosphate
IC	EPA 9056A	Sulfate
CVAA	EPA 7470A	Mercury
CVAA	EPA 245.1	Mercury
ICP	EPA 200.7	Aluminum
ICP	EPA 200.7	Antimony
ICP	EPA 200.7	Arsenic
ICP	EPA 200.7	Barium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 200.7	Beryllium
ICP	EPA 200.7	Boron
ICP	EPA 200.7	Cadmium
ICP	EPA 200.7	Calcium
ICP	EPA 200.7	Chromium
ICP	EPA 200.7	Cobalt
ICP	EPA 200.7	Copper
ICP	EPA 200.7	Iron
ICP	EPA 200.7	Lead
ICP	EPA 200.7	Magnesium
ICP	EPA 200.7	Manganese
ICP	EPA 200.7	Molybdenum
ICP	EPA 200.7	Nickel
ICP	EPA 200.7	Potassium
ICP	EPA 200.7	Selenium
ICP	EPA 200.7	Silicon
ICP	EPA 200.7	Silver
ICP	EPA 200.7	Sodium
ICP	EPA 200.7	Sulfur
ICP	EPA 200.7	Thallium
ICP	EPA 200.7	Tin
ICP	EPA 200.7	Titanium
ICP	EPA 200.7	Vanadium
ICP	EPA 200.7	Zinc
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silicon
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Sulfur
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Zinc
ICP	EPA 6010D	Aluminum
ICP	EPA 6010D	Antimony

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 6010D	Arsenic
ICP	EPA 6010D	Barium
ICP	EPA 6010D	Beryllium
ICP	EPA 6010D	Boron
ICP	EPA 6010D	Cadmium
ICP	EPA 6010D	Calcium
ICP	EPA 6010D	Chromium
ICP	EPA 6010D	Cobalt
ICP	EPA 6010D	Copper
ICP	EPA 6010D	Iron
ICP	EPA 6010D	Lead
ICP	EPA 6010D	Magnesium
ICP	EPA 6010D	Manganese
ICP	EPA 6010D	Molybdenum
ICP	EPA 6010D	Nickel
ICP	EPA 6010D	Potassium
ICP	EPA 6010D	Selenium
ICP	EPA 6010D	Silicon
ICP	EPA 6010D	Silver
ICP	EPA 6010D	Sodium
ICP	EPA 6010D	Thallium
ICP	EPA 6010D	Tin
ICP	EPA 6010D	Titanium
ICP	EPA 6010D	Vanadium
ICP	EPA 6010D	Zinc
ICP-MS	EPA 6020B	Aluminum
ICP-MS	EPA 6020B	Antimony

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020B	Arsenic
ICP-MS	EPA 6020B	Barium
ICP-MS	EPA 6020B	Beryllium
ICP-MS	EPA 6020B	Boron
ICP-MS	EPA 6020B	Cadmium
ICP-MS	EPA 6020B	Calcium
ICP-MS	EPA 6020B	Chromium
ICP-MS	EPA 6020B	Cobalt
ICP-MS	EPA 6020B	Copper
ICP-MS	EPA 6020B	Iron
ICP-MS	EPA 6020B	Lead
ICP-MS	EPA 6020B	Magnesium
ICP-MS	EPA 6020B	Manganese
ICP-MS	EPA 6020B	Molybdenum
ICP-MS	EPA 6020B	Nickel
ICP-MS	EPA 6020B	Potassium
ICP-MS	EPA 6020B	Selenium
ICP-MS	EPA 6020B	Silicon
ICP-MS	EPA 6020B	Silver
ICP-MS	EPA 6020B	Sodium
ICP-MS	EPA 6020B	Thallium
ICP-MS	EPA 6020B	Tin
ICP-MS	EPA 6020B	Titanium
ICP-MS	EPA 6020B	Vanadium
ICP-MS	EPA 6020B	Zinc
ISE	EPA 9040C	Corrosivity (pH)
ISE	EPA 9040C	pH

Non-Potable Water		
Technology	**Method**	**Analyte**
pH Paper	EPA 9041A	pH
ISE	EPA 9050A	Conductivity
Physical	EPA 1010A	Ignitability
Titrimetric	EPA 9034	Sulfide
Probe21	EPA 9040C	pH
TOC	EPA 9060/9060A	Total organic carbon
Turbidimetric	EPA 9038	Sulfate
UV/VIS	EPA 7196A	Chromium VI
UV/VIS	EPA 9012B	Total cyanide
UV/VIS	EPA 9065	Total phenolics
Preparation	**Method**	**Type**
Distillation	EPA 9010C	Total cyanide
Organic Preparation	EPA 3510C	Separatory Funnel
Clean Up	EPA 3620C	Florisil Cleanup
Clean Up	EPA 3630C	Silica Gel Cleanup
Clean Up	EPA 3640A	Gel-Permeation Cleanup
Clean Up	EPA 3660	Sulfur Cleanup
Clean Up	EPA 3665A	Sulfuric Acid Permanganate Cleanup
Inorganic Preparation	EPA 3050B	Hotblock
Inorganic Preparation	EPA 3010A	Hotblock
Volatile Organic Preparation	EPA 5030B	Purge and Trap
Distillation	EPA 9030B	Sulfide
Extraction/Titrimetric	EPA 9031	Sulfide

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/FID	NJDEP EPH 10/08, Rev.3	C9 to C12 Aliphatics
GC/FID	NJDEP EPH 10/08, Rev.3	C12 to C16 Aliphatics
GC/FID	NJDEP EPH 10/08, Rev.3	C16 to C21 Aliphatics
GC/FID	NJDEP EPH 10/08, Rev.3	C21 to C40 Aliphatics
GC/FID	NJDEP EPH 10/08, Rev.3	Total Aliphatics
GC/FID	NJDEP EPH 10/08, Rev.3	C10 to C12 Aromatics
GC/FID	NJDEP EPH 10/08, Rev.3	C12 to C16 Aromatics
GC/FID	NJDEP EPH 10/08, Rev.3	C16 to C21 Aromatics
GC/FID	NJDEP EPH 10/08, Rev.3	C21 to C40 Aromatics
GC/FID	NJDEP EPH 10/08, Rev.3	Total Aromatics
GC/FID	NJDEP EPH 10/08, Rev.3	Total EPH
GC/ECD	EPA 8081B	4,4`-DDD
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	alpha Chlordane
GC/ECD	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	gamma Chlordane
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Heptachlor
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 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Picloram
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	DCPA (Dacthal)
GC/ECD	EPA 8151A	Dichlorobenzoic acid (3,5-)
GC/ECD	EPA 8151A	Dichlorprop

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Nitrophenol (4-)
GC/ECD	EPA 8151A	Pentachlorophenol
GC/FID	EPA 8015D	Diesel range organics (DRO)
GC/FID	EPA 8015D	GRO
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	1,1,2-Trichlorotrifluoroethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,1-Dichloroethylene
GC/MS	EPA 8260C	1,1-Dichloropropene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,2-Dichloroethane
GC/MS	EPA 8260C	1,2-Dichloropropane
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	1,4-Dichlorobenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	2,2-Dichloropropane
GC/MS	EPA 8260C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acrolein (Propenal)
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	m+p-xylene
GC/MS	EPA 8260C	o-xylene
GC/MS	EPA 8260C	cis-1,2-Dichloroethylene
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	Dibromochloromethane

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	p-Dioxane
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	tert-butyl alcohol
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	trans-1,2-Dichloroethylene
GC/MS	EPA 8260C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260C	Trichlorofluoromethane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	Xylene (total)
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Diethyl Ether
GC/MS	EPA 8260C	Diisopropyl ether
GC/MS	EPA 8260C	Hexachloroethane
GC/MS	EPA 8260C	Isopropyl Acetate
GC/MS	EPA 8260C	Methyl Acetate
GC/MS	EPA 8260C	Methyl Iodide
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,2-Diphenylhydrazine
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D	2-Chloronaphthalene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methyl-4,6-dinitrophenol
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D	3+4-Methylphenol
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(g,h,i)perylene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	Diphenylamine
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Butylbenzylphthalate
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	1,4-Dioxane
GC/MS	EPA 8270D	1,1’-Biphenyl
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D SIM	1,4-Dioxane
GC/MS	EPA 8270D SIM	2-Methylnaphthalene
GC/MS	EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D SIM	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D SIM	Fluoranthene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D SIM	Pyrene
Colorimetric	EPA 9012B	Total cyanide
CVAA	EPA 7471B	Mercury
Gravimetric	EPA 9071B	Oil & Grease
Colorimetric	HACH 8146	Ferrous Iron
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	O-phosphate
IC	EPA 9056A	Sulfate
ICP	EPA 6010D	Aluminum
ICP	EPA 6010D	Antimony
ICP	EPA 6010D	Arsenic
ICP	EPA 6010D	Barium
ICP	EPA 6010D	Beryllium
ICP	EPA 6010D	Boron
ICP	EPA 6010D	Cadmium
ICP	EPA 6010D	Calcium
ICP	EPA 6010D	Chromium
ICP	EPA 6010D	Cobalt
ICP	EPA 6010D	Copper

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	EPA 6010D	Iron
ICP	EPA 6010D	Lead
ICP	EPA 6010D	Magnesium
ICP	EPA 6010D	Manganese
ICP	EPA 6010D	Molybdenum
ICP	EPA 6010D	Nickel
ICP	EPA 6010D	Potassium
ICP	EPA 6010D	Selenium
ICP	EPA 6010D	Silicon
ICP	EPA 6010D	Silver
ICP	EPA 6010D	Sodium
ICP	EPA 6010D	Thallium
ICP	EPA 6010D	Tin
ICP	EPA 6010D	Titanium
ICP	EPA 6010D	Vanadium
ICP	EPA 6010D	Zinc
ICP-MS	EPA 6020B	Aluminum
ICP-MS	EPA 6020B	Antimony
ICP-MS	EPA 6020B	Arsenic
ICP-MS	EPA 6020B	Barium
ICP-MS	EPA 6020B	Beryllium
ICP-MS	EPA 6020B	Boron
ICP-MS	EPA 6020B	Cadmium
ICP-MS	EPA 6020B	Calcium
ICP-MS	EPA 6020B	Chromium
ICP-MS	EPA 6020B	Cobalt
ICP-MS	EPA 6020B	Copper

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020B	Iron
ICP-MS	EPA 6020B	Lead
ICP-MS	EPA 6020B	Magnesium
ICP-MS	EPA 6020B	Manganese
ICP-MS	EPA 6020B	Molybdenum
ICP-MS	EPA 6020B	Nickel
ICP-MS	EPA 6020B	Potassium
ICP-MS	EPA 6020B	Selenium
ICP-MS	EPA 6020B	Silicon
ICP-MS	EPA 6020B	Silver
ICP-MS	EPA 6020B	Sodium
ICP-MS	EPA 6020B	Thallium
ICP-MS	EPA 6020B	Tin
ICP-MS	EPA 6020B	Titanium
ICP-MS	EPA 6020B	Vanadium
ICP-MS	EPA 6020B	Zinc
ICP/Titrimetric	Chemtech SOP M-AVS	AVS/SEM
pH Paper	EPA 9041A	pH
Probe	EPA 9045C	pH
ISE	EPA 9040C	pH/Corrosivity
TOC	EPA 9060 Mod/ 9060A Mod	Total organic carbon
TOC	Lloyd Kahn Method	Total organic carbon
Physical	EPA 1010A	Ignitability
Titrimetric	EPA 9034	Sulfide
Turbidimetric	EPA 9038	Sulfate
Physical	EPA 9095A/B	Paint Filter Liquids Test

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
UV/VIS	EPA 7196A	Chromium VI
UV/VIS	EPA 9012B	Total cyanide
UV/VIS	EPA 9065	Total phenolics
Preparation	**Method**	**Type**
Preparation	EPA 3060A	Chromium VI
Distillation	EPA 9010C	Total cyanide
Distillation	EPA 9013	Total cyanide
Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
Preparation	EPA 1312	SPLP
Organic Preparation	EPA 3541	Automated Soxhlet Extraction
Clean Up	EPA 3620C	Florisil Cleanup
Clean Up	EPA 3630C	Silica Gel Cleanup
Clean Up	EPA 3640A	Gel-Permeation Cleanup
Clean Up	EPA 3660	Sulfur Cleanup
Clean Up	EPA 3665A	Sulfuric Acid Permanganate Cleanup
Inorganics Preparation	EPA 3050B	Hotblock
Volatile Organics Preparation	EPA 5035A	Closed System Purge and Trap
Organic Preparation	EPA 3580A	Waste dilution
Distillation	EPA 9030B	Sulfide
Extraction/Titrimetric	EPA 9031	Sulfide
Soxhlet	EPA 3540C	Extraction Preparation Method

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. L2219.

R.D.

Vice President

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

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ENVIRONMENTAL

Valid To: December 31, 2020 Certificate Number: 2936.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, ISO IEC 17025:2017, the 2009 TNI Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.1 of the DoD Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP/MS, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, LC/MS/MS, Ion Chromatography, Misc.- Electronic Probes (pH, O_2), Oxygen Demand, Hazardous Waste Characteristics Tests, Spectrophotometry (Visible), Spectrophotometry (Automated), Titrimetry, Total Organic Carbon

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Metals		
Aluminum	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C
Antimony	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Arsenic	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Barium	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Beryllium	EPA 200.8 EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C EPA 6020/6020A/6020B
Boron	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Cadmium	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Calcium	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C
Chromium	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Cobalt	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Copper	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Iron	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C
Lead	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Lithium	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C
Magnesium	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C
Manganese	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Mercury	EPA 245.1 EPA 7470A	EPA 7471A/7471B
Molybdenum	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C
Nickel	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Phosphorus	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C
Potassium	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C
Selenium	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Silicon	EPA 200.7 EPA 6010B/6010C	------------------------------------
Silver	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Sodium	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C
Strontium	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Thallium	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Tin	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C
Titanium	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C
Thorium	EPA 200.8 EPA 6020/6020A/6020B	
Uranium	EPA 200.8 EPA 6020/6020A/6020B	EPA 6020/6020A/6020B
Vanadium	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Zinc	EPA 200.7/200.8 EPA 6010B/6010C EPA 6020/6020A/6020B	EPA 6010B/6010C EPA 6020/6020A/6020B
Zirconium	EPA 200.7 EPA 6010B/6010C	EPA 6010B/6010C
Prep Methods	EPA 3015A	EPA 3051A
Nutrients		
Ammonia (as N)	EPA 350.1	EPA 350.1
Kjeldahl nitrogen	EPA 351.2	-----------------------------------
Nitrate (as N)	EPA 300.0 EPA 353.2 EPA 9056/9056A SM 4500NO_3-F	EPA 300.0 EPA 9056/9056A
Nitrate-nitrite (as N)	EPA 300.0/353.2/9056/9056A SM 4500NO_3-F	EPA 9056/9056A
Nitrite (as N)	EPA 300.0 EPA 354.1 EPA 9056/9056A	EPA 300.0 EPA 9056/9056A
Orthophosphate (as P)	EPA 365.2 SM 4500-P E-1999/2011	EPA 365.2
Total Phosphorus	EPA 365.4	-----------------------------------
Demands		
Biochemical Oxygen Demand	SM 5210 B-2001/2011	-----------------------------------
Chemical Oxygen Demand	EPA 410.4MOD HACH 8000	-----------------------------------
Total Organic Carbon	EPA 415.1/9060A SM 5310 C-2000/2011	-----------------------------------
Wet Chemistry		
Acidity	EPA 415.1-9060A SM 2310B-1997/2011 (4a/d)	-----------------------------------
Alkalinity	EPA 310.2 SM 2320 B-1997/2011	-----------------------------------
Bromide	EPA 300.0 EPA 9056/9056A	EPA 300.0 EPA 9056/9056A

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Chloride	EPA 300.0 EPA 325.2 EPA 9056/9056A SM 4500-CL E-2011	EPA 325.2 EPA 9056/9056A SM 4500-CL E-1997/2011
Chlorine, Residual	SM 4500Cl-G 2000/2011	-----------------------------------
Conductivity	EPA 120.1 SM 2510B-1997/2011	-----------------------------------
Cyanide	EPA 9010C EPA 9014 SM 4500 CN-C,E-1999/2011	EPA 9010C EPA 9014
Cyanide, Amenable	EPA 9010C EPA 9014 SM 4500 CN-G/E	EPA 9010C EPA 9014
Ferrous Iron	SM 3500-Fe B-2011	-----------------------------------
Filterable Residue	EPA 160.1 SM 2540 C-2011	-----------------------------------
Flashpoint	EPA 1010A	EPA 1010A EPA 1030
Fluoride	EPA 300.0 EPA 9056/9056A SM 4500 F,C-2011	EPA 300.0 EPA 9056/9056A SM 4500 F,C-1997/2011
Hardness	EPA 130.2 SM 2340C-2011	-----------------------------------
Hexavalent Chromium	EPA 7196A SM 3500-Cr B-2011	EPA 3060A EPA 7196A SM 3500-Cr B -2011
MBAS	SM 5540C-2000/2011	-----------------------------------
Nitrate as N	EPA 300.0	--
Nitrite as N	EPA 300.0	--
Nonfilterable Residue	EPA 160.2 SM 2540 D-1997/2011	-----------------------------------
Total Residue	EPA 160.3 SM2540 B, G-1997	--
Total Volatile Residue	EPA 160.4 SM 2540 E, G-2011	--
Oil and Grease	EPA 1664A/1664B	EPA 9071
Osmotic Pressure	PA-DEP 391-2000-008	-----------------------------------
pH	EPA 9040C SM 4500-H$^+$ B-2000/2011	EPA 9040C EPA 9045D
Percent Solids / Moisture	---	ASTM D2216-10
Phenols	EPA 420.1	EPA 420.1
Sulfate	EPA 300.0 EPA 375.4 EPA 9056/9056A SM 4500 SO4 E-2011	EPA 300.0 EPA 375.4 EPA 9056/9056A SM 4500 SO4 E-2011
Sulfide	EPA 376.1 SM 4500-S F-2000/2011	EPA 9030B EPA 9034
TOC	SM 5310C	-----------------------------------
Turbidity	EPA 180.1 SM 2130B-2011	-----------------------------------

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Purgeable Organics (Volatiles)		
Acetone	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Acetonitrile	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Acrolein	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Acrylonitrile	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Allyl chloride	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
T-amylmethylether	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Benzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Bromobenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Bromochloromethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Bromodichloromethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Bromoform	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Bromomethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,3-Butadiene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
2-Butanone	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
n-Butyl alcohol	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
tert-Butyl alcohol	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
n-Butylbenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
sec-Butylbenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
tert-Butylbenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Carbon Disulfide	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Carbon Tetrachloride	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Chloroacetonitrile	EPA 8260B	EPA 8260B
Chlorobenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1-Chlorobutane	EPA 8260B	EPA 8260B
Chloroethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C

2-Chloroethyl Vinyl Ether	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Chloroform	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Chloroprene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1-Chlorohexane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Chloromethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
2-Chlorotoluene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
4-Chlorotoluene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Cyclohexane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Cyclohexanone	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Dibromochloromethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Dibromofluoromethane *Surrogate	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,2-Dibromo-3-chloropropane (DBCP)	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Dibromomethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,2-Dibromomethane (EDB)	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,2-Dichlorobenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,3-Dichlorobenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,4-Dichlorobenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
trans-1,4-Dichloro-2-butene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Dichlorodifluoromethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,1-Dichloroethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,2-Dichloroethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,1-Dichloroethene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
cis-1,2-Dichloroethene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
trans-1,2-Dichloroethene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,2-Dichloropropane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
1,3-Dichloropropane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
2,2-Dichloropropane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,1-Dichloropropene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
cis-1,3-Dichloropropene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
trans-1,3-Dichloropropene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Diethyl Ether	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Di-isopropyl Ether	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Dimethyldisulfide	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Dimethyl Sulfide	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,4-Dioxane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Ethyl Acetate	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Ethyl-t-butyl Ether	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Ethyl Methacrylate	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Ethyl Benzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Gas Range Organics (GRO)	EPA 8015B /8015C/8015D OK-GRO	EPA 8015B/8015C/8015D OK-GRO
2-Hexanone	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Hexachlorobutadiene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Hexachloroethane	EPA 8260B	EPA 8260B
n-Hexane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Isoprene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Isopropylbenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,4-Isopropyltoluene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Iodomethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Isobutyl Alcohol	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Methacrylonitrile	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Methyl Acetate	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Methylcyclohexane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Methyl Methacrylate	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
alpha-Methylstyrene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Methyl Tert-Butyl Ether	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Methylene Chloride	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
4-Methyl-2-pentanone	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Naphthalene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
2-Nitropropane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
n-Propylbenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Propionitrile	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Styrene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,1,1,2-Tetrachloroethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,1,2,2-Tetrachloroethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Tetrachloroethene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Tetrahydrofuran	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Toluene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,1,1-Trichloroethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,1,2-Trichloroethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Trichloroethene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Trichlorofluoromethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,2,3-Trichlorobenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,2,3-Trichloropropane	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,2,4-Trichlorobenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
1,2,4-Trimethylbenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,3,5-Trimethylbenzene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Vinyl Acetate	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Vinyl Chloride	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Xylenes, Total	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,2-Xylene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,3-Xylene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
1,4-Xylene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
m,p-Xylene	EPA 624/624.1 EPA 8260B/8260C	EPA 8260B/8260C
Prep Methods	EPA 5030B/5030C EPA 5035/5035A	EPA 5035/5035A
Alcohol Organics		
2-Hexanone	EPA 8015C	EPA 8015C
Butanol	EPA 8015C	EPA 8015C
Ethanol	EPA 8015C	EPA 8015C
Isobutyl Alcohol	EPA 8015C	EPA 8015C
Isopropyl Alcohol	EPA 8015C	EPA 8015C
Methanol	EPA 8015C	EPA 8015C
Propanol	EPA 8015C	EPA 8015C
Headspace Organics		
n-Butane	EPA 5021/RSK175	-----------------------------------
Carbon dioxide	EPA 5021/RSK175	-----------------------------------
Methane	EPA 5021/RSK175	-----------------------------------
Ethane	EPA 5021/RSK175	-----------------------------------
Ethene	EPA 5021/RSK175	-----------------------------------
Propane	EPA 5021/RSK175	-----------------------------------
Acetylene	EPA 5021/RSK175	-----------------------------------
Acenaphthene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Acenaphthylene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Acetophenone	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2-Acetylaminofluorene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
4-Aminobiphenyl	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Aniline	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Anthracene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Aramite	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Atrazine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Benzidine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Benzoic acid	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Benzo (a) anthracene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Benzo (b) fluoranthene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Benzo (k) fluoranthene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Benzo (g,h,i) perylene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Benzo (a) pyrene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Benzyl Alcohol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Benzaldehyde	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Biphenyl	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Bis(2-chloroethoxy) Methane	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Bis (2-chloroethyl) Ether	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Bis(2-chloroisopropyl) Ether	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Bis (2-ethylhexyl) Phthalate	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
4-Bromophenylphenylether	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Butyl benzyl Phthalate	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Caprolactam	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Carbazole	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
4-Chloroaniline	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Chlorobenzilate	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
4-Chloro-3-methylphenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
1-Chloronaphthalene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2-Chloronaphthalene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2-Chlorophenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
4-Chlorophenylphenyl Ether	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Chrysene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Cresols	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Diallate	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Dibenzo (a,c) anthracene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Dibenzo (a,h) anthracene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Dibenzofuran	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
1,2-Dichlorobenzene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
1,3-Dichlorobenzene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
1,4-Dichlorobenzene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
3,3’-Dichlorobenzidine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dichlorophenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2,6-Dichlorophenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Diethyl Phthalate	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Dimethoate	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
4-Dimethylaminoazobenzene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
7,12-Dimethylbenz(a)anthracene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
3,3’-Dimethylbenzidine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D

Parameter/Analyte	Non-potable Water (1)	Solid and Chemical Materials (2)
Alpha,alpha-dimethylphenethylamine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dimethylphenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Dimethyl Phthalate	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Di-n-butyl Phthalate	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Di-n-octyl Phthalate	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dinitrophenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dinitrotoluene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2,6-Dinitrotoluene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
1,4-Dioxane	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Diphenylamine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
1,2-Diphenylhydrazine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Disulfoton	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
DRO/ORO	EPA 8015B/8015C/8015D OK-DRO	EPA 3546/8015B/8015C/8015D OK-DRO
Ethyl Methanesulfonate	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Ethyl parathion	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Famphur	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Fluoroanthene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Fluorene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Hexachlorobenzene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Hexachlorobutadiene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Hexachlorocyclopentadiene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Hexachloroethane	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Hexachlorophene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Hexachloropropene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Indeno (1,2,3-cd) pyrene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Isodrin	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Isophorone	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Isosafrole	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Kepone	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Methapyrilene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
3-Methylcholanthrene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2-Methyl-4,6-dinitrophenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Methyl Methanesulfonate	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
1-Methylnaphthalene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
2-Methylnaphthalene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Methyl Parathion	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2-Methyl Phenol	EPA 625 EPA 8270C/8270D	EPA 8270C/8270D
3,4-Methyl Phenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Naphthalene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
1,4-Naphthoquinone	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
1-Naphthylamine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2-Naphthylamine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2-Nitroaniline	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
3-Nitroaniline	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
4-Nitroaniline	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Nitrobenzene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
5-Nitro-o-toluidine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2-Nitrophenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
4-Nitrophenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Nitroquinoline-1-oxide	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
n-Nitrosodiethylamine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
n-Nitrosodimethylamine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
n-Nitroso-di-n-butylamine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
n-Nitrosodi-n-propylamine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
n-Nitrosodiphenylamine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
n-Nitrosomethylethylamine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
n-Nitrosomorpholine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
n-Nitrosopiperidine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
n-Nitrosopyrrolidine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Pentachlorobenzene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Pentachloroethane	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Pentachloronitobenzene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Pentachlorophenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Perylene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Phenacetin	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Phenanthrene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Phenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
1,4-Phenylenediamine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Phorate	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2-Picoline	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Pronamide	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Pyrene	EPA 625/625.1 EPA 8270C/8270D EPA 8270C SIM/8270D SIM	EPA 8270C/8270D EPA 8270C SIM/8270D SIM
Pyridine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Safrole	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Sulfotepp	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
1,2,4,5-Tetrachlorobenzene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2,3,4,6-Tetrachlorophenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
o,o,o-Triethyl Phosphorothioate	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Thionazin	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
1,2,4-Trichlorobenzene	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2,4,5-Trichlorophenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
2,4,6-Trichlorophenol	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
o-Toluidine	EPA 625/625.1 EPA 8270C/8270D	EPA 8270C/8270D
Prep Methods	EPA 3510C/3520C	EPA 3550B/3550C EPA 3580A EPA 3546
Pesticides/Herbicides/PCB		
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011	-----------------------------------
1,2-Dibromomethane (EDB)	EPA 8011	-----------------------------------
Aldrin	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
alpha-BHC	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
beta-BHC	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
delta-BHC	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
gamma-BHC	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
Chlordane (technical)	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
alpha-chlordane	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
gamma-chlordane	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
4,4’-DDD	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
4,4’-DDE	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
4,4’,-DDT	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
Dieldrin	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
Endosulfan I	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
Endosulfan II	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
Endonsulfan Sulfate	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
Endrin	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
Endrin Aldehyde	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
Endrin Ketone	EPA 8081A/8081B	EPA 8081A/8081B
Heptachlor	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
Heptachlor Epoxide	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
Methoxychlor	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
Mirex	EPA 608/608.3	
Toxaphene	EPA 608/608.3 EPA 8081A/8081B	EPA 8081A/8081B
PCB-1016 (aroclor)	EPA 608/608.3 EPA 8082/8082A	EPA 8082/8082A
PCB-1221	EPA 608/608.3 EPA 8082/8082A	EPA 8082/8082A
PCB-1232	EPA 608/608.3 EPA 8082/8082A	EPA 8082/8082A
PCB-1242	EPA 608/608.3 EPA 8082/8082A	EPA 8082/8082A
PCB-1248	EPA 608/608.3 EPA 8082/8082A	EPA 8082/8082A
PCB-1254	EPA 608/608.3 EPA 8082/8082A	EPA 8082/8082A
PCB-1260	EPA 608/608.3 EPA 8082/8082A	EPA 8082/8082A
PCB-1262	EPA 8082/8082A	EPA 8082/8082A
PCB-1268	EPA 8082/8082A	EPA 8082/8082A
Prep Methods	EPA 3510C	EPA 3550B/3550C/3546/3580A
Acifluorfen	EPA 8151A	EPA 8151A
Bentazon	EPA 8151A	EPA 8151A
Chloramben	EPA 8151A	EPA 8151A
2,4-D	EPA 8151A	EPA 8151A
3,5-Dichlorobenzoic acid	EPA 8151A	EPA 8151A

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Dalapon	EPA 8151A	EPA 8151A
2,4-DB	EPA 8151A	EPA 8151A
Dicamba	EPA 8151A	EPA 8151A
Dichloroprop	EPA 8151A	EPA 8151A
Dinoseb	EPA 8151A	EPA 8151A
MCPA	EPA 8151A	EPA 8151A
MCPP	EPA 8151A	EPA 8151A
Pentachlorophenol	EPA 8151A	EPA 8151A
Picloram	EPA 8151A	EPA 8151A
2,4,5-T	EPA 8151A	EPA 8151A
2,4,5-TP	EPA 8151A	EPA 8151A
HPLC		
1,3,5-Trinitrobenzene	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
1,3-Dinitrobenzene	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
2,4,6-Trinitrotoluene	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
2,4-Dinitrotoluene	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
2,6-Dinitrotoluene	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
2-Amino-4,6-dinitrotoluene	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
2-Nitrotoluene	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
3-Nitrotoluene	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
4-Amino-2,6-dinitrotoluene	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
4-Nitrotoluene	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
Nitrobenzene	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
Nitroglycerin	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
HMX	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
PETN	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
RDX	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
Tetryl	EPA 8330B/8330A(modified)	EPA 8330B/8330A(modified)
Prep Methods	EPA 3535A	----------------------------------
Formaldehyde	EPA 8315A	EPA 8315A
Acetaldehyde	EPA 8315A	EPA 8315A
Proponal	EPA 8315A	EPA 8315A
Acetic acid	830MBA	-----------------------------------
Butyric acid	830MBA	-----------------------------------
Lactic acid	830MBA	-----------------------------------
Propionic acid	830MBA	-----------------------------------
Pyruvic acid	830MBA	-----------------------------------
Acetate	AOAC 986.13	-----------------------------------
Formate	AOAC 986.13	-----------------------------------
Hazardous Waste Characteristics		
Corrosivity	EPA 9040C	EPA 9040C/9045D
Ignitibility	EPA 1010A	EPA 1010A EPA 1030
Reactive cyanide	EPA SW 846 Ch 7 7.3.3.2-1996	EPA SW 846 Ch 7 7.3.3.2-1996
Reactive sulfide	EPA SW 846 Ch 7 7.3.4.2-1996	EPA SW 846 Ch 7 7.3.4.2-1996
Synthetic precipitation leaching procedure (SPLP)	EPA 1312	EPA 1312

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Toxicity characteristic leaching procedure (TCLP)	EPA 1311	EPA 1311
Water Leach	------------------------------------	ASTM D3987-06/85
Clean-Up		
----------------------------------	EPA 3620B	EPA 3620B
----------------------------------	EPA 3665A	EPA 3665A
----------------------------------	EPA 3630C	EPA 3630C
----------------------------------	EPA 3660B	EPA 3660B
LC/MS/MS		
Perchlorate	EPA 331/6850	EPA 6850
PFAS by LC/MS/MS		
N-Ethylperfluorooctanesufonamido acetic acid (N-EtFOSAA)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
N-Methylperfluorooctanesulfonamido acetic acid (N-MeFOSAA)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
6:2 Fluorotelomersulfonate (6:2FTS)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
8:2 Fluorotelomersulfonate (8:2FTS)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluorotetradecanoic acid (PFTeDA)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluorododecanoic acid (PFDoA)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluoroundecanoic acid (PFUdA)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluorodecanoic acid (PFDA)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluorononanoic acid (PFNA)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluoroheptanoic acid (PFHpA)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluorooctane sulfonate (PFOS)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluorohexane sulfonate (PFHxS)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluorobutane sulfonate (PFBS)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluorooctanoic acid (PFOA)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluorohexanoic acid (PFHxA)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluoropentanoic acid (PFPeA)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluorobutyric acid (PFBA)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------
Perfluoroheptane sulfonic Acid (PFHpS)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	------------------------------------

Parameter/Analyte	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Perfluorodecane sulfonate (PFDS)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	-----------------------------------
Perfluorotridecanoic acid (PFTrDA)	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	-----------------------------------

Parameter/Analyte	**Potable Water**	**Non-potable Water (1)**	**Solid and Chemical Materials (2)**
Radiochemistry			
Gross alpha	EPA 900.0	EPA 900.0	EPA 900.0
Gross beta	EPA 900.0	EPA 900.0	EPA 900.0
Ra-226	EPA 903.0	EPA 903.0	EPA 903.0
Ra-228	EPA 904.0	EPA 9320/904.0	EPA 9320/904.0
Gamma emitters	EPA 901.1	EPA 901.1	EPA 901.1
Total alpha	----------------	EPA 900.0/9310	EPA 900.0/9310
Total beta	----------------	EPA 900.0/9310	EPA 900.0/9310
Total radium	----------------	EPA 903.0/9315	EPA 903.0/9315

(1) Method List includes Clean Water Act and RCRA water parameters.
(2) Method List includes RCRA parameters only.

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2009 TNI Standard, accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Parameter/Analyte	**Potable Water**
Metals	
Aluminum	EPA 200.7
Antimony	EPA 200.8
Arsenic	EPA 200.7/200.8
Barium	EPA 200.7/200.8
Beryllium	EPA 200.7/200.8
Boron	EPA 200.7
Cadmium	EPA 200.7/200.8
Calcium	EPA 200.7
Chromium	EPA 200.7/200.8
Cobalt	EPA 200.7/200.8
Copper	EPA 200.7/200.8
Iron	EPA 200.7
Lead	EPA 200.7/200.8
Lithium	EPA 200.7
Magnesium	EPA 200.7
Manganese	EPA 200.7/200.8
Mercury	EPA 245.1
Molybdenum	EPA 200.7
Nickel	EPA 200.7/200.8
Potassium	EPA 200.7
Selenium	EPA 200.7/200.8
Silver	EPA 200.7/200.8
Sodium	EPA 200.7

Parameter/Analyte	**Potable Water**
Strontium	EPA 200.7
Thallium	EPA 200.8
Uranium	EPA 200.8
Vanadium	EPA 200.7
Zinc	EPA 200.7/200.8
Wet Chemistry	
Alkalinity	EPA 310.1
Bromide	EPA 300.0
Chloride	EPA 300.0 EPA 325.2 SM 4500-Cl-E
Conductivity	SM 2510B
Dissolved Methane	RSK 175
Hardness	SM 2340B
MBAS	SM 5540C
Nitrate	EPA 300.0 EPA 353.2 SM 4500-NO$_3$-F
pH	EPA 150.1 SM 4500-H+B
TOC	SM 5310C
Total Dissolved Solids	EPA 160.1 SM 2540C
Total Suspended Solids	EPA 160.2 SM 2540D
PFAS by LC/MS/MS	
N-Ethylperfluorooctanesufonamido acetic acid (N-EtFOSAA)	EPA 537
N-Methylperfluorooctanesulfonamido acetic acid (N-MeFOSAA)	EPA 537
Perfluorobutane sulfonate (PFBS)	EPA 537
Perfluorodecanoic acid (PFDA)	EPA 537
Perfluorododecanoic acid (PFDoA)	EPA 537
Perfluoroheptanoic acid (PFHpA)	EPA 537
Perfluorohexane sulfonate (PFHxS)	EPA 537
Perfluorohexanoic acid (PFHxA)	EPA 537
Perfluorononanoic acid (PFNA)	EPA 537
Perfluorooctane sulfonate (PFOS)	EPA 537
Perfluorooctanoic acid (PFOA)	EPA 537
Perfluorotetradecanoic acid (PFTA)	EPA 537
Perfluorotridecanoic acid (PFTrDA)	EPA 537
Perfluoroundecanoic acid (PFUnA)	EPA 537

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MICROBAC LABORATORIES, INC.
OHIO VALLEY DIVISION

Marietta, OH

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, ISO/IEC 17025:2017, the 2009 TNI Environmental Testing Laboratory Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.1 of the DoD Quality System Manual for Environmental Laboratories (QSM), accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated *April 2017*).

Presented this 21st day of December 2018.

1978
A2LA

Senior Director, Accreditation Services
For the Accreditation Council
Certificate Number 2936.01
Valid to December 31, 2020

For the tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

L1 - Analysis of Volatile Organic Analytes by Method 8260

STANDARD OPERATING PROCEDURES
ANALYSIS OF VOLATILE ORGANIC ANALYTES BY METHOD 8260

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1-10-19

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1.0 SCOPE AND APPLICATION

1.1 Microbac SOP MSV01 pertains to the determination of volatile organic compounds in solid and liquid matrices using purge and trap GC/MS. This method references USEPA SW846 Methods 8000D (July 2014), 8260B (December 1996), 8260D (June 2018), 5030C (May 2003), and 5035A (July 2002). SOP MSV01 applies to all volatile mass spectral analyses except where client specific Quality Assurance Project Plan's (QAPP) overrides this method's quality assurance plan.

1.2 Table 1 contains the target compound list for this method.

1.3 Appendix I contains suggested primary and secondary quantitation ions. Section 11.13 contains information regarding the analysis of wipe samples.

1.4 Definitions and Acronyms

The following is a list of terms, definitions, and acronyms referenced in this SOP that are unique to the method.

BFB	Bromofluorobenzene
BS	Blank Spike
BSD	Blank Spike Duplicate
CCV	Continuing calibration verification
DI water	Deionized water
GC	Gas Chromatography
GC/MS	Gas Chromatograph/Mass Spectrometer
HCl	Hydrochloric acid
ICAL	Initial calibration
ICV	Initial calibration verification
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
LIMS	Laboratory Information System
LOD	Limit of Detection
LOQ	Limit of Quantitation
MB	Method blank
MDL	Method detection limit
MS	Mass Spectrometer
MS	Matrix spike
MSD	Matrix spike duplicate
NCR	Nonconformance report
PFTBA	Perfluorotributylamine
PPE	Personal Protective Equipment

QC	Quality control
RGT	Reagent
RL/LLOQ	Reporting limit/lower limit of quantitation
RT	Retention time
SDS	Safety Data Sheets
SOP	Standard Operating Procedure
STD	Standard
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compounds

For a more comprehensive list of common terms and definitions, consult Appendix A in Microbac SOP LQAP.

2.0 SAFTY PRECAUTIONS

2.1 Standard laboratory safety procedures must be followed when working with unknown samples. Gloves must be worn while handling any chemicals, standards, or samples. Other required PPE includes lab coats and safety glasses with side shields.

2.2 **WARNING:** The following VOC's have been tentatively classified as known or suspected human or mammalian carcinogens:

benzene
carbon tetrachloride
chloroform
vinyl chloride

The toxicity or carcinogenicity of the other reagents and analytes used in this method have not been precisely defined, therefore, each chemical and sample must be treated as a potential health hazard and exposure reduced to the lowest possible level. Procedures involving primary standards and sample preparation shall be performed in a fume hood.

2.3 SDS for each analyte and reagent used within the laboratory are available to all employees. Consult SDSs prior to handling chemicals.

2.4 Thermal Hazards

Several zones on the GC are heated to high temperatures. Care must be exercised when working around these areas to avoid severe burns to the skin.

2.5 Broken Glassware Hazards

All dilutions that require the use of glassware must be made with care to reduce the possibility of cuts from broken glass. All broken or defective glassware must be disposed of in the broken glass container located in the laboratory.

3.0 SAMPLE PRESERVATION AND STORAGE

3.1 Pre-cleaned 40 mL glass screw-cap VOA vials with Teflon-faced silicone septa must be used for both liquid and solid matrices utilizing methods 5030 and 5035. Soil samples not utilizing Method 5035 must be collected in 125 mL pre-cleaned glass screw cap jars with teflon-lined lids. Soil samples collected via 5035 must also be collected in Encore (or equivalent) containers then transferred to 40 mL VOA vials for analysis. Refer to Microbac SOP PAT01 for additional requirements.

3.2 Water samples preserved with HCl (pH < 2) must be analyzed within 14 days of sample collection. Unpreserved water samples (pH ≥ 2) must be analyzed within 7 days of sample collection. Waste, soil, and sludge samples do not require the addition of preservative but must be stored at 0 to 6° C. Solid samples utilizing Method 5035 require preservation if analysis cannot be performed within 48 hours of collection. Waste, soil, oil, and sludge samples have a holding time of fourteen days from the date of collection. Soil samples collected in wide mouth bottles, are stored at 0 to 6° C. Samples collected via 5035 must be stored at -10° C to -20° C. Concentrated waste, oil, soil, sludge, or any other matrix can be stored in an ambient location segregated from low-level environmental samples.

3.3 Sample hold time is defined as time elapsed from sample collection date and time to sample analysis date and time.

3.4 Samples are stored in assigned locations until expiration of hold times. After hold-time expiration, samples are removed from storage refrigerators and returned to sample archive. Samples requiring internal chain-of-custody are returned to the sample receiving custodian.

3.5 Temperature logs are maintained for all refrigerator and freezer storage units. Refer to Microbac SOP GP-TEMP-SSU for temperature monitoring of sample storage units.

3.6 Sample preservation should be 0 to 6°C. Samples exceeding the upper temperature limit are to be flagged CT1.

4.0 METHOD PERFORMANCE

4.1 Table 2 summarizes the performance data for water analysis; Table 3 summarizes performance data for soil/solid waste analysis. These tables include the analyte list, ranges for accuracy and precision, current laboratory MDL, nominal laboratory RLs/LLOQs, true values, and suggested calibration range.

4.2 The laboratory performed an initial assessment of the MDL using the procedures outlined in 40 CFR Part 136. Results are filed electronically at H:\DATA\COMMON\MDL.

4.3 The LOD, or verified MDL, are presented in Tables 2 and 3 were established using verification procedures outlined in Microbac SOP 45.

4.4 The LOQ are the nominal laboratory RLs/LLOQs and were established per Microbac SOP 45. Actual project RLs/LLOQs may be higher. The LLOQ is verified quarterly by analysis of duplicate samples spiked at 0.5-2 times the established LLOQ. The verification is performed per instrument and in both solid and aqueous matrices. The recovery of target analytes should be within the LCS criteria ±20%.

4.5 Precision and accuracy data were derived from an initial demonstration of capability using spiked control samples. The laboratory uses results from LCS to assess precision/accuracy and to annually evaluate the associated control limits.

4.6 Other specific QA objectives may be found in the appropriate Statement-of-Work or QAPP.

4.7 All new analysts are certified in the methodology by performing a successful initial demonstration of capability (DOC) using spiked control samples and assessing the resultant precision and accuracy data. Thereafter an on-going DOC must be performed annually to retain certification.

5.0 INTERFERENCES AND CORRECTIVE ACTION

5.1 Samples for volatile organics analyses are susceptible to laboratory contaminants (e.g.: methylene chloride, acetone, n-hexane). To eliminate the potential for interferences from other areas of the laboratory, the Volatiles Laboratory has an independent air intake system and positive air pressure is maintained in the laboratory.

5.2 Samples preserved with HCl or sodium bisulfate may result in the loss of 2-chloroethylvinylether as a target or spiked analyte due to its reactivity with the preservatives.

5.3 Soil analyses may result in low internal and/or surrogate standard recovery due to the poor purging efficiencies of some matrices. Reanalysis must be performed to confirm matrix interference.

5.4 Carry-over contamination may occur when a sample containing low levels of VOC's is analyzed immediately following a sample containing high levels of VOC's. If this situation occurs during a non-monitored analysis, the sample containing the low concentration VOC's may require reanalysis.

5.5 Samples may become contaminated by diffusion of volatile organics through the septum seal into the sample during shipment and storage. A trip blank prepared from organic-free reagent water and carried through the sampling, handling, and analysis steps serves as a check on such contamination.

5.6 Storage blanks are placed in refrigerator and freezer units used for the storage of samples for volatiles analysis. Refer to Section 13.0 for storage blank procedures.

6.0 EQUIPMENT AND SUPPLIES

6.1 GC/MS: Hewlett-Packard (HP), Agilent 6890 Gas Chromatograph equipped with HP, Agilent 5973 Mass Spectrometer, Agilent 7890 GC equipped with Agilent 5977 MSD.

Chemstation: HP, Agilent Eviroquant; Agilent Mass Hunter

6.2 Purge-and-trap: Tekmar liquid sample concentrator (LSC), 3000, Stratum; Varian, Archon auto-sampler; Tekmar Atomx liquid sample concentrator/ autosampler.

6.3 Top loading balance: Ohaus Navigator, Mettler PE600,

6.4 Capillary column: Restek 502.2: 60 m, 0.32 mm ID, 1.8 μm film thickness. Restek RTX-VMS: 20 m, 0.18 mm, 1 mm film thinkness.

6.5 Trap: Supelco Vocarb 3000; Tekmar trap #9.

6.6 Volumetric flask: Class A; 1 mL to 200 mL

6.7 Mininert vial with septum valve: 1 mL to 10 mL

6.8 40 mL VOA vial: I-Chem, Thermo Scientific

6.9 Syringe: Hamilton Gas tight with Luer lock tip: 25 mL, 5 mL; Gas tight with fixed needle: 10 uL, 25 uL, 50 uL, 100 uL, 250 uL, 500 uL, 1000 uL (Hamilton syringes accuracy: ±1% at or above 10% of syringe volume)

6.10 Steel and wooden spatulas

6.11 Disposable Pasteur pipets

6.12 Equivalent equipment and supplies may be used.

6.13 Refer to Table 4 for suggested GC/MS and purge-and-trap operating parameters.

6.14 Computer, software, hardware:

Instrument	Operation System	Computer Name	Connection Type	Instrument Software
HPMS6	Windows XP Professional	C10028	1 Gbps	Enviroquant Chemstation C.00.00
HPMS8	Windows 7	HPMS8	10/100 Mbps	Enviroquant Chemstation C.00.00
HPMS9	Windows XP Professional	HPMS9	10/100 Mbps	Enviroquant Chemstation C.00.00
HPMS11	Windows XP Professional	HPMS11	10/100 Mbps	Enviroquant Chemstation C.00.00
HPMS17	Windows 7 Professional	Microbac-HP	1 Gbps	Masshunter B.07.00; MSD Chemstation F.01.00.1903

7.0 STANDARDS AND REAGENTS

All purchased stock standards and reagents are logged into the LIMS system and assigned certificate of analysis (COA) numbers. All intermediate and working solutions are similarly logged into the LIMS and assigned STD or RGT numbers. Detailed information regarding solution concentrations, aliquot volumes and final volumes and concentrations are included under the STD or RGT number.

7.1 Primary calibration standards:

STANDARD	VENDOR	PART NUMBER	CONCENTRATION
502.2 Mega Mix with MTBE	Ultra	DWM-596	2000 ug/mL
Custom VOC Mix 3	Restek	567801	2000 ug/mL
2-Chloroethyl vinyl ether (2-CVE)	Ultra	EPA-1016	5000 ug/mL
Acrolein-Acrylonitrile Mix	Ultra	AMN-623	2000 ug/mL
Custom Concentrated Ketones #2	Restek	567523	2000 ug/mL
Vinyl Acetate	Restek	30216	2000 ug/mL
Custom 8260 VMS CCV ADDS Standard	Restek	569679	2000-4000 ug/mL
502.2 Mix #1	Restek	30042	2000 ug/mL
Freon 113	Restek	30462	2000 ug/mL
Mass. Oxygenates Standard	Supelco	21624806	2000-4000 ug/mL
1,3-Butadiene	Accustandard	S-406A-10X	2000 ug/mL
1-Bromopropane	Ultra	CUS-12711	10000 ug/mL

7.2 Primary internal and surrogate standard mixtures:

STANDARD	VENDOR	PART NUMBER	CONCENTRATION
Method 8260 Internal Standards	Ultra	STM-520	2500 ug/mL (fluorobenzene, chlorobenzene-d5, 1,4-dichlorobenzene-d4)
Method 8260 Surrogate Standard Mixture	Ultra	STM-530	2500 ug/mL (dibromofluorobenzene, 1,2-dichloroethane-d4, toluene-d8, 4-bromofluorobenzene)

7.3 Primary laboratory control sample (LCS) / matrix spike (MS), alternate source (ICV) standards:

STANDARD	VENDOR	PART NUMBER	CONCENTRATION
Volatile Organic Compound (VOC) Mixture	Accustandard	M-502A-R-PAK	200 ug/mL
Volatile Organic Compounds (VOC) Additional Mixture 8260 Calibration Mix 2	Supelco	21678315	200 ug/mL
Ma. Oxygenates Standard	CPI	Z-G34-120696-02	2000/4000 ug/mL
Gas Mix	CPI	Z-120313-02	2000 ug/mL
Vinyl Acetate	Accustandard	APP-9-211-20X	2000 ug/mL
Acrolein	Restek	30645	5000 ug/mL
1,3-Butadiene	Supelco	21696443	200 ug/mL
1-Bromopropane	Sigma-Aldrich	B78106-5mL	99%
Custom VMS LCS ADDS	Supelco	2195749	200-2000 ug/mL

NOTE: Source of LCS/MS/ICV standards different than primary calibration standards.

7.4 Primary 4-bromofluorobenzene (BFB) standard: Ultra STS-112, 2500 ug/mL

7.5 Intermediate calibration standards: Primary calibration standards diluted to prepare intermediate standards as follows:

INTERMEDIATE STANDARD	PRIMARY STANDARD	CONCENTRATION (ugmL)	VOLUME (uL)	FINAL VOLUME (mL methanol)	FINAL CONCENTRATION (ugmL)
VOA Mix 1	502.2 Mega Mix with MTBE	2000	500	5	200
	502.2 Calibration Mix #1	2000	500		
	Freon 113	2000	500		
VOA Mix 2	Custom Concentrated Ketones #2	2000	500	5	200
	2-Chlorethylvinyl ether (2-CVE)	5000	200		
VOA Mix 3	1,3-Butadiene	2000	500	5	200
	Custom VOC Mix 3	2000	500		
	1-Bromopropane	10000	100		
VOA Mix 4	Acrolein-Acrylonitrile Mix	2000	500	10	100-400
	MA Oxygentates Standard	2000-4000	1000		
Vinyl Acetate	Vinyl Acetate	2000	500	5	200

VMS Column

INTERMEDIATE STANDARD	PRIMARY STANDARD	CONCENTRATION (ugmL)	VOLUME (uL)	FINAL VOLUME (mL methanol)	FINAL CONCENTRATION (ugmL)
VOA Mix 1	502.2 Mega Mix with MTBE	2000	500	5	200
	Custom Standard (Gases)	2000	500		
VOA Mix 2	Custom Concentrated Ketones #2	2000	500	5	200
	2-Chlorethylvinyl ether (2-CVE)	5000	200		
VMS CCV STD	1,3-Butadiene	2000	500	5	200-400
	Acrolein-Acrylonitrile Mix	2000	500		
	Custom RTX-VMS Standard	200-400	500		
Vinyl Acetate	Vinyl Acetate	2000	500	5	200

7.6 Intermediate internal and surrogate standards preparation:

PRIMARY STANDARD	CONCENTRATION (ug/mL)	VOLUME (uL)	FINAL VOLUME (mL METHANOL)	FINAL CONCENTRATION (ug/mL)
Intermediate internal and surrogate standards	2500	1000	10	250

7.7 Intermediate LCS / MS / ICV standards prepared as follows:

INTERMEDIATE STANDARD	PRIMARY STANDARD	CONCENTRATION (ug/mL)	VOLUME (uL)	FINAL VOLUME (mL MEHTANOL)	FINAL CONCENTRATION (ug/mL)
Gases & Adds	Custom Gases	250	1800	10	20
	VOC Adds Mix	200	1000	10	20
Mega	VOC Mega Mix 1-Bromopropane Intermediate*	200 1000	1000 20	10 10	20 20
1,3-Butadiene and Vinyl Acetate Mix	Vinyl acetate	2000	100	10	20
	1,3-Butadiene	200	1000	10	20
Oxygenates LCS Mix	MA Oxygenates Acrolein	2000-4000 5000	500 200	10 10	100-200 100

1-Bromopropane Intermediate solution is prepared by diluting 0.1g of 99% 1-Bromopropane into 10mL of methanol.

VMS Column

INTERMEDIATE STANDARD	PRIMARY STANDARD	CONCENTRATION (ug/mL)	VOLUME (uL)	FINAL VOLUME (mL MEHTANOL)	FINAL CONCENTRATION (ug/mL)
8260 LCS Mix	VOC Mix	200	1000	10	20
	Custom Gases	250	800	10	20
VMS ADDS Mix	Custom VMS LCS ADDS	200-2000	500	5	20-200
1,3-Butadiene and Vinyl Acetate Mix	Vinyl acetate	2000	100	10	20
	1,3-Butadiene	200	1000	10	20
Acrolein Alt	Acrolein	5000	100	5	100

7.8 50 ug/mL BFB intermediate solution preparation:

PRIMARY STANDARD	CONCENTRATION (ug/mL)	VOLUME (uL)	FINAL VOLUME (mL METHANOL)	FINAL CONCENTRATION (ug/mL)
BFB Intermediate Solution	2000	125	5	50

7.9 Working standards preparation

7.9.1 Working standards used for initial calibration and calibration verification are prepared by diluting intermediate standards in DI water as follows:

Soil Initial Calibration Standards, ug/Kg(suggested preparation)

STOCK STANDARD, CONCENTRATION	WORKING STANDARDS CONCENTRATIONS (ug/Kg)								
	0.5	1 [5]	2 [25]	5 [50]	20 [80]	50* [100]	100 [200]	200	300 [300]
VOA Mix 1 (200 ug/mL)	N/A	N/A	N/A	N/A	5 uL	12.5uL	25 uL	50 uL	N/A
VOA Mix 2 (200 ug/mL)	N/A	N/A	N/A	N/A	5 uL	12.5uL	25 uL	50 uL	75 uL
VOA Mix 3 (200 ug/mL)	N/A	N/A	N/A	N/A	5 uL	12.5uL	25 uL	50 uL	75 uL
VOA Mix 4 (200-400 ug/mL)	N/A	2.5 uL	6.25 uL	12.5uL	20 uL	25 uL	50 uL	N/A	75 uL
20 ppm mix 1+2+3 Intermediate Std	2.5 uL	5 uL	5 uL	12.5uL	N/A	N/A	N/A	N/A	N/A
Surrogate Standard (20 ug/mL)	N/A	5 uL	5 uL	12.5uL	N/A	N/A	N/A	N/A	N/A
Surrogate Standard (200 ug/mL)	N/A	N/A	N/A	N/A	5 uL	12.5uL	25 uL	50 uL	75 uL
Final Volume, DI Water (mL)	100	100	50	50	50	50	50	50	50

20 ppm intermediate = Mix 1 + Mix 2 + Mix 3

$$\left(20\,ppm\ intermediate = 50uL\ Mix1 + 50uL\ Mix2 + 50uL\ Mix3 + 350uL\ MeOH\right)*$$

Denotes CCV

[ ] Denotes Oxygenates

Water Initial Calibration Standards, ug/L
(suggested preparation)

STOCK STANDARD, CONCENTRATION	WORKING STANDARDS CONCENTRATIONS (ug/L)									
	0.3	0.4	1 [5]	2 [25]	5 [50]	20 [80]	50* [100]	100 [200]	200	300 [300]
VOA Mix 1 (200 ug/mL)	N/A	N/A	N/A	N/A	N/A	5 uL	12.5 uL	25 uL	50 uL	N/A
VOA Mix 2 (200 ug/mL)	N/A	N/A	N/A	N/A	N/A	5 uL	12.5uL	25 uL	50 uL	75 uL
VOA Mix 3 (200 ug/mL)	N/A	N/A	N/A	N/A	N/A	5 uL	12.5uL	25 uL	50 uL	75 uL
VOA Mix 4 (200-400 ug/mL)	N/A	N/A	2.5 uL	6.25 uL	12.5uL	20 uL	25 uL	50 uL	N/A	75 uL
20 ppm mix 1+2+3 Intermediate Std	3 uL	2 uL	5 uL	5 uL	12.5uL	N/A	N/A	N/A	N/A	N/A
Surrogate Standard (10 ug/mL)	N/A	N/A	5 uL	5 uL	12.5uL	N/A	N/A	N/A	N/A	N/A
Surrogate Standard (100 ug/mL)	N/A	N/A	N/A	N/A	N/A	5 uL	12.5uL	25 uL	50 uL	75 uL
Final Volume, DI Water (mL)	200	100	100	50	50	50	50	50	50	50

20 ppm intermediate = Mix 1 + Mix 2 + Mix 3

$$\left(20ppm\ intermediate = 50uL\ Mix1 + 50uL\ Mix2 + 50uL\ Mix3 + 350uL\ MeOH\right)$$

* Denotes CCV
[ ] Denotes Oxygenates

7.9.2 Procedure for preparing working standard in volumetric flask: The appropriate volume of intermediate standard is injected into the expanded area of a volumetric flask containing DI water. The flask is adjusted to volume then inverted three times. An aliquot is transferred to a 5 mL Luer lock syringe or 40 mL VOA vial and placed on the autosampler.

7.9.3 Procedure for preparing standard in 5 mL Luer lock syringe: The volume of stock standard is injected into a 5 mL Luer lock syringe containing DI water.

7.10 Working standards used for LCS/MS/ICV are prepared by diluting intermediate standards in DI water as follows:

Water Analyses

STOCK STANDARD, CONCENTRATION	LCS/MS VOLUME (uL)	ICV VOLUME (uL)	FINAL VOLUME DI Water (mL)	LCS/MS FINAL CONCENTRATION (ug/L)	ICV FINAL CONCENTRATION (ug/L)
Gases & Adds (20 ug/mL)	50	125	50	20	50
Mega (20 ug/mL)	50	125	50	20	50
1,3-Butadiene Vinyl acetate (20 ug/mL)	50	125	50	20	50
Oxygenates (50-100 ug/mL)	50	50	50	100-200	100-200

Soil Analyses

STOCK STANDARD, CONCENTRATION	LCS/MS VOLUME (uL)	ICV VOLUME (uL)	FINAL VOLUME DI Water (mL)	LCS/MS FINAL CONCENTRATION (ug/Kg)	ICV FINAL CONCENTRATION (ug/Kg)
Gases & Adds (20 ug/mL)	5	12.5	5	20	50
Mega (20 ug/mL)	5	12.5	5	20	50
1,3-Butadiene Vinyl acetate (20 ug/mL)	5	12.5	5	20	50
Oxygenates (50-100 ug/mL)	5	5	5	100-200	100-200

7.11 50ng BFB: Prepared by diluting 10 uL of BFB intermediate solution in 50 mL of DI water then purging 5 mL (else 1 uL of BFB intermediate solution is injected into the GC injection port).

7.12 Purge and trap grade methanol: (Fisher Scientific)

7.13 Reagent water (ASTM Type II DI water, UV treated)

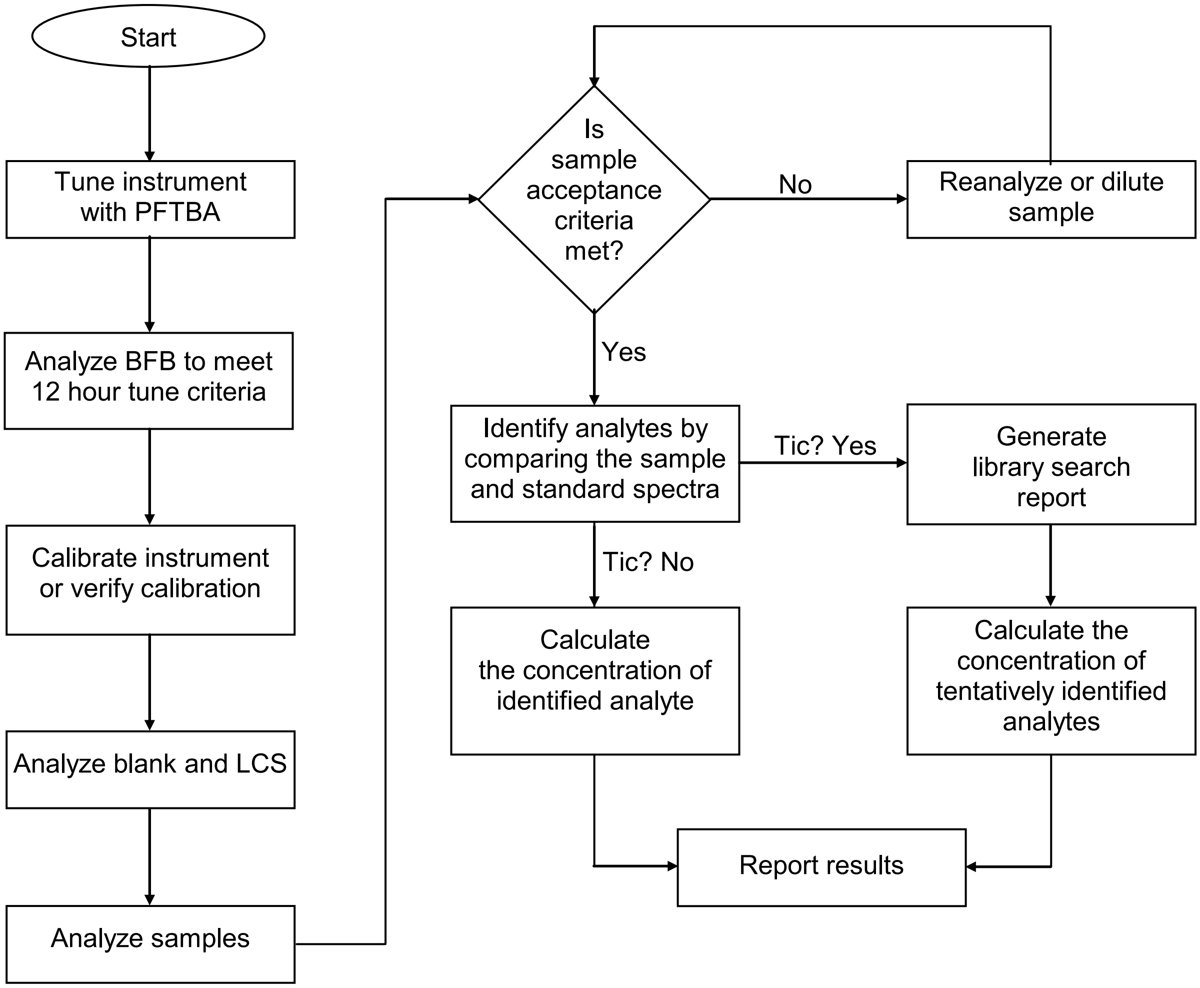
7.14 Purified Sand: J.T. Baker (Baked 150°C)

7.15 Concentration of calibration standards may vary depending on, but not limited to, availability, purity, and project requirements, therefore, recipes for standards preparation will be adjusted accordingly. Autosampler adds 1 uL of 250 ug/mL internal standards mixture.

7.16 Equivalent standards and reagents may be used.

7.17 Standards are stored at < 0°C or per manufacturer's instructions. Standards are stored in glass vials with Teflon-lined lids and/or mininert vials. Expiration dates for primary standards are per manufacturer's instructions; intermediate standards have a 30 day expiration date from the preparation date.

8.0 DIAGRAM OR TABLE TO OUTLINE PROCEDURES



9.0 SAMPLE PREPARATION

9.1 Purge-and-trap procedures are found in Microbac SOP PAT01 for 5030C and 5035A.

10.0 CALIBRATION PROCEDURES

10.1 The GC/MS is hardware-tuned via auto-tune or manual tune.

10.2 50ng of BFB is analyzed via direct inject or purging and the mass spectrum is compared to acceptance criteria in Table 5. Evaluation is performed using the "Autofind" option of the Enviroquant software [the average of the apex, 1(-)apex, 1(+)apex is calculated and a background scan is then subtracted]. Once acceptance criteria is met, an initial calibration or calibration verification is performed. All standards, samples, and QC samples associated with a BFB analysis must use identical mass spectrometer instrument conditions.

10.3 For Initial calibration a minimum of five calibration levels containing target analytes and surrogate standards is required. The lowest calibration level must be equal to or below the required reporting limit/lower limit of quantitation for each analyte.

10.4 Standards used for soil calibration are loaded into 40 mL VOA vials containing 5.00 g (±0.1g) of oven baked reagent sand and utilize a heated purge (40° C).

10.5 Following analysis of the initial calibration, relative response factors (RRF) and average RRF for each surrogate and target analyte are calculated. The accuracy of the calibration curve is assessed by calculating the percent error (12.7) for each level of the curve. A maximum percent error of ± 50% (residual test) of the standard's true concentration should be achieved if it is the lowest point, and within ± 30% for all others.

10.6 Five analytes designated as system performance check compounds (SPCC) must meet minimum average response factor criteria ($\overline{RRF}$) as follows:

COMPOUND	MINIMUM $\overline{RRF}$
chloromethane	0.10
1,1-dichloroethane	0.10
bromoform	0.10
chlorobenzene	0.30
1,1,2,2-tetrachloroethane	0.30

10.7 The percent relative standard deviation (%RSD) is calculated for all surrogates and target analytes. The %RSD for all target analytes must be less than 15%, however 6 analytes designated calibration check compounds (CCC) must have %RSD less than or equal to 30%. The CCC's are:

COMPOUND	ICAL MAX %RSD	CCV MAX %D
1,1-dichloroethene	± 30	± 20
chloroform	± 30	± 20
1,2-dichloropropane	± 30	± 20
toluene	± 30	± 20
ethyl benzene	± 30	± 20
vinyl chloride	± 30	± 20

10.8 Method 8260 Calibration Options

Linear – Using Average RF with RSD ≤ 15%

If the % RSD for all target analytes is less than or equal to 15%, then the response factor is assumed constant over the calibration range. Average response factor, therefore, may be used for quantitation. If the CCC's are not target analytes for a specific project, all required analytes must be ≤ 30% RSD.

If more than 5 calibration levels were analyzed, high and/or low points for poor responding and/or saturated compounds can be removed. The low calibration levels must be at or below the required reporting limit/lower limit of quantitation. The curve still must contain a minimum of 5 levels.

The average RF option is the preferred method of GC/MS calibration, since linearity may be assumed throughout the full calibration range. However, linear and quadratic models may be used under the conditions discussed in the following sections. If the % RSD for any target analyte is greater than 15%, one of the following procedures may be employed.

Linear Regression with Coefficient of Determination (COD) rˆ2 ≥ 0.99

Linear regression is an alternative to average RF, but has the potential for significant bias at the lower concentration levels .It should only be used when refitting the lowest calibration standard yields a maximum % error (12.7) of 30% (residual test). If a particular analyte exceeds 15% RSD, then linear regression may be utilized for that analyte. The fit for the equation (r^2) must be ≥ 0.99.

Quadratic Calibration with COD (rˆ2) ≥ 0.99

Several compounds on the 8260/8270 extended lists and the EPA Appendix IX list do not display consistently linear behavior. Quadratic calibration, employing at least six calibration points, may be used to improve accuracy for these analytes, particularly at the lower calibration levels, and is a better alternative than linear regression when linear fails the residual (% error) test. Quadratic calibration must never be used to compensate for a poorly maintained GC/MS system, and should not be used for analytes with a previous history of linear performance. Quadratic regression can be employed provided the COD (r^2) is $\geq$ 0.990. Those analytes utilizing first and/or second order calibration are noted on the initial calibration report.

NOTE: Origin not forced when using linear and quadratic regressions. Quadratic regression cannot be used to extend the calibration range.

For samples received from California, quadratic models for analytes that normally display linear responses in the calibration ranges will not be employed. Listed below are 8260 compounds that do not consistently exhibit linear behavior:

8260 Compounds	**Additional 8260 Compounds**	
vinyl acetate	t-butyl alcohol	paraldehyde
vinyl chloride	1,4-dioxane	1-bromopropane
2-chloroethylvinyl ether	propionitrile	isobutyl alcohol
naphthalene	tetrahydrofuran	1-butanol
acetone	acrolein	1-chlorohexane
	iodomethane	

10.9 Following the initial calibration an ICV is performed. Acceptance criteria is ± 30% drift. Criteria may be different depending on the sample's state of origin or a project specific QAPP.

10.10 The mid-point standard of the calibration curve must be used to establish the relative retention time window position for each analyte and surrogate.

10.11 A CCV is performed every 12 hours of analysis time following an acceptable BFB. Acceptance criteria:

10.11.1 SPCC's meet minimum $\overline{RRF}$ criteria in Section 10.6.

10.11.2 CCC's in Section 10.7 $\leq$ 20 % difference when using average response factor or $\leq$ 20 % drift when using regression fit. Non-CCC's must be $\leq$ 20% difference/drift. Some compounds are historically poor performing analytes and may not meet $\leq$ 20% difference/drift criteria. Any compound not meeting criteria must be addressed in the case narrative. These compounds are listed below:

dichlorodifluoromethane	dimethyl disulfide
chloromethane	t-1,4-dichloro-2-butene
bromomethane	1,3-butadiene
chloroethane	acetonitrile
trichlorofluoromethane	2-chloro-1,3-butadiene
2-chloroethyl vinyl ether	ethyl acetate
acetone	methacrylonitrile
vinyl acetate	isobutyl alcohol
2-butanone	1-butanol
2-hexanone	methyl methacrylate
4-methyl-2-pentanone	2-nitropropoane
1,2-dibromo-3-chloropropane	cyclohexanone
bromoform	paraldehyde
acrolein	1-bromopropane
iodomethane	acrylonitrile

10.11.3 CCV internal standard response and retention times within –50% to +100% and ±30 seconds, respectively, compared to the same calibration standard in the initial calibration.

10.11.4 Target analytes that do not meet the CCV criteria and are reported in the associated samples must be qualified to indicate the reported concentrations are potentially estimated or biased values. In cases where compounds fail low, they may be reported as non-detect if it can be demonstrated that there was adequate sensitivity to detect the compounds at the LOQ or project specific level of interest by analyzing a standard near that level to confirm the analyte could be qualitatively identified if it were present.

Alternatively, the non-detect could be qualified or the LOQ raised to a higher level. In cases where compounds fail high in the CCV and are not found in the associated field samples, they may be reported without qualification.

10.12 Single-point calibration may be performed for Appendix IX and F list analytes. Analytes detected above reporting limits/lower limit of quantitation require reanalysis using a multi-point calibration curve.

10.13 The separation of 2-chlorotoluene and 4-chlorotoluene will be evaluated for standards and QC samples using the “evaluation resolution” option in Chemstation. The resolution between 2-chlorotoluene and 4-chlorotoluene must be greater than 25% as evaluated by Chemstation.

10.14 Refer to Section 13.0 for quality control requirements and corrective action.

10.15 Calibration training materials are available on the intranet home page in the "General" links section, "Calibration Training". Review of "Calibration Models" and "The Effect that Saturation of the Detector has Upon Calibration" are recommended training for all new analysts. There are additional calibration training materials available through the same link on the homepage.

11.0 ANALYTICAL PROCEDURES

11.1 Prior to sample analysis, instruments must pass tuning and calibration criteria per Section 8.0.

11.2 Method blank: Analyzed prior to environmental samples. Method blanks are matrix specific.

11.2.1 Preparation of method blank

Water blank preparation: Fill a 40 mL VOA vial with UV-treated DI water (headspace not present). Place vial in Autosampler. Autosampler adds 1 uL of 250 ug/mL internal and surrogate standard mixtures.

Soil blank preparation: 5.00 g (±0.1g) of oven baked reagent sand is weighed into a tared 40 mL VOA vial containing a stir bar. 5 mL of UV-treated DI water is added to the vial. The vial is placed on the Autosampler. The Archon autosampler adds 5 mL of UV-treated DI water containing 1 uL of 250 ug/mL internal and surrogate standards mixtures. A 2 minute preheat (40° C) and heated purge (40° C) is utilized.

Middle-level extraction blank: 5.00 g (±0.1g) of oven baked reagent sand is weighed into a tared 40 mL VOA vial. 10 mL of methanol is added to the vial. The vial is shaken then allowed to settle. A 50x dilution is performed on the extract. The Autosampler adds 1 uL of 250 ug/mL internal standard mixture and surrogate standards mixtures.

11.3 Following the method blank a matrix specific LCS containing selected 8260 target analytes is analyzed. An LCS/LCS duplicate analyses is performed when the client does not provide sufficient volume for MS/MSD analyses.

Water and low-level soil LCS preparation: Refer to Section 7.0. **NOTE:** For low-level soil LCS, 2 minute preheat and heated purge (40° C) is utilized.

Middle-level extraction LCS: 5.00 g (±0.1g) of oven baked reagent sand is weighed into a tared 40 mL VOA vial. 8.5 mL of methanol and 0.5 mL of the LCS mixtures are added to the vial (**NOTE:** 8.5 mL methanol volume is dependent upon the number of LCS mixtures added; extract final volume is 10 mL). The vial is shaken then allowed to settle. A 50x dilution is performed on the extract. The dilution is loaded on the autosampler and analyzed.

11.4 MS/MSD are analyzed when the client provides appropriate sample volume.

11.4.1 Water MS/MSD preparation: Refer to Section 7.0 with the exception of sample used in place of DI water.

11.4.2 Low-level and mid-level soil MS/MSD preparation: Refer to Section 7.0 with the exception of 5.00 g (± 0.1 g) sample used in place of reagent sand.

11.5 Sample/sample duplicate analyses may be analyzed providing there is appropriate volume. Sample/sample duplicate analyses are generally associated with concentrated soil/waste samples and oils and are used to determine precision.

11.6 Samples are prepared per Microbac SOP PAT01.

11.7 Samples are analyzed within the 12 hour tune, which begins with the injection of BFB. At the end of tune time, a new BFB, blank, CCV, and LCS must be injected.

11.8 Once sample analysis is complete, a computer generated quantitation report containing all target analytes and their concentrations is generated. Also, detailed spectrum are generated for all target analytes detected above a nominal amount.

11.9 Qualitative analysis

An analyte is identified by comparison of the sample mass spectrum with the mass spectrum of a standard of the suspected compound (standard reference spectrum). These standard reference spectra are obtained through analysis of the calibration standards. Two criteria must be satisfied to verify identification: (1) elution of the sample component at the same GC relative retention time (RRT) as the standard component; and (2) correspondence of the sample component and the standard component mass spectrum.

11.9.1 The sample component RRT must compare within ± 0.06 RRT units of the RRT of the standard component. For reference, the standard must be run within the same 12 hours as the sample. If coelution of interfering components prohibits accurate assignment of the sample component RRT from the total ion chromatogram, the RRT must be assigned by using extracted ion current profiles for ions unique to the component of interest.

11.9.2 All ions present in the standard mass spectrum at a relative intensity greater than 10% (most abundant ion in the spectrum equals 100%) must be present in the sample spectrum. The relative intensities of the characteristic ions must agree within 30% of the relative intensities of these ions in the reference spectrum. Analyst judgment is permitted even if these criteria are not met. The positive identification of a hit should not be made based solely on the criteria mentioned above.

11.10 If the response for any target analyte exceeds the initial calibration range, the sample must be diluted. Dilutions are prepared so that the majority of compounds above the calibration range fall near the midpoint of the calibration. Water and mid-level soil dilutions are prepared by using syringes or pipets to transfer aliquots of sample into a volumetric flask containing DI water. Examples of water dilutions are presented below.

DILUTION	SAMPLE VOLUME (mL)	DI WATER VOLUME (mL)	FINAL DILUTION VOLUME (mL)
10x	5	45	50
50x	1	49	50
100x	0.5	49.5	50
1000x	0.05	49.95	50

Low-level soil dilutions are prepared by weighing an aliquot less than 5.00 g in a 40 mL VOA vial. Examples of low-level soil dilutions:

DILUTION	SAMPLE AMOUNT (g)	DI WATER VOLUME (mL)
2x	2.5	5
2.5x	2.0	5
5x	1.0	5

11.10.1 Low level soils collected via 5035 must utilize the mid-level aliquot for dilutions.

Mid-level soil dilutions are prepared by diluting an aliquot of the methanol extract in a volumetric flask. Examples of mid-level soil dilutions:

DILUTION	METHANOL EXTRACT VOLUME (mL)	DI WATER VOLUME (mL)	FINAL VOLUME (mL)
50x	1	49	50
100x	0.5	49.5	50
500x	0.1	49.9	50
1000x	0.05	49.95	50

11.11 The raw data is processed using the chem station software and the data is uploaded into the LIMS. The laboratory then performs a primary and secondary review of the raw data and quality control forms.

11.12 Tentatively identified compounds (TIC): For samples containing components not associated with the calibration standards, a library search may be performed for the purpose of tentative identification. Guidelines for making tentative identification are:

Relative intensities of major ions in the reference spectrum (ions > 10% of the most abundant ion) must be present in the sample spectrum.

The relative intensities of the major ions must agree within ± 40% for TIC's. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance must be between 30% -70%.)

Molecular ions present in the reference spectrum must be present in the sample spectrum.

Ions present in the sample spectrum but not in the reference spectrum must be reviewed for possible background contamination or presence of coeluting compounds.

Ions present in the reference spectrum but not in the sample spectrum must be reviewed for possible subtraction from the sample spectrum because of background contamination or coeluting peaks. Data system library reduction programs can sometimes create these discrepancies.

11.13 Wipe Sample analysis: Wipes must be stored in 40 mL VOA vials containing 10 mL of methanol after collection. Prior to analysis, a glass rod (or similar) is inserted through the septum to completely immerse the wipe in methanol. Vortex the vial for 20 seconds. Remove ample volume of methanol by inserting the needle of a syringe (or similar) through the septum for a 50x dilution. Prepare as per the mid-level extraction procedures.

12.0 DETAILS OF CALCULATIONS

12.1 Relative response factor (RRF):

$$RRF = \frac{(A_x)(C_{is})}{(A_{is})(C_x)}$$

where:

A_x = Area of the characteristic ion for the surrogate or compound being measured.
A_{is} = Area of the characteristic ion for the specific internal standard.
C_{is} = Concentration of the specific internal standard.
C_x = Concentration of the surrogate or compound being measured.

12.2 Average RRF $\left(\overline{RRF}\right)$:

$$\overline{RRF} = \frac{\sum_{1}^{n} RRF}{n}$$

12.3 Standard deviation (s):

$$s = \sqrt{\frac{\sum\left(x - \bar{x}\right)^2}{n-1}}$$

12.4 Percent relative standard deviation (%RSD):

$$\%RSD = \left(\frac{s}{\bar{x}}\right)100$$

where:

$\bar{x} = \overline{RRF}$: $\overline{RRF} = \frac{\sum_{1}^{n} RRF}{n}$

s = standard deviation(s): $s = \sqrt{\frac{\sum\left(x - \bar{x}\right)^2}{n-1}}$

12.5 Percent recovery (%R)

LCS, surrogate:

$$\%R = \left(\frac{C_x}{C_t}\right)100$$

where:

C_x = the concentration of the analyte in the LCS
C_t = the theoretical spike concentration.
$\%R$ = percent recovery

MS/MSD:

$$\%R = \left[\frac{(C_{spk} - C_x)}{C_t}\right]100$$

where:

C_{spk} = the concentration of the analyte in the spiked sample
C_x = the concentration of the analyte in the reference (parent) sample
C_t = the theoretical spike concentration.
$\%R$ = percent recovery

12.6 Relative percent difference (RPD):

$$RPD = \left[\frac{|C_1 - C_2|}{(C_1 + C_2)/2}\right]100$$

where:

C_1 = concentration of the first sample
C_2 = concentration of the second sample

12.7 Percent difference (%D), percent drift (% drift), percent error (% error):

$$\%D = \left[\frac{(C_t - C_x)}{C_t}\right]100$$

where:

C_t = True concentration of the analyte or surrogate in the standard
C_x = Measured concentration of analyte or surrogate in the standard

12.8 Coefficient of correlation (r):

$$\frac{\sum XY - \sum X \sum Y / n}{\sqrt{\left(\sum X^2 - \left(\sum X\right)^2 / n\right)\left(\sum Y^2 - \left(\sum Y\right)^2 / n\right)}}$$

where:

X = individual values of the independent variable, i.e. concentration
Y = individual values of the dependent variable, i.e. response
n = number of pairs of data

12.8 Coefficient of determination (COD):

$$\left[\frac{\sum XY - \sum X \sum Y / n}{\sqrt{\left(\sum X^2 - \left(\sum X\right)^2 / n\right)\left(\sum Y^2 - \left(\sum Y\right)^2 / n\right)}}\right]^2$$

12.9 Sample concentration using $\overline{RRF}$:

Water (ug/L):

$$ug/L = \frac{(A_x)(I_s)(DF)}{(A_{is})(\overline{RRF})(V_o)}$$

where :

A_x = area of characteristic ion for compound being measured
I_s = amount of internal standard injected (250ng)
A_{is} = area of characteristic ion for the internal standard
$\overline{RRF}$ = mean relative response factor for compound being measured
V_o = volume of water purged (10mL)
DF = dilution factor

Low-level soil/sediment:

$$ug/Kg = \frac{(A_x)(I_s)}{(A_{is})(\overline{RRF})(W_s)(D)}$$

where :

A_x, I_s, A_{is}, $\overline{RRF}$, = same as for water
W_s = weight of sample purged in grams
D = % dry weight of sample divided by 100, or 1 for a wet-weight basis

Medium-level soil/sediment:

$$ug/kg = \frac{(A_x)(I_s)(V_i)(DF)}{(A_{is})(\overline{RRF})(V_o)(V_t)(D)}$$

where :

A_x, I_s, A_{is}, $\overline{RRF}$, V_o, DF= same as for water
W_s = weight of sample extracted in grams
V_t = volume of total extract (mL) = $V_m + \left[(W_s)\left(\frac{100-D}{100}\right)\right]$
V_m = adjusted volume of solvent
V_i = volume of extract added (mL) for purging
D = % dry weight of sample (not applicable for a wet-weight basis)

12.10 Linear calibration calculations:

The response ratio is plotted vs. the concentration ratio giving a linear equation:

$$y = mx + b$$

where:

y = Response ratio = Response(x)/Response(istd) = R_x/R_{istd}
x = Concentration ratio = Conc(x)/Conc(istd) = C_x/C_{istd}
And m and b are the slope and intercept from the regression equation

For a given response ratio we can solve for C_x/C_{istd} :

$$C_x/C_{istd} = [R_x/R_{istd} - b]/m$$

Use equations 12.13 or 12.14 to calculate the unknown concentration, C_x.

12.11 Quadratic calibration calculations:

The response ratio is plotted vs. the concentration ratio giving a quadratic equation:

$$y = ax^2 + bx + c$$

OR

$$ax^2 + bx + (c - y) = 0$$

Solving for x using the quadratic equation:

$$x = \frac{b \pm \sqrt{(b^2 - 4a(c - y))}}{2a}$$

where:

y = Response ratio = Response(x)/Response(istd) = R_x/R_{istd}
x = Concentration ratio = Conc(x)/Conc(istd) = C_x/C_{istd}
a ,b, c are constants from the regression equation
Use equations 12.13 or 12.14 to calculate the unknown concentration, C_x

12.12 Solving for the concentration in water sample:

For a given concentration ratio, compute the unknown, C_x

$$C_x = (C_{is})(C_x/C_{istd})(V_f/V_i)(DF)(1000)$$

where:

C_{istd} = concentration of the internal standard (ug/mL)
V_f = final sample (extract) volume (mL)
V_i = initial sample volume (mL)
DF = dilution factor
C_x = concentration of the sample in ug/L

12.13 Solving for the concentration in soil sample:

$$C_x = (C_{is})(C_x/C_{istd})(V_f/W_i)(DF)(1000)$$

where:

C_{istd} = concentration of the internal standard (ug/mL)
V_f = final sample (extract) volume (mL)
W_i = initial sample volume (mL)
DF = dilution factor
C_x = concentration of the sample (ug/Kg) (as received)

12.14 Tentatively identified compounds (TIC) estimated concentration determination:

TIC water (ug/L):

$$ug/L = \frac{(A_x)(I_s)(DF)}{(A_{is})(\overline{RRF})(V_o)}$$

where :

A_x = total area of the peak from the total ion chromatogram
I_s = amount of internal standard injected (250ng)
A_{is} = total area of the internal standard from the total ion chromatogram
$\overline{RRF} = 1$
V_o = volume of water purged (10mL)
DF = dilution factor

TIC low-level soil/sediment:

$$ug/Kg = \frac{(A_x)(I_s)}{(A_{is})(\overline{RRF})(W_s)(D)}$$

where :

A_x, I_s, A_{is}, $\overline{RRF}$, = same as for water
W_s = weight of sample purged in grams
D = % dry weight of sample divided by 100, or 1 for a wet-weight basis

TIC medium-level soil/sediment:

$$ug/Kg = \frac{(A_x)(I_s)(V_t)(DF)}{(A_{is})(\overline{RRF})(V_o)(W_s)(D)}$$

where :

A_x, I_s, A_{is}, $\overline{RRF}, V_o$ = same as for water
W_s = weight of sample extracted in grams

V_t = volume of total extract (mL) = $V_m + \left[(W_s) \left(\frac{100 - D}{100} \right) \right]$

V_i = volume of extract added (mL) for purging

D = % dry weight of sample divided by 100, or 1 for a wet-weight basis

DF = dilution factor

V_m = volume of methanol added (mL)

12.15 Wipe:

$$ug/wipe = (C)(D_F)(E_V)$$

where:

C = extract concentration, ug/L

D_F = dilution factor

E_V = extract volume, L/wipe

NOTE: E_V assumed to be 0.01 L

13.0 QUALITY CONTROL REQUIREMENTS

13.1 The quality control procedures discussed in this section are intended to monitor and control the entire analytical process. Batch quality samples are specified for ICAL, MB, LCS, MS, MSD, laboratory duplicates (LD), and surrogate compounds. Additional procedures were defined in Section 8.0 for initial calibration, ICV using a second source, and CCV, and are included in the overall review process. The procedures, required frequency, acceptance criteria, and the required corrective action measures are outlined in Table 7.

13.2 Workgroups are analytical batches that contain instrument performance checks (BFB), calibration standards (ICAL, ICV, CCV), QC samples, and client samples.

13.3 Workgroups are comprised of:

- Instrument performance check: BFB tune evaluation to verify detector is working properly
- ICAL/CCV standards: used to calibrate instrument or verify accuracy of the calibration curve

- ICV: standard from an alternate source used to verify accuracy of the calibration curve
- Method blank: verify system is free of contaminants and interferences
- LCS/LCSD: verify precision and accuracy of the system
- MS/MSD: measure matrix effect of environmental sample on target analytes; measure precision
- Sample/sample duplicate: dual analysis of environmental system to measure precision
- Environmental sample: samples submitted for analysis

13.4 Method blank analyzed per method requirements. Target analytes must be less than ½ the RL/LLOQ. Exceptions may include common laboratory solvents which must be less than the RL/LLOQ or the exceptions of section 13.11.3. All blanks are evaluated down to the current MDL for the presence of target analytes. Any amount of target analytes found in the blank at a level greater than the current MDL are reported in the LIMS and these values will appear on the QC summary sheet for the batch.

13.5 The LCS must be evaluated using acceptance criteria listed in Tables 2 and 3, as well as any project specific criteria. Upon completion of a batch of samples, LCS summary reports are generated by the analyst, which compare the actual recoveries to the applicable acceptance ranges for the samples in the batch. The standard laboratory limits specified in Tables 2 and 3 are used in the absence of a project QAPP or program specified control limits. If more than 10% of the LCS analytes are out of the laboratory limits, the analyst must stop the analysis, prepare an NCR, and contact the department supervisor for the appropriate corrective action. If any of the identified project specific chemicals of concern (COC) are outside the control limits, the analyst must stop the analysis and prepare an NCR to be reviewed by the department supervisor.

13.6 The MS/MSD is analyzed per method requirements. MS/MSD results are included in the QC summary report and are used to monitor matrix accuracy and precision. For MS/MSD, Sample/sample duplicate, failure to meet surrogate and internal standard areas acceptance criteria does not necessarily warrant corrective action. Sample MS/MSD or sample/duplicate results can be used to confirm sample matrix interference. In obvious cases of error, reanalysis would be performed.

13.7 When ICAL acceptance criteria are not met, corrective action may include (but is not limited) to the following:

- Evaluate individual data points and reanalyze
- Evaluate calibration standards and reanalyze

- Prepare fresh calibration standards and reanalyze
- Perform instrument maintenance to include but not limited to:
  - Reanalyze calibration curve
  - Tune instrument
  - Replace trap
  - Bake analytical system
  - Replace column
  - Replace transfer line(s)
  - Service auto-sampler, sample concentrator, gas chromatograph, and/or mass spectrometer
- Qualify results and address in case narrative

13.8 When CCV acceptance criteria are not met, corrective action may include (but not, limited to) the following:

- Reanalyze CCV
- Prepare fresh standards
- Bake analytical system
- Perform instrument maintenance

13.9 Surrogate is added to all standards, QC samples, and environmental samples. Table 6 lists surrogate acceptance limits.

13.10 Storage blanks are placed in sample refrigerators and freezers to monitor potential cross contamination. Storage blanks consists of 40 mL of analyte free DI water or 5 mL DI water and 5.00 g of sand stored for 14 days in each VOA refrigerator/freezer. Analyses are performed via Method 8260 with results quantitated to the MDL. Storage blanks are prepared weekly and logged into the LIMS laboratory account. Weekly, (after storage blanks have been stored for two full weeks) storage blanks are analyzed via 8260 (storage blanks must be analyzed within the 12 hour tune time).

Target analytes must be less than ½ the reporting limit/lower limit of quantitation with the exception of common lab contaminants. Common lab contaminants must be less than the reporting limit/lower limit of quantitation. During primary review of the data, the analyst will review storage blank results to ensure acceptance criteria are met. If acceptance criteria are not met the analyst must initiate corrective action. Corrective action begins with determining the non-compliant analyte(s) and recording any known reason for the failure then reanalysis of the duplicate vial of the storage blank. If reanalysis of the storage blank yields results within acceptance criteria then no further corrective action is required. If the reanalysis results confirm the initial analysis results or the reason for the initial failure is not evident then a Form NC02 is initiated. After primary review, results are uploaded to the LIMS. The laboratory will conduct an internal investigation and assess impact on associated samples if these criteria are not met with the next group of storage blanks analyzed. The laboratory will attempt to identify the source of contamination, and evaluate the impact on data reported for the contaminant during the period of storage. Clients may be contacted based on the investigation, if the QAO judges that to be necessary.

13.10.1 Storage blanks held in VOAX (waste sample storage) are allowed up to 10 times normal blank limits due to waste samples held in this storage unit running no more concentrated than a tenfold dilution.

13.11 Control of Nonconforming Data

The laboratory implements general procedures to be followed when departures from documented policies, procedures and quality control have occurred. The policies and procedures are found in Section 13.0 of Microbac SOP LQAP (Laboratory Quality Assurance Program), Microbac SOP GP-CAPA (Corrective Action/Preventive Action: Initiating, Tracking and Monitoring) and Microbac SOP GP-RCA (Root Cause Analysis).

13.11.1 Nonconformances Requiring Corrections

A nonconformance occurs when any aspect of the method QC in an analysis, as outlined in Table 7 does not meet acceptance criteria. When nonconforming data occurs the employee initiates an NCR and proceeds with indicated corrections as per Table 7.

All data shall be scrutinized by the analysts for method and project specific compliance. Checklists are utilized and accompany each data batch Figure 1. A nonconformance shall be documented in the NCR followed by one or more of the following actions.

- Reanalysis of the sample(s) in question
- Discussion and qualification of data (report and narrative)
- Client notification with approval
- Data qualification (Q-flagging)
- Re-sampling and reanalysis (client decision)

13.11.2 Nonconformances Requiring Corrective Action

Corrective action is required when a nonconformance is recurring, if the correction is ineffective or if the departure is so significant that it negatively effects data quality, sample integrity or customer satisfaction. When an event requiring corrective action is identified, the employee shall initiate a Corrective Action/ Preventive Action form as per Microbac SOP GP-CAPA. The corrective action process includes a root cause analysis as per Microbac SOP GP-RAC, corrections, corrective action(s) and evidence of effectiveness.

13.11.3 Nonconformances Not Requiring Corrections

There are some standard contingencies to the traditional corrections that maybe invoked, provided they comply with the project QAPP requirements. In many situations it may not be necessary to perform sample reanalysis or re-extraction for the following quality control departures, provided they are not a chronic problem or indicative of a trend, and the laboratory provides documentation in the report narrative and project files. In addition, the employee is required to initiate an NCR to record the event.

- An LCS or surrogate recovery exceeds the upper control limit, but the corresponding sample results are non-detect.
- A method blank exceeds the upper limit, but the corresponding sample results are non-detect.
- A method blank exceeds the upper limit, but the corresponding sample results are greater than ten (10) times the level in the blank.

13.12 Table 7 contains method 8260B quality control criteria.

13.13 LCS control limits are reviewed annually.

14.0 DATA REVIEW AND REPORTING REQUIREMENTS

14.1 Data review:

14.1.1 All data undergoes a 100% primary review to ensure method and project specific compliance, reduce the data into reportable results, and generate appropriate QC forms. All items in Figure 1 (data review checklist) are reviewed and results are uploaded to the LIMS.

14.1.1.1 Data may be reviewed by an analyst other than the primary analyst provided the reviewing analyst’s initials are recorded on the “Data Checklist”.

14.1.2 Following the primary review the data undergoes a 100% peer review. All items in 14.1.1 are repeated by the peer. The peer review is performed by the supervisor or designee.

14.2 Data reporting:

14.2.1 Following peer review all uploaded results are reviewed, verified, and qualified.

14.2.2 Default reporting units are “ug/L” for water and “ug/Kg” for soil/sediments/oils.

14.2.3 All uploaded results are uploaded to a maximum number of significant figures dictated by the LIMS. The number of significant figures in the final report vary per project requirements.

14.2.4 Dilution and sample matrix confirmation analyses are uploaded into the LIMS and per the client’s request may be reported as separate analyses or combined (concatenated) into one set of results.

14.3 Quantitative results between the MDL and RL/LLOQ are qualified as “estimated” if requested by the client.

14.4 Refer to Microbac SOP 41 for acceptable procedure on manual integration if necessary.

14.5 Electronic run logs and preparation logs are reviewed electronically.

15.0 PREVENTIVE MAINTENANCE

15.1 Gas pressures are monitored daily. Other maintenance performed as needed. Laboratory maintenance log books maintained per instrument.

15.2 Instrument configuration and maintenance is recorded in the instrument maintenance log book.

15.3 Trouble-shooting involves, but is not limited to, direct injections, chromatography review, evaluating contamination, standards recoveries, injection port maintenance, and leak check.

15.4 Vendor instrument repair reports will be included in maintenance log.

16.0 WASTE MANAGEMENT AND POLLUTION CONTROL

16.1 Microbac is dedicated to eliminating or minimizing any and all laboratory waste which requires disposal or contributes to pollution of any type. To that extent

Microbac has implemented new technology and converted to micro techniques when available to facilitate these goals.

Each laboratory generates specific waste streams which are segregated and collected in labeled satellite containers. The analysts in each department are responsible for proper disposal of the spent samples and chemical waste in the specified satellite waste collection vessel. The waste management technician checks the satellite containers either daily, or as needed. They are then combined into waste drums in our explosion-proof waste building located outside of the Microbac laboratory facility. These drums are labeled with start date and a manifest is created for each. They are picked up on a regular basis for disposal at a licensed disposal facility.

16.2 The waste streams are as follows:

- Volatile Laboratory – non-halogenated solvents, solid waste (methanol)

16.3 Laboratory policies and procedures for management of hazardous waste are found in Microbac SOP 33, Laboratory Waste Management and the waste management section of the analytical SOPs contain procedures specific to each method. Our procedures comply with all federal and state laws and regulations. Each employee receives training in the proper handling and disposal hazardous waste that this is specific to their job description. As a hazardous generator, we are subject to inspection from the Ohio EPA.

17.0 REFERENCES

17.1 *Test Methods for Evaluating Solid Waste,* SW-846, US-EPA, Office of Solid Waste, including updates I, II, III, IV, and V:

8000D	July 2014
8260B	December 1996
5030C	May 2003
5035A	July 2002
8260D	June 2018

17.2 U.S. EPA, 40 CFR, Part 136, October 26, 1984

17.3 Microbac SOP PAT01 “Methods 5030 and 5035 Purge and Trap for Volatile ` Organics”

17.4 Microbac SOP 45 “Method Validation Procedures”

17.5 Microbac SOP 41 “Manual Integration of Chromatographic Peaks”

17.6 Microbac SOP 33 “Laboratory Waste Management”

17.7 Microbac SOP LQAP “Laboratory Quality Assurance Plan”

17.8 Microbac SOP GP-TEMP-SSU “Temperature control Systems for Sample Storage Units”

Appendix I
Suggested 8260B Quantitation Ions

COMPOUND NAME	SUGGESTED PRIMARY ION	SUGGESTED SECONDARY ION	MICROBAC'S PRIMARY ION
fluorobenzene (internal std)	**96**	**77**	**96**
dichlorodifluoromethane	85	87	85
chloromethane	50	52	50
vinyl chloride	62	64	62
1,3-butadiene	54	39.53	54
bromomethane	94	96	94
chloroethane	64	66	64
Trichlorofluoromethane	101	151, 153	101
diethyl ether	59	45, 74	59
isoprene	67	53	67
acrolein	56	55, 58	56
trichlorotrifluoromethane	101	151	101
Acetone	43	58	43
1,1-dichloroethene	96	61, 63	96
t-butyl alcohol	59	41, 47	59
dimethyl sulfide	62	47	62
iodomethane	142	127, 141	142
methyl acetate	43	74, 59	43
acetonitrile	41	40, 39	41
methylene chloride	84	86, 49	84
carbon disulfide	76	78	76
acrylonitrile	53	52, 51	53
methyl-tert-butyl ether	73	57	73
3-chloro-1-propene	41	76	41
trans-1,2-dichloroethene	96	61, 98	96
n-hexane	57	43	57
diisopropyl ether	45	43, 87	45
vinyl acetate	43	86	43
1,1-dichloroethane	63	65, 83	63
ethyl-t-butyl ether	59	87, 57	59
2-butanone	43	72	43
2-chloro-1,3-butadiene	53	88, 90, 51	53
propionitrile	54	52, 55, 40	54
2,2-dichloropropane	77	97	77
cis-1,2-dichloroethene	96	61, 98	96
chloroform	83	85	83
1-bromopropane	122	124	122
bromochloromethane	128	49, 130	128
methacrylonitrile	41	67, 39, 52, 66	67
isobutyl alcohol	43	41, 42, 74	73
Tetrahydofuran	42	72, 71	42
dibromofluoromethane **(surrogate)**	111	113	111
1,1,1-trichloroethane	97	99, 61	97
cyclohexane	56	84	56
1,1-dichloropropene	75	110, 77	75
t-amyl-methyl ether	73	55, 87	73
carbon tetrachloride	117	119	117
1,2-dichloroethane-d4 **(surrogate)**	65	67	65
1,2-dichloroethane	62	98	62
1-butanol	56	43	56

Appendix I (continued)

COMPOUND NAME	SUGGESTED PRIMARY ION	SUGGESTED SECONDARY ION	MICROBAC'S PRIMARY ION
benzene	78	77, 52	78
Trichloroethene	130	95, 97, 132	130
Methylcyclohexane	83	55, 198	83
1,2-dichloropropane	62	112	62
Methyl methacrylate	41	100, 39, 69	41
1,4-dioxane	88	58, 43, 47	88
bromodichloromethane	83	85, 127	83
2-nitropropane	43	41	43
ethyl acetate	43	61	43
methyl methacrylate	41	69, 100	41
dibromomethane	93	95, 174	93
2-chloroethylvinyl-ether	63	65, 106	63
4-methyl-2-pentanone	100	43, 58, 85	58
cis-1,3-dichloropropene	75	77, 39	75
dimethyl disulfide	79	94	79
chlorobenzene-d5 (internal std)	**117**	**82**	**117**
toluene-d8 **(surrogate)**	98	100	98
toluene	92	91	91
ethyl methacrylate	69	41, 99, 86, 114	69
Paraldehyde	89	87	89
trans-1,3-dichloropropene	75	77, 39	75
1,1,2-trichloroethane	83	97, 85	97
2-hexanone	43	58, 58, 57, 100	43
1,3-dichloropropane	76	78	76
tetrachloroethene	164	129, 131, 166	164
dibromochloromethane	129	127	129
1,2-dibromoethane	107	109, 188	107
1-chlorohexane	91	55	91
chlorobenzene	112	77, 114	112
1,1,1,2-tetrachloroethane	131	133, 119	131
Ethylbenzene	106	91	106
m+p-xylene	106	91	106
Cyclohexanone	55	42, 98	55
o-xylene	106	91	106
styrene	104	78	104
bromoform	173	175, 254	173
isopropylbenzene	105	120	105
1,4-dichlorobenzene-d4 (internal std)	**152**	**115, 150**	**152**
1,1,2,2-tetrachloroethane	83	131, 85	83
p-bromofluorobenzene **(surrogate)**	95	174, 176	95
1,2,3-trichloropropane	75	77, 110	110
trans-1,4-dichloro-2-butene	53	88, 75	53
n-propyl-benzene	91	120	91
bromobenzene	156	77, 158	156
1,3,5-trimethylbenzene	105	120	105
2-chlorotoluene	91	126	91
4-chlorotoluene	91	126	91
alpha-methyl-styrene	118	103	118
tert-butyl-benzene	119	91, 134	119
1,2,4-trimethylbenzene	105	120	105
sec-butyl-benzene	105	134	105
p-isopropyl-toluene	119	134, 91	119

Appendix I (continued)

COMPOUND NAME	SUGGESTED PRIMARY ION	SUGGESTED SECONDARY ION	MICROBAC'S PRIMARY ION
1,3-dichlorobenzene	146	111, 148	146
1,4-dichlorobenzene	146	111, 148	146
n-butyl-benzene	91	92, 134	91
1,2-dichlorobenzene	146	111, 148	146
1,2-dibromo-3-chloropropane	75	115, 157	157
1,2,4-trichlorobenzene	180	182, 145	180
hexachlorobutadiene	225	223, 227	225
naphthalene	128	127	128
1,2,3-trichlorobenzene	180	182, 145	180

Appendix II

8260D Criteria

Initial calibration

The RSD should be ≤ 20% for each target analyte. The CCV may be omitted if samples are analyzed within 12 hours of an ICAL, and injection of the last ICAL standard may be used as the starting time reference for evaluation.

Table 8 contains minimum RFs that may be used as guidance in determining whether the system is behaving properly and as a check to see if calibration standards are prepared correctly. Because the minimum RFs in Table X were determined using specific ions and instrument conditions that may vary, it is neither expected nor required that all analytes meet these minimum RFs. The information in the table is proved as guidance only.

BFB Tune

Tune checks are only required prior to ICAL.

Structural Isomer Resolution

Unresolved structural isomers with similar mass spectra are identified as isomeric pairs. Isomers are considered resolved if the peaks are at least 50% resolved. The resolution should be verified on the mid-point concentration of the ICAL as well as the laboratory-designated CCV level if closely eluting isomers are to be reported. It is important to check the separation of structural isomers in the ICV and the daily CCV check standards to verify if the instrument performance is adequate regarding separation of compounds of interest which are structural isomers.

Table 1
Method Analytes for MSV01

ANALYTE	CAS NUMBER
1,1,1,2-tetrachloroethane	630-20-6
1,1,1-trichloroethane	71-55-6
1,1,2,2-tetrachloroethane	79-34-5
1,1,2-trichloro-1,2,2-trifluoroethane	76-13-1
1,1,2-trichloroethane	79-00-5
1,1-dichloroethane	75-34-3
1,1-dichloroethene	75-35-4
1,1-dichloropropene	563-58-6
1,2,3-trichlorobenzene	87-61-6
1,2,3-trichloropropane	98-18-4
1,2,4-trimethylbenzene	95-63-6
1,2,4-trimethylbenzene	95-63-6
1,2-dibromo-3-chloropropane	96-12-8
1,2-dibromoethane	106-93-4
1,2-dichlorobenzene	95-50-1
1,2-dichloroethane	107-06-2
1,2-dichloropropane	78-87-5
1,3,5-trimethylbenzene	108-67-8
1,3-butadiene	106-99-0
1,3-dichlorobenzene	541-73-1
1,3-dichloropropane	142-28-9
1,4-dichlorobenzene	106-46-7
1,4-dioxane	123-91-1
1-bromopropane	106-94-5
1-butanol	71-36-3
1-chlorohexane	544-10-5
2,2-dichloropropane	594-20-7
2-butanone	78-93-3
2-chloroethylvinylether	110-75-8
2-chlorotoluene	95-49-8
2-hexanone	591-78-6
2-nitropropane	79-46-9
4-chlorotoluene	106-43-4
4-methyl-2-pentanone	108-10-1
acetone	67-64-1
acetonitrile	75-05-8
acrolein	107-02-8
acrylonitrile	107-13-1
allylchloride (3-chloroprene)	107-05-1
a-methyl styrene	98-83-9
benzene	71-43-2
bromobenzene	108-86-1
bromochloromethane	74-97-5
bromodichloromethane	75-27-4
bromoform	75-25-2
bromomethane	74-83-9
carbon disulfide	75-15-0
carbon tetrachloride	56-23-5
chlorobenzene	108-90-7
chloroethane	75-00-3
chloroform	67-66-3
chloromethane	74-87-3

ANALYTE	CAS NUMBER
chloroprene (2-chloro-1,3-butadiene)	126-99-8
cis-1,2-dichloroethene	156-59-2
cis-1,3-dichloropropene	10061-01-5
cyclohexane	110-82-7
cyclohexanone	108-94-1
dibromochloromethane	124-48-1
dibromomethane	74-95-3
dichlorodifluoromethane	75-71-8
diethyl ether	60-29-7
diisopropyl ether	108-20-3
dimethyl disulfide	624-92-0
dimethylsulfide	75-18-3
ethyl acetate	141-78-6
ethyl ether	60-29-7
ethyl methacrylate	97-63-2
ethyl t-butyl ether	637-92-3
ethylbenzene	100-41-4
hexachlorobutadiene	87-68-3
iodomethane	74-88-4
isobutanol	78-83-1
isoprene	78-79-5
isopropyl benzene	98-82-8
m+p-xylene	179601-23-1
methacrylonitrile	126-98-7
methyl acetate	79-20-9
methyl cyclohexane	108-87-2
methylene chloride	75-09-2
methylmethacrylate	80-62-6
methyl-tert-butyl-ether	1634-04-4
naphthalene	91-20-3
n-butyl-benzene	104-51-8
n-hexane	110-54-3
n-propyl benzene	103-65-1
o-xylene	95-47-6
paraldehyde	123-63-7
p-isopropyl-toluene	99-87-6
propionitrile (ethyl cyanide)	107-12-0
sec-butyl-benzene	135-98-8
styrene	100-42-5
t-amylmethyl ether	994-05-8
t-butanol	75-65-0
tert-butyl-benzene	98-06-6
tetrachloroethene	127-18-4
tetrahydrofuran	109-99-9
toluene	108-88-3
trans-1,2-dichloroethene	156-60-5
trans-1,3-dichloropropene	10061-02-6
trans-1,4-dichloro-2-butene	110-57-6
trichloroethene	79-01-6
trichlorofluoromethane	75-69-4
vinyl acetate	108-05-4
vinyl chloride	75-01-4

Table 2
MICROBAC'S QA OBJECTIVES AND ANALYTICAL METHODS FOR VOLATILE ORGANIC ANALYSES OF GROUNDWATER

PARAMETER	CAS #	ACCURACY (% REC)	PRECISION (RPD)	MDL (ug/L)	REPORTING LIMITS (ug/L)	LCS, MS/MSD, TRUE VALUE (ug/L)	SUGGESTED CALIBRATION RANGE (ug/L)
1,1,1,2-tetrachloroethane	630-20-6	80-130	20	0.25	1	20	1-300
1,1,1-trichloroethane	71-55-6	80-134	20	0.25	1	20	1-300
1,1,2,2-tetrachloroethane	79-34-5	79-125	20	0.2	1	20	1-300
1,1,2-trichloro-1,2,2-trif	76-13-1	40-160	20	1	5	20	1-300
1,1,2-trichloroethane	79-00-5	80-125	20	0.25	1	20	1-300
1,1-dichloroethane	75-34-3	80-125	20	0.125	1	20	1-300
1,1-dichloroethene	75-35-4	80-132	20	0.5	1	20	1-300
1,1-dichloropropene	563-58-6	75-130	20	0.25	1	20	1-300
1,2,3-trichlorobenzene	87-61-6	80-120	20	0.125	1	20	1-300
1,2,3-trichloropropane	96-18-4	75-125	20	0.75	1	20	1-300
1,2,4-trichlorobenzene	120-82-1	80-120	20	0.2	1	20	1-300
1,2,4-trimethylbenzene	95-63-6	80-125	20	0.25	1	20	1-300
1,2-dibromo-3-chloropropane	96-12-8	65-135	20	1.0	2	20	1-300
1,2-dibromoethane	106-93-4	80-129	20	0.25	1	20	1-300
1,2-dichlorobenzene	95-50-1	80-125	20	0.125	1	20	1-300
1,2-dichloroethane	107-06-2	80-129	20	0.25	1	20	1-300
1,2-dichloroethene (total)	540-59-0	80-124	20	0.25	1	40	1-300
1,2-dichloropropane	78-87-5	80-120	20	0.2	1	20	1-300
1,3,5-trimethylbenzene	108-67-8	80-127	20	0.25	1	20	1-300
1,3-butadiene	106-99-0	10-200	20	1	5	20	1-300
1,3-dichlorobenzene	541-73-1	80-120	20	0.25	1	20	1-300
1,3-dichloropropane	142-28-9	80-120	20	0.2	1	20	1-300
1,4-dichlorobenzene	106-46-7	80-120	20	0.125	1	20	1-300
1,4-dioxane	123-91-1	20-160	20	50	100	200	1-300
1-bromopropane	106-94-5	50-150	20	1	2	20	1-300
1-chlorohexane	544-10-5	80-127	20	0.125	1	20	1-300
2,2-dichloropropane	594-20-7	80-133	20	0.25	1	20	1-300
2-butanone	78-93-3	40-160	20	2.5	5	20	1-300
2-chloroethyl vinyl ether	110-75-8	45-160	20	2.0	5	20	1-300
2-chlorotoluene	95-49-8	80-127	20	0.125	1	20	1-300
2-hexanone	591-78-6	55-130	20	2.5	5	20	1-300
2-nitropropane	79-46-9	10-150	20	5	50	100	1-300
3-chloro-1-propene	107-05-1	70-130	20	2.5	10	20	1-300
4-chlorotoluene	106-43-4	80-126	20	0.25	1	20	1-300
4-methyl-2-pentanone	108-10-1	64-140	20	2.5	5	20	1-300
acetone	67-64-1	40-180	20	2.5	5	20	1-300
acetonitrile	75-05-8	70-130	20	5	100	100	1-300
Acrolein	107-02-8	10-200	20	20	10	20	1-300
acrylonitrile	107-13-1	50-150	20	2.5	10	20	1-300
alpha-methyl-styrene	98-83-9	50-150	20	0.5	5	20	1-300
benzene	71-43-2	80-121	20	0.125	1	20	1-300
bromobenzene	108-86-1	80-120	20	0.125	1	20	1-300
bromochloromethane	74-97-5	65-130	20	0.2	1	20	1-300
bromodichloromethane	75-27-4	80-131	20	0.25	1	20	1-300
bromoform	75-25-2	70-130	20	0.5	1	20	1-300

Table 2 (continued) 1-300

PARAMETER	CAS #	ACCURACY (% REC)	PRECISION (RPD)	MDL (ug/L)	REPORTING LIMITS (ug/L)	LCS, MS/MSD, TRUE VALUE (ug/L)	SUGGESTED CALIBRATION RANGE (ug/L)
bromomethane	74-83-9	50-150	20	0.50	1	20	1-300
carbon disulfide	75-15-0	58-128	20	0.50	1	20	1-300
carbon tetrachloride	56-23-5	65-140	20	0.25	1	20	1-300
chlorobenzene	108-90-7	80-120	20	0.125	1	20	1-300
chloroethane	75-00-3	60-135	20	0.5	1	20	1-300
chloroform	67-66-3	80-125	20	0.125	1	20	1-300
Chloromethane	74-87-3	60-140	20	0.5	1	20	1-300
chloroprene	126-99-8	70-130	20	2.5	100	100	1-300
cis-1,2-dichloroethene	156-59-2	75-125	20	0.25	1	20	1-300
cis-1,3-dichloropropene	10061-01-5	75-125	20	0.25	1	20	1-300
cyclohexane	110-82-7	70-130	20	0.58	1	20	1-300
cyclohexanone	108-94-1	10-140	20	5	100	100	1-300
dibromochloromethane	124-48-1	70-130	20	0.25	1	20	1-300
dibromomethane	74-95-3	75-125	20	0.25	1	20	1-300
dichlorodifluoromethane	75-71-8	40-160	20	0.25	1	20	1-300
diethyl ether	60-29-7	70-130	20	5	10	100	1-300
diisopropyl ether	108-20-3	70-130	20	5	10	100	1-300
dimethyl disulfide	624-92-0	70-130	20	1.0	5	20	1-300
dimethyl sulfide	75-18-3	70-130	20	0.5	5	20	1-300
ethyl acetate	141-78-6	70-130	20	5	50	100	1-300
ethyl benzene	100-41-4	80-122	20	0.25	1	20	1-300
ethyl methacrylate	97-63-2	70-130	20	1.0	10	20	1-300
ethyl-tert-butyl ether	637-92-3	70-130	20	5	10	100	1-300
hexachlorobutadiene	87-68-3	72-132	20	0.25	1	20	1-300
iodomethane	74-88-4	10-160	20	0.5	1	20	1-300
Isobutanol	78-83-1	10-180	20	50	100	200	1-300
isoprene	78-79-5	70-130	20	0.53	10	20	1-300
isopropylbenzene	98-82-8	80-122	20	0.25	1	20	1-300
m+p-xylene **	179601-23-1	80-122	20	0.5	1	40	1-300
methacrylonitrile	126-98-7	70-130	20	1	1	100	1-300
Methyl acetate	79-20-9	50-190	20	1	1	20	1-300
Methyl cyclohexane	108-87-2	80-130	20	1	1	20	1-300
1-300methyl methacrylate	80-62-6	70-130	20	1	1	100	1-300
methylene chloride	75-09-2	80-123	20	0.25	1	20	1-300
methyl-tert-butyl ether	1634-04-4	75-130	20	0.5	1	20	1-300
naphthalene	91-20-3	59-130	20	0.2	1	20	1-300
n-butylbenzene	104-51-8	80-131	20	0.25	1	20	1-300
n-hexane	110-54-3	74-137	20	0.56	1	20	1-300
o-xylene	95-47-6	80-122	20	0.25	1	20	1-300
p-isopropyl-toluene	99-87-6	80-122	20	0.25	1	20	1-300
propionitrile	107-12-0	50-150	20	1	1	100	1-300
propylbenzene	103-65-1	80-129	20	0.125	1	20	1-300
sec-butylbenzene	135-98-8	80-127	20	0.25	1	20	1-300
styrene	100-42-5	80-123	20	0.125	1	20	1-300
tert-amyl-methyl ether	994-05-8	70-130	20	5	10	100	1-300
tert-butyl alcohol	75-65-0	10-180	20	50	100	200	1-300

Table 2 (continued)

PARAMETER	CAS #	ACCURACY (% REC)	PRECISION (RPD)	MDL (ug/L)	REPORTING LIMITS (ug/L)	LCS, MS/MSD, TRUE VALUE (ug/L)	SUGGESTED CALIBRATION RANGE (ug/L)
tert-butylbenzene	98-06-6	80.126	20	0.25	1	20	1-300
tetrachloroethene	127-18-4	80-124	20	0.25	1	20	1-300
tetrahydrofuran	109-99-9	60-140	20	5	50	100	1-300
Toluene	108-88-3	80-124	20	0.25	1	20	1-300
trans-1,2-dichloroethene	156-60-5	80-127	20	0.25	1	20	1-300
trans-1,3-dichloropropene	10061-02-6	80-130	20	0.5	1	20	1-300
trans-1,4-dichloro-2-butene	110-57-6	50-150	20	2.0	2	20	1-300
trichloroethene	79-01-6	80-122	20	0.25	1	20	1-300
trichlorofluoromethane	75-69-4	62-151	20	0.25	1	20	1-300
vinyl acetate	108-05-4	10-190	20	2.5	5	20	1-300
vinyl chloride	75-01-4	50-150	20	0.25	1	20	1-300
xylenes (total)	1330-27-7	80-121	20	0.5	15	60	1-300

** Unresolvable compound

Table 3
MICROBAC'S QA OBJECTIVES AND ANALYTICAL METHODS FOR VOLATILE ORGANIC ANALYSES OF SOLID WASTE

PARAMETER	CAS #	ACCURACY (% REC)	PRECISION (RPD)	MDL (ug/Kg)	REPORTING LIMITS (ug/Kg)	LCS, MS/MSD, TRUE VALUE (ug/Kg)	SUGGESTED CALIBRATION RANGE (ug/Kg)
1,1,1,2-tetrachloroethane	630-20-6	71-137	30	0.5	5	20	5-200
1,1,1-trichloroethane	71-55-6	70-135	30	0.5	5	20	5-200
1,1,2,2-tetrachloroethane	79-34-5	55-130	30	0.5	5	20	5-200
1,1,2-trichloro-1,2,2-trif	76-13-1	70-130	30	1.0	10	20	5-200
1,1,2-trichloroethane	79-00-5	60-125	30	0.5	5	20	5-200
1,1-dichloroethane	75-34-3	75-125	30	1.0	5	20	5-200
1,1-dichloroethene	75-35-4	65-135	30	0.5	5	20	5-200
1,1-dichloropropene	563-58-6	57-138	30	0.5	5	20	5-200
1,2,3-trichlorobenzene	87-61-6	60-135	30	0.5	5	20	5-200
1,2,3-trichloropropane	96-18-4	65-130	30	1.0	5	20	5-200
1,2,4-trichlorobenzene	120-82-1	65-130	30	0.5	5	20	5-200
1,2,4-trimethylbenzene	95-63-6	75-132	30	0.5	5	20	5-200
1,2-dibromo-3-chloropropane	96-12-8	40-135	30	2.0	5	20	5-200
1,2-dibromoethane	106-93-4	69-128	30	0.5	5	20	5-200
1,2-dichlorobenzene	95-50-1	70-130	30	0.5	5	20	5-200
1,2-dichloroethane	107-06-2	63-133	30	0.5	5	20	5-200
1,2-dichloroethene (total)	540-59-0	74-127	30	0.5	5	40	5-200
1,2-dichloropropane	78-87-5	72-130	30	0.5	5	20	5-200
1,3,5-trimethylbenzene	108-67-8	74-133	30	0.5	5	20	5-200
1,3-butadiene	106-99-0	40-160	30	1	10	20	10-200
1,3-dichlorobenzene	541-73-1	70-130	30	0.5	5	20	5-200
1,3-dichloropropane	142-28-9	65-128	30	0.5	5	20	5-200
1,4-dichlorobenzene	106-46-7	70-130	30	0.5	5	20	5-200
1,4-dioxane	123-91-1	50-150	30	50	100	200	5-200
1-butanol	71-36-3	50-150	30	50	100	200	50-400
1-chlorohexane	544-10-5	40-160	30	0.5	3	20	5-200
2,2-dichloropropane	594-20-7	66-135	30	0.5	5	20	5-200
2-butanone	78-93-3	37-180	30	2.5	10	20	5-200
2-chloroethyl vinyl ether	110-75-8	35-154	30	2.0	10	20	5-200
2-chlorotoluene	95-49-8	63-147	30	0.5	5	20	5-200
2-hexanone	591-78-6	45-145	30	2.5	10	20	5-200
2-nitropropane	79-46-9	60-140	30	5	50	100	5-200
3-choro-1-propene	107-05-1	50-150	30	2.5	10	20	5-200
4-chlorotoluene	106-43-4	70-138	30	0.5	5	20	5-200
4-methyl-2-pentanone	108-10-1	47-146	30	2.5	10	20	5-200
Acetone	67-64-1	20-160	30	5.0	10	20	5-200
acetonitrile	75-05-8	50-150	30	50	100	100	5-200
acrolein	107-02-8	50-150	30	20	100	20	5-200
acrylonitrile	107-13-1	60-140	30	2.5	100	20	5-200
alpha-methyl-styrene	98-83-9	70-130	30	0.5	10	20	5-200
benzene	71-43-2	70-130	30	0.5	5	20	5-200
bromobenzene	108-86-1	72-131	30	0.5	5	20	5-200
bromochloromethane	74-97-5	70-130	30	0.5	5	20	5-200
bromodichloromethane	75-27-4	72-137	30	0.5	5	20	5-200
bromoform	75-25-2	49-136	30	0.5	5	20	5-200
bromomethane	74-83-9	37-143	30	1.0	10	20	5-200

Table 3 (continued)

PARAMETER	CAS #	ACCURACY (% REC)	PRECISION (RPD)	MDL (ug/Kg)	REPORTING LIMITS (ug/Kg)	LCS, MS/MSD, TRUE VALUE (ug/Kg)	SUGGESTED CALIBRATION RANGE (ug/Kg)
carbon disulfide	75-15-0	39-139	30	0.5	5	20	5-200
carbon tetrachloride	56-23-5	59-136	30	0.5	5	20	5-200
chlorobenzene	108-90-7	70-130	30	0.5	5	20	5-200
chloroethane	75-00-3	52-135	30	1.0	10	20	5-200
chloroform	67-66-3	74-129	30	0.5	5	20	5-200
chloromethane	74-87-3	30-131	30	2.0	10	20	5-200
chloroprene	126-99-8	50-150	30	2.5	5	100	5-200
cis-1,2-dichloroethene	156-59-2	70-130	30	0.5	5	20	5-200
cis-1,3-dichloropropene	10061-01-5	70-142	30	0.5	5	20	5-200
Cyclohexane	110-82-7	70-130	30	1.0	10	20	5-200
cyclohexanone	108-94-1	60-140	30	5	50	100	5-200
dibromochloromethane	124-48-1	59-136	30	0.5	5	20	5-200
dibromomethane	74-95-3	69-130	30	0.5	5	20	5-200
dichlorodifluoromethane	75-71-8	25-130	30	1.0	5	20	5-200
diethyl ether	60-29-7	60-140	30	5	10	100	5-200
diisopropyl ether	108-20-3	60-140	30	5	10	100	5-200
dimethyl disulfide	624-92-0	60-140	30	0.5	10	20	5-200
dimethyl sulfide	75-18-3	60-140	30	0.5	10	20	5-200
ethyl acetate	141-78-6	60-140	30	5	50	100	5-200
ethyl benzene	100-41-4	70-130	30	0.5	5	20	5-200
ethyl methacrylate	97-63-2	60-140	30	1.0	10	20	5-200
ethyl-tert-butyl ether	637-92-3	60-140	30	5	10	100	5-200
hexachlorobutadiene	87-68-3	65-135	30	0.5	5	20	5-200
iodomethane	74-88-4	20-288	30	1.0	10	20	5-200
isobutanol	78-83-1	50-150	30	50	100	200	10-400
Isoprene	78-79-5	40-140	30	2.0	10	20	5-200
isopropylbenzene	98-82-8	68-129	30	0.5	5	20	5-200
m+p-xylene **	179601-23-1	70-130	30	0.5	5	40	5-200
methacrylonitrile	126-98-7	60-140	30	2.5	5	100	5-200
methyl acetate	79-20-9	70-130	30	1	10	20	5-200
methyl cyclohexane	108-87-2	70-130	30	1	10	20	5-200
methyl methacrylate	80-62-6	70-130	30	2.5	5	100	5-200
methylene chloride	75-09-2	74-128	30	1.0	5	20	5-200
methyl-tert-butyl ether	1634-04-4	54-151	30	0.5	5	20	5-200
naphthalene	91-20-3	50-146	30	0.5	5	20	5-200
n-butylbenzene	104-51-8	70-136	30	0.5	5	20	5-200
n-hexane	110-54-3	58-142	30	0.5	10	20	5-200
o-xylene	95-47-6	70-130	30	0.5	5	20	5-200
p-isopropyl-toluene	99-87-6	72-128	30	0.5	5	20	5-200
propionitrile	107-12-0	60-140	30	2.5	5	100	5-200
propylbenzene	103-65-1	72-136	30	0.5	5	20	5-200
sec-butylbenzene	135-98-8	71-132	30	0.5	5	20	5-200
styrene	100-42-5	74-130	30	0.5	5	20	5-200
tert-amyl-methyl ether	994-05-8	60-140	30	5	10	100	5-200
tert-butyl alcohol	75-65-0	50-150	30	50	100	200	50-400
tert-butylbenzene	98-06-6	72-130	30	0.5	5	20	5-200

Table 3 (continued)

PARAMETER	CAS #	ACCURACY (% REC)	PRECISION (RPD)	MDL (ug/Kg)	REPORTING LIMITS (ug/Kg)	LCS, MS/MSD, TRUE VALUE (ug/Kg)	SUGGESTED CALIBRATION RANGE (ug/Kg)
tetrachloroethene	127-18-4	72-130	30	0.5	5	20	5-200
tetrahydrofuran	109-99-9	50-150	30	25	50	100	5-200
toluene	108-88-3	77-126	30	0.5	5	20	5-200
trans-1,2-dichloroethene	156-60-5	72-127	30	0.5	5	20	5-200
trans-1,3-dichloropropene	10061-02-6	65-139	30	0.5	5	20	5-200
trans-1,4-dichloro-2-butene	110-57-6	50-150	30	1.0	10	20	5-200
trichloroethene	79-01-6	72-126	30	0.5	5	20	5-200
trichlorofluoromethane	75-69-4	48-154	30	1.0	5	20	5-200
vinyl acetate	108-05-4	10-150	30	2.5	10	20	5-200
vinyl chloride	75-01-4	45-140	30	1.0	10	20	5-200
xylenes (total)	1330-27-7	70-130	30	0.5	5	60	5-600

** Unresolvable compound

Table 4*

GC/MS PURGE AND TRAP PARAMETERS	
purge time	9 – 11 minutes
dry purge time	0 – 2 minutes
desorb preheat	245° C
desorb	0.5 – 1 minute at 250° C
bake	9 -12 minutes at 260° C
LSC temp	valve 150˚ C, lines: 150° C
Archon temp	valve 95˚ C, lines 110° C
Soil Vial Temp	40° C
GAS CHROMATOGRAPH PARAMETERS	
carrier gas	helium, 99.999 %
injector temperature	220° C
oven temperature program	35° C for 4 minutes 10° C/minute to 240° C (hold 2 minutes)
MASS SPECTROMETER PARAMETERS	
beginning mass	35
ending mass	265
scan rate / sampling	8 scans/sec

* **S**uggested parameters: Adjustments may be made to improve efficiency.

Table 5
BFB Key Ion Abundance Criteria

MASS	ION ABUNDANCE CRITERIA
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	base peak, 100% relative abundance
96	5 to 9% of mass 95
173	less than 2% of mass 174
174	greater than 50% of mass 95
175	5 to 9% of mass 174
176	greater than 95%, but less than 101% of mass 174
177	5 to 9% of mass 176

Table 6
Surrogate Standards Recovery Limits

SURROGATE COMPOUND	8260 WATER *	8260 SOIL *	8260 OIL
dibromofluoromethane	86-118	80-120	52-122
Toluene-d_8	88-110	81-117	35-127
4-bromofluorobenzene	86-115	74-121	26-158
1,2-dichloroethane-d_4	80-120	80-120	43-128

*Denotes one outlier permitted given % R > 10%. Reanalysis required if two or more recovery results are outside acceptance limits.

Table 7
Quality Control Criteria
Volatile GC/MS Analysis
Method 8260B / 8260D

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
Mass spectral ion intensities (BFB criteria)	Every 12 hours prior to ICAL, ICV or CCV	See Table 5	Retune instrument and repeat BFB check
Initial Calibration (ICAL)	When Continuing Calibration is out of control or when system conditions have been altered.	≤ 30% RSD for CCC compounds, < 15% RSD for all target compounds, if >15% RSD, then linear regression, provided r ≥ 0.995 and % error ≤ 30%,then quadratic regression, provided r^2 ≥ 0.990 SPCC minimum $\overline{\text{RRF}}$	Evaluate cause; repeat calibration; or qualify data and discuss in narrative (1) See section 13.7 for additional corrective action.
Second source calibration verification (ICV)	After each initial calibration	≤ 20% drift for each analyte (1)	Re-analyze ICV; upon second failure, repeat initial calibration (1)
Continuing calibration verification (CCV)	Each 12 hours	SPCC minimum RRF, ≤ 20% difference/drift for each analyte	Re-analyze CCV; upon second failure, repeat initial calibration (1) See Section 13.8 for additional corrective action.
Internal standard (IS)	Every sample, standard, and quality control sample	Retention time within 30 seconds of IS retention time in ICAL midpoint STD and area within –50% t +100% of IS midpoint area	Check for MS malfunctions or interference; re-analyze sample
Method Blank (MB)	One per matrix/batch; maximum of 20 samples per batch	Target analytes < ½ RL/LLOQ except common laboratory solvents which must be < RL/LLOQ	Notify supervisor and initiate NCR; investigate; re-analyze samples
Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD)	One per matrix/batch; maximum of 20 samples per batch	Target compounds within the designated ranges; use project QAPP or standard control criteria (1,2)	Notify supervisor and initiate NCR; investigate; re-analyze samples
Matrix Spikes/ Matrix Spike Duplicate (MS/MSD) Sample/Sample Duplicate	One per matrix/batch; maximum of 20 samples per batch	Target compounds within the designated ranges; use project QAPP or standard control criteria (1,2)	Qualify data and/or address in the report narrative
Surrogate spike	Every sample, standard, and quality control sample	Recoveries within designated ranges: use project QAPP or standard control criteria; (one surrogate outlier permitted provided % R > 10%) (1)	Notify supervisor and initiate NCR; investigate; re-analyze samples

(1) Evaluation criteria are often project specific. Check the project QAPP.
(2) Standard criteria are set at three standard deviations from the mean; 10% marginal failure allowed, otherwise re-extract and re-analyze batch; consult supervisor and project QAPP for any exceptions.

Table 8

Guidance response factors criteria from Method SE-846 8260D

Analyte	RF
Acetone	0.01
Benzene	0.2
Bromochloromethane	0.1
Bromodichloromethane	0.3
Bromoform	0.1
Bromomethane	0.01
2-Butanone	0.01
Carbon disulfide	0.1
Carbon tetrachloride	0.1
Chlorobenzene	0.4
Chloroethane	0.01
Chloroform	0.3
Chloromethane	0.01
Cyclohexane	0.01
Dibromochloromethane	0.2
1,2-Dibromo-3-chloropropane	0.01
1,2-Dibromoethane	0.2
1,2-Dichlorobenzene	0.6
1,3-Dichlorobenzene	0.5
1,4-Dichlorobenzene	0.6
Dichlorodifluoromethane	0.01
1,1-Dichloroethane	0.3
1,2-Dichloroethane	0.07
1,1-Dichloroethene	0.06
cis-1,2-Dichloroethene	0.2
trans-1,2-Dichloroethene	0.1
1,2-Dichloropropane	0.2
cis-1,3-Dichloropropene	0.3
trans-1,3-Dichloropropene	0.3
Ethylbenzene	0.4
2-Hexanone	0.01
Isopropylbenzene	0.4
Methyl acetate	0.01
4-Methyl-2-pentanone	0.03
Methyl tert-butyl ether (MTBE)	0.1
Methylcyclohexane	0.05

Table 8 (continued)

Methylene chloride	0.01
Styrene	0.2
1,1,2,2-Tetrachloroethane	0.2
Tetrachloroethene	0.1
Toluene	0.3
1,2,3-Trichlorobenzene	0.1
1,2,4-Trichlorobenzene	0.1
1,1,1-Trichloroethane	0.05
1,1,2-Trichloroethane	0.2
1,1,2-Trichlorotrifluoroethane	0.05
Trichloroethene (Trichloroethylene)	0.2
Trichlorofluoromethane	0.01
Vinyl chloride	0.01
m,p-Xylene	0.2
o-Xylene	0.2

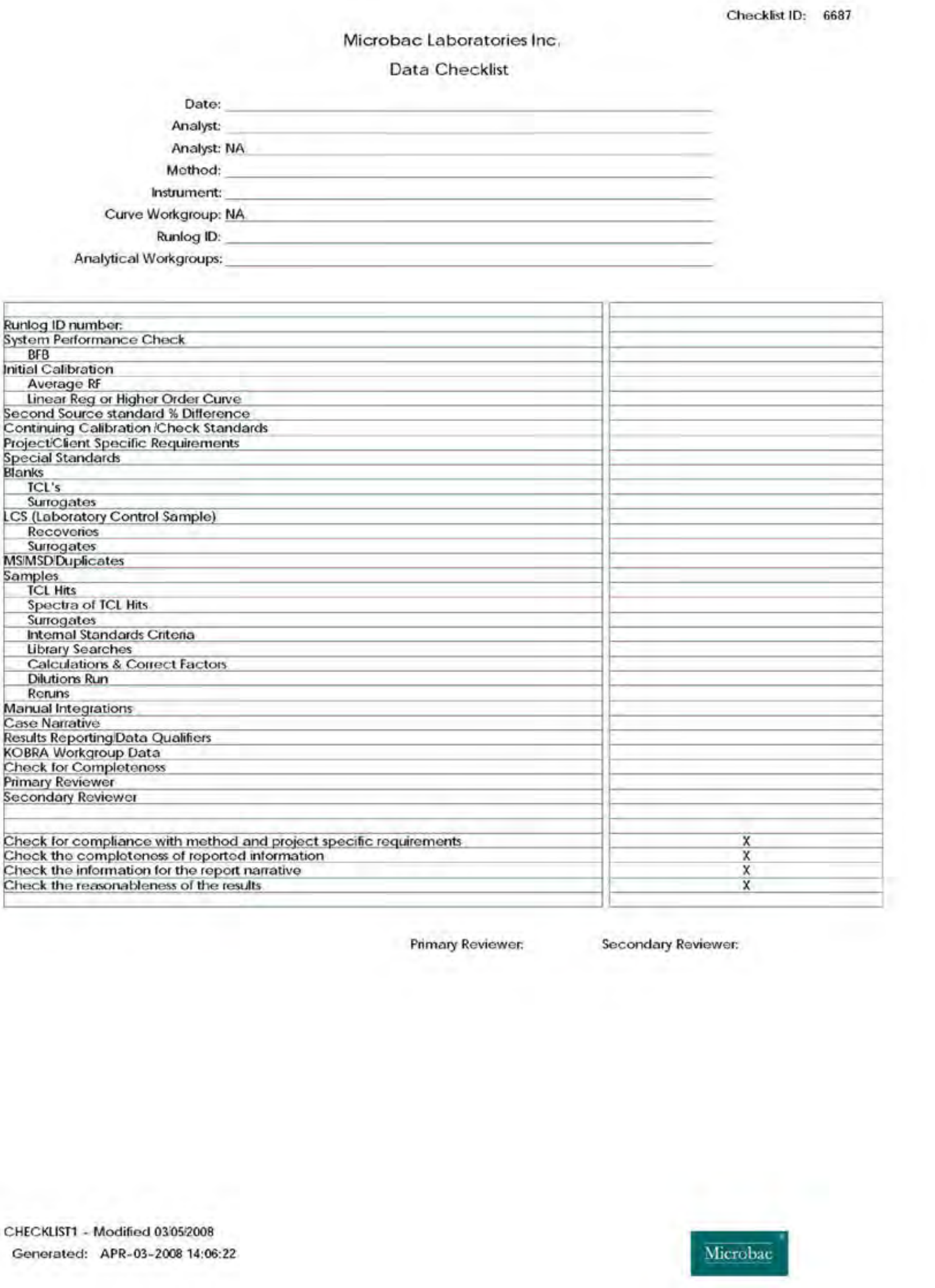
These response factors are provided as guidance only and are not intended to be a requirement.

Table 9

4-Bromofluorobenzene (BFB) suggested criteria 8260D

M/Z	Intensity (relative abundance)
95	50 to 200% of mass 174
96	5 to 9% of m/z 95
173	< 2% of m/z 174
174	50 to 200% of mass 95
175	5 to 9% of mass 174
176	95% to 105% of m/z 174
177	5 to 10% of m/z 176

Figure 1



Checklist ID: 6687

Microbac Laboratories Inc.

Data Checklist

Date: ____________________
Analyst: ____________________
Analyst: NA ____________________
Method: ____________________
Instrument: ____________________
Curve Workgroup: NA ____________________
Runlog ID: ____________________
Analytical Workgroups: ____________________

Runlog ID number:	
System Performance Check	
BFB	
Initial Calibration	
Average RF	
Linear Reg or Higher Order Curve	
Second Source standard % Difference	
Continuing Calibration /Check Standards	
Project/Client Specific Requirements	
Special Standards	
Blanks	
TCL's	
Surrogates	
LCS (Laboratory Control Sample)	
Recoveries	
Surrogates	
MS/MSD/Duplicates	
Samples	
TCL Hits	
Spectra of TCL Hits	
Surrogates	
Internal Standards Criteria	
Library Searches	
Calculations & Correct Factors	
Dilutions Run	
Reruns	
Manual Integrations	
Case Narrative	
Results Reporting/Data Qualifiers	
KOBRA Workgroup Data	
Check for Completeness	
Primary Reviewer	
Secondary Reviewer	
Check for compliance with method and project specific requirements	X
Check the completeness of reported information	X
Check the information for the report narrative	X
Check the reasonableness of the results	X

Primary Reviewer: Secondary Reviewer:

CHECKLIST1 - Modified 03/05/2008
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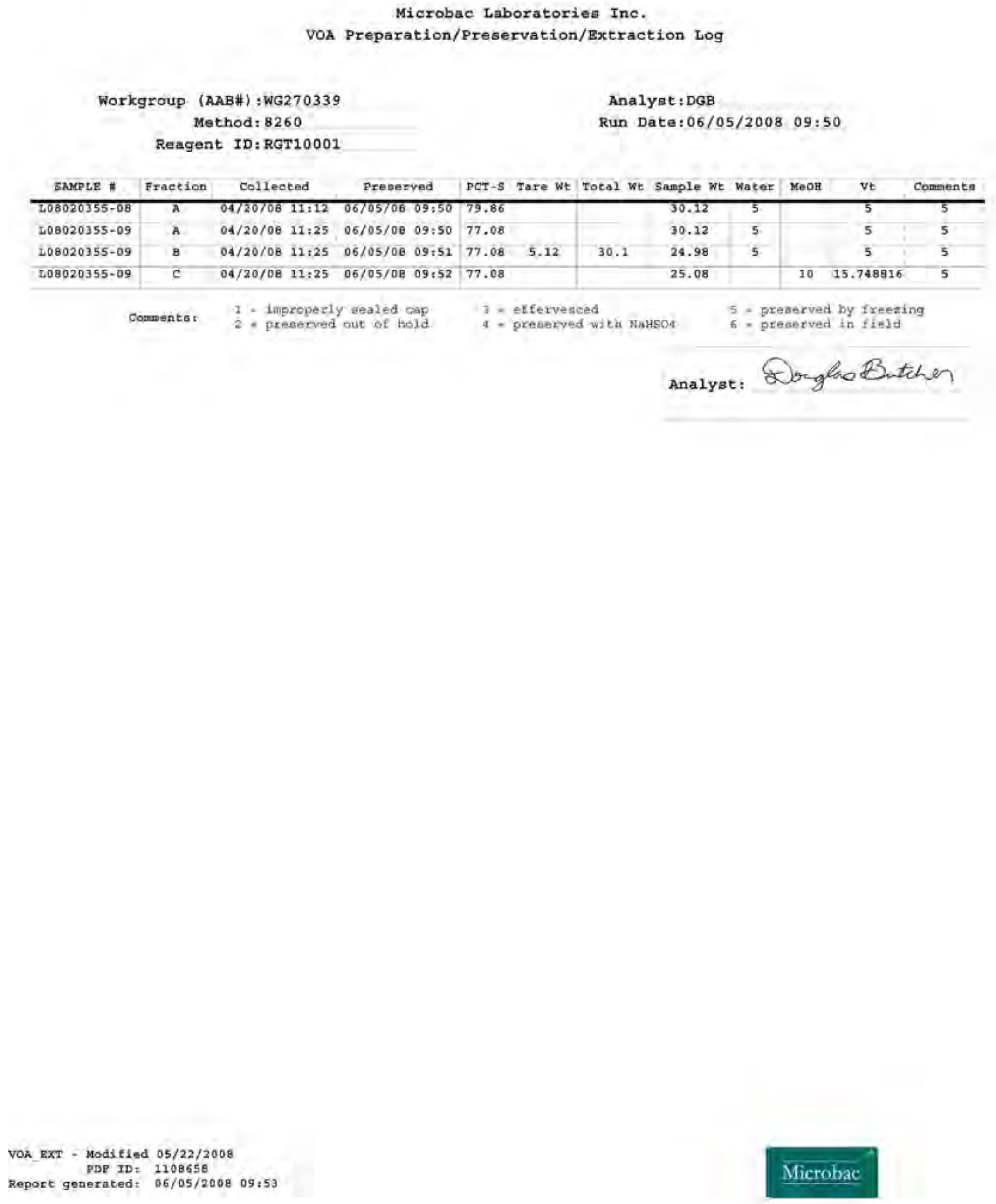
Figure 2
VOA Preparation/Preservation and Extraction Log



Microbac Laboratories Inc.
VOA Preparation/Preservation/Extraction Log

Workgroup (AAB#):WG270339
Method:8260
Reagent ID:RGT10001

Analyst:DGB
Run Date:06/05/2008 09:50

SAMPLE #	Fraction	Collected	Preserved	PCT-S	Tare Wt	Total Wt	Sample Wt	Water	MeOH	Vt	Comments
L08020355-08	A	04/20/08 11:12	06/05/06 09:50	79.86			30.12	5		5	5
L08020355-09	A	04/20/08 11:25	06/05/08 09:50	77.08			30.12	5		5	5
L08020355-09	B	04/20/08 11:25	06/05/08 09:51	77.08	5.12	30.1	24.98	5		5	5
L08020355-09	C	04/20/08 11:25	06/05/08 09:52	77.08			25.08		10	15.748816	5

Comments:
1 - improperly sealed cap
2 = preserved out of hold
3 = effervesced
4 = preserved with NaHSO4
5 = preserved by freezing
6 = preserved in field

Analyst: Douglas Butcher

VOA_EXT - Modified 05/22/2008
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L2 - Sample Receiving and Login

Uncontrolled Copy

STANDARD OPERATING PROCEDURE
SAMPLE RECEIVING AND LOGIN

Issue/Implementation Date: 02 November 2018

Last Review Date: 02 January 2019

Microbac Laboratories, Inc.
Marietta Division
158 Starlite Drive
Marietta, Ohio 45750

Approved By:

Richard Petty for CEB
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12-20-18
Date

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Adriane L. Steed, Quality Assurance Officer

12-20-18
Date

Wade T. Doty for LSB
Leslie S. Bucina, Operations Manager

12-20-18
Date

Document Control # 239

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SECTION **PAGE**

1.0 SCOPE AND APPLICATION

1.1 This document outlines procedures for sample handling, custody, container preparation, preservation, receipt, inspection/pH, login, Internal Chain of Custody, and storage. The document also addresses Temperature Monitoring and IR gun calibration.

1.2 Except as noted in Section 7.0, the support services supervisor shall have primary responsibility for implementation of these policies and procedures. Section 6.0 describes the duties of the sample custodians. Section 7.0 describes the specific duties of the customer service staff with respect to the procedures for logging samples into the LIMS.

1.3 Definitions and Acronyms

The following is a list of terms, definitions, and acronyms referenced in this SOP that are unique to the method.

COC	Chain of Custody
DI water	Deionized water
ICOC	Internal Chain of Custody
IR gun	Infrared Temperature Gun
LIMS	Laboratory Information Management System
LQAP	Laboratory Quality Assurance Plan
MD	Marietta Division
SDS	Safety data sheet
SOP	Standard Operating Procedure
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compounds

For a more comprehensive list of common terms and definitions, consult Appendix A in Microbac SOP LQAP.

2.0 SAFETY PRECAUTIONS

2.1 Safety glasses with side shields, gloves, and lab coats are worn when samples are being handled. (Safety glasses are worn at all times in the laboratory.) Additional personal safety equipment (respirators and dust masks) are available in the login area.

2.2 Occasionally samples are received broken. When this occurs, the cooler is placed immediately under the hood and samples are removed. When possible, the broken sample is placed in another container. The client is then notified by his/her Account Manager to confirm what appropriate action to take.

2.3 Broken glass is disposed of in the proper containers provided in the laboratory.

2.4 The cooler is cleaned by waste disposal personnel. All contaminated material is disposed of properly using proper waste disposal procedures. See Microbac SOP 33, “Laboratory Waste Management”.

2.5 Unknown waste samples that are received broken are placed in a container and taken to sample archive for proper disposal.

2.6 Radiological screening of samples may be performed on coolers received for special projects if required by the project QAPP. The screening is performed by the login personnel and noted in receipt information.

2.7 When highly contaminated samples are received, special precautions are taken. These samples receive special handling and storage and are tagged with a “Special Instructions” sticker. Any comments available are entered into the LIMS for the laboratory.

2.8 SDSs for each analyte and reagent used within the laboratory are available to all employees. Consult SDSs prior to handling chemicals.

3.0 EQUIPMENT AND SUPPLIES

3.1 Thermometers

3.2 pH strips: Low range 0.0 - 6.0; High range 7.5 - 14.0

3.3 Hood

3.4 IR Temperature Guns

3.5 Pipets - disposable

3.6 Geiger Counter

3.7 Gloves - disposable

3.8 PDA, Laptop or notebook computer (equipped for bar coding)

4.0 REAGENTS

4.1 20% Nitric Acid (HNO_3) Baker Instra-analyzed, or equivalent; prepared when needed in the metals laboratory. A 1000 mL glass dispenser is used to store and dispense the preservative. When HNO_3 is used as a preservative, a red label with HNO_3 is placed on the lid of the container. Label container with expiration date of 6 months after date prepared.

4.2 1:1 Hydrochloric Acid (HCL) Baker Instra-analyzed, or equivalent; prepared in the metals laboratory. 500 mL of concentrated HCL is added to 400 mL of DI water and diluted to 1L. A 1000 mL glass dispenser is used to store and dispense the preservative. When HCL is used as a preservative, a blue label with HCL is placed on the lid of the container. Label container with expiration date of 6 months after date prepared.

4.3 1:1 Sulfuric Acid (H_2SO_4) Baker Instra-analyzed or equivalent; prepared when needed in the conventional lab. 500 mL of concentrated H_2SO_4 is added to 400 mL of DI water and diluted to 1 L. A 4 L glass container is used to refill to 1000 mL glass dispenser. When H_2SO_4 is used as a preservative, a yellow label with H_2SO_4 is placed on the lid of the container. Label the container with expiration date of 6 months after date prepared.

4.4 50% Sodium Hydroxide (NaOH) comes in a ready to use solution, or equivalent. No mixing is required. A 250 mL glass container is used to store and dispense this preservative. When NaOH is used as a preservative, a blue label with NaOH is placed on the lid of the container. A sterile pipet is used to add preservative to the container. Use expiration date from the manufacturer.

4.5 Zinc Acetate/Sodium Hydroxide (ZnAc/NaOH). Zinc Acetate: prepared when needed in the conventional lab. 88 g of Zinc Acetate dihydrate crystal is dissolved in 200 mL of DI water and diluted to 250 mL. A 250 mL amber glass container is used to store and dispense the preservative. To make ZnAc/NaOH, 2 mL of ZnAc is added to the container using a sterile pipet. Add 2 mL of NaOH with another sterile pipet. Then a gold dot with ZnAc/NaOH is placed on the lid of the container. This preservative is only used for sulfide. Label container with expiration date for 6 months after date prepared.

4.6 Ascorbic Acid (C6H806) comes ready to use Ascorbic Acid, Fine Powder. No mixing is required. A 125 mL pre-cleaned wide mouth glass container is used to store and dispense the preservative. A spatula is used to add 25 mg to a 40 mL, pre-cleaned vial with septa lid. Use expiration date from the manufacturer.

4.7 Hexane: 95% ULTRA resi-Analyzed; used in PCB – wipes.

4.8 Methylene Chloride (CH2CL2) ULTRA – Resi – Analyzed used in PAH – wipes.

4.9 Sodium Thiosulfate (Na2S2O3) tablets come ready to use in a sterile plastic container. No preparation is needed.

4.10 Methanol (MeOH): EDM OmniSolv or equivalent grade suitable for purge and trap.

5.0 CUSTOMIZED SAMPLE KITS

5.1 Microbac prepares customized sampling kits for many environmental sampling projects for wastewater, groundwater, soil and waste. The process for preparing a sample kit begins when an Account Manager generates a work order (B Number) and the associated kit request/packing list.

5.1.2 The support service staff member uses the packing list to assemble the specified containers for the work order.

5.1.3 Staff member then prints out labels from the LIMS database table that states client, test, preservative and the site where the samples will be taken.

5.1.4 Containers are then set up on the work station table to be labeled and preserved.

5.1.5 Sample containers are then packed in coolers with packing material, packing lists, custody seals and chain of custody forms.

5.1.6 Cooler is then sealed with the custody seal and shipped or delivered to client.

5.1.7 Container Preparation:

All sample containers are received pre-cleaned. Pre-cleaned containers are received in cases that are labeled. Lot numbers and analyte certification records are tracked and filed with start and end dates of the Certificate of Analysis. Sample containers are never reused.

5.2 Sample Containers, Volume and Preservative

Tables 1-6 list the container type, minimum volume, and type of preservative for each analysis parameter or method. Additional instructions are provided below for conventional and wet chemistry parameters.

5.2.1 Acidity (acid) – by itself in 250 mL plastic. No preservative.

5.2.2 Alkalinity (Alk) – by itself in 250 mL plastic. No preservative.

5.2.3 Biochemical Oxygen Demand (BOD) – by itself in 500 mL plastic. No preservative

5.2.4 Bromide (Br) – by itself in 250 mL plastic. No preservative.

5.2.5 Cyanide (CN) – by itself in 250 mL plastic with 3.5 mL of 50% NAOH = pH > 12.

5.2.6 Cyanide, Amenable (CN-A) – by itself in 250 mL plastic or with CN with 3.5 mL of 50% NAOH pH > 12.

5.2.7 Coliform Fecal (Col-FC) – by itself in sterile plastic container with pellet of $Na_2S_2O_3$. (These sterile containers come prepared.)

5.2.8 Coliform Total (Col-TC) – by itself plastic container with pellet of NA2S2O3. (These sterile containers come prepared.)

5.2.9 Dissolved Oxygen (DO) – by itself in 500 mL lab glass bottle with glass stopper. When sampling be sure there is no headspace. No preservative.

5.2.10 Fluoride, Total (distilled) (F-Dist.) – by itself in 250 mL plastic. No preservative.

5.2.10.1 Distilled (subbed out) 250 mL plastic by itself – no preservatives

5.2.10.2 Non –Distilled, 250 mL, no preservative

5.2.11 Hardness (Hard) – by itself in 250 mL plastic with 3 mL of 20% HNO_3 pH < 2.

5.2.12 Iodide (I) – by itself in 250 mL plastic. No preservative. Can be included with Br.

5.2.13 Coliform Fecal/MPN – by itself in sterile plastic container with pellet of $Na_2S_2O_3$.

5.2.14 Nitrogen Organic (N_ORG) –250 mL plastic with H_2SO_4 pH<2. Can be combined with other preservative parameters.

5.2.15 Oil and Grease (OG) – by itself in 1000 mL glass with 5 mL of 1:1 HCL pH<2.

5.2.16 Phenolics, Total (T-Phen) – by itself in 250 mL amber glass with 1 mL of 1:1 H_2SO_4= pH<2.

5.2.17 Sulfite (SO_3) – by itself in 250 mL plastic. No preservative. Must notify lab.

5.2.18 Settleable Solids (Set –S) – need two bottles in 1000 mL plastic. No preservative.

5.2.19 Silica Dissolved (Silica) – by itself in 250 mL plastic. No preservative.

5.2.20 Sulfide (S) – by itself in 500 mL plastic with 4 mL of ZnAce/NaOH – pH > 9.

5.2.21 Total Dissolved Solids (TDS) – by itself in a 250 mL plastic or together with TSS in a 500 mL plastic. No preservative.

5.2.22 Total Organic Carbon (TOC) – can be put with other parameters with the same preservative. If by itself it goes into 250 mL plastic with 1 mL 1:1 H_2SO_4. Other requirements for TOC are as follows: TOC-4 used 4x250 mL plastic with 1:1 H_2SO_4, TOC -14 uses 1x250 mL glass with 1:1 H_2SO_4, TOC-44 uses 4x250 mL glass with 1:1 H_2SO_4.

5.2.23 Total Organic Halides (TOX) – by itself in 250 mL amber glass, septa lid with 1 mL of 1:1 H_2SO_4. No headspace in sample. Other requirements for TOX are TOX-4 uses 4x250 mL amber glass, septa lid with 1:1 H_2SO_4. No headspace in sample.

5.2.24 Total Suspended Solids (TSS) – by itself in a 250 mL plastic or together with TDS in a 500 mL plastic. No preservative.

5.3 Volume of Preservative use for Container Sizes:

H_2SO_4:	40 mL	½ mL = pH < 2
	250 mL	1 mL = pH < 2
	500 mL	2 mL = pH < 2
	1000 mL	4 mL = pH < 2
HNO_3:	250 mL	3 mL = pH < 2
	500 mL	5 mL = pH < 2
	1000 mL	10 mL = pH < 2
HCL:	40 mL	3 drops = pH < 2
	1000 mL	5 mL = pH < 2
NAOH:	250 mL	3.5 mL = pH > 12
MeOH:	40 mL	10 mL used in 5035 Field Prep/tare weight

5.4 Special Procedures for Volatile Organics Analysis (VOA)

5.4.1 General

Samples for VOA analysis should always be collected in separate containers. If this is not possible, the VOA analyses should be performed first or split into a separate VOA container to avoid contamination of the sample with common lab solvents.

5.4.2 Water

All water VOA containers must be filled completely with no headspace/bubbles >6mm. Preservatives, if required, consist of 3 drops of 1:1 HCl per each 40 mL vial (pH should be < 2). Pre-preserved vials are also purchased from our container vendor. These include the HCl pre-preserved as well as the $Na_2S_2O_3$ pre-preserved.

5.4.3 Oils and Waste Samples

No preservative is required for waste samples. Depending on the client and project, waste and oil samples may be collected in various glass bottles or vials. Sample volume of 5-10 mL is normally sufficient for VOA analysis of wastes and oils.

5.5 Procedure for Method 5035 – Methanol Preserved Vials

Methanol preserved vials are obtained from a container vendor when possible. If out of stock, we will employ the following procedures to prepare these in-house. Contact the Quality Assurance Officer before proceeding.

5.5.1 Print labels with client's name, parameter and preservative (MeOH).

5.5.2 Go to volatiles lab and get 40 mL VOA vial for prep of 5035 method, place label on bottles.

5.5.3 Using a calibrated volumetric dispenser, add 10 mL of MeOH to each vial. Replace cap and septum.

5.5.4 Determine the tare weight to 0.01 g and record on the vial label (beside the parameter) using a permanent marker.

5.5.5 The kit request will specify the number of containers to be provided. Place the containers in bubble bags and pack them in shipping cooler. Label the outside of the cooler with a label that states "This package conforms to 49CFR – 173.4".

5.6 Storage blanks are placed in sample refrigerators and freezers to monitor potential cross contamination. Storage blanks consists of 40 mL of analyte free DI water or

5 mL DI water and 5.00 g of sand stored for 14 days in each VOA refrigerator/freezer. Analyses are performed via Method 8260 with results quantitated to the MDL. Storage blanks are prepared weekly and logged into the LIMS laboratory account. Weekly, (after storage blanks have been stored for two full weeks) storage blanks are analyzed via 8260 (storage blanks must be analyzed within the 12 hour tune time).

5.7 Special Instruction for Coliform fecal/MPN

5.7.1 When a new lot number of sterile plastic containers is received, a container will be pulled and logged into our LIMS system. This will alert the lab of a new lot number in house that is in need of a sterility check.

6.0 SAMPLE HANDLING AND CUSTODY PROCEDURES

6.1 This section describes the procedures for receipt, inspection/pH, labeling, storage internal custody and handling of laboratory samples. These are the primary duties and responsibilities of the sample custodian(s) under the direction of the support services supervisor. Many of the processes in this section require knowledge of the Microbac-MD LIMS and specific training in the use of electronic devises including the IR temperature guns, barcode scanning devices, and PDAs, or laptop/notebook style computers. The following sections provide more details on these procedures and the tools required.

6.2 Sample Receipt Checklist/Discrepancies

The cooler inspection form (Record of Sample Receipt and Inspection) contains the following details: the cooler received date, client identification, shipping agency and time received, opened by, login number, which IR gun was used, the assigned cooler number, the cooler temperature, the air bill number, the cooler seal information, was the chain of custody provided, were samples received intact, labels legible/complete, were correct containers used, were the correct preservatives used, was the pH range acceptable, were VOA's free of head space, is the chain of custody signed and dated, were samples received within EPA hold times, were the temperatures required for each type of sample in the cooler, any discrepancies are documented on cooler inspection form and the Account Manager is notified. An example of the Record of Sample Receipt and Inspection is presented in Figure 1.

6.3 Sample Receipt and Inspection, General

6.3.1 Samples are received through shipping and receiving and moved directly to the login area. Coolers and/or boxes are checked to determine if they are sealed with tape or bandings when received.

6.3.2 When samples are returned through Microbac couriers, coolers are not sealed unless requested by client.

6.3.3 Coolers are opened in the login area. When coolers are identified as Radiological projects, the custodian will open them under the fume hood. Radiological screening will occur as outlined in the Microbac Radsafety SOP for known radiological projects before opening the coolers. This practice must be followed for all coolers containing potentially hazardous samples, unknowns, or any broken or leaking containers.

6.3.4 Samples that are delivered to the laboratory on the same day they are collected may not meet requirements of ≤6°C and not frozen. In these cases, the samples shall be considered acceptable if the samples were received on ice. The allowance for samples exceeding temperature requirements when delivered shortly after sampling does not alleviate the requirement to record a temperature, even in the presence of ice. Documentation of receipt on ice is not sufficient to meet method requirements, since methods require the temperature upon receipt. Methods and regulations require that the temperature upon receipt be recorded, regardless of whether that information is in compliance or out of compliance. A temperature blank or sample is immediately removed from the cooler and the temperature is taken with the IR Temperature Gun and recorded in the Record of Sample Receipt and Inspection. The temperature is taken by shooting the bottom of a sample. Upon receipt, samples that originate from the State of West Virginia are required to have the temperature of every bottle checked for preservation requirements. If a cooler temperature or bottle temperature requirement is not met, the affected samples must be tracked using the Discrepancy field on the inspection form. Each container must be listed from the cooler when out of temperature. See Section 9.0 for details of this procedure.

6.3.5 Samples are removed from coolers and lined up in order on carts with the Chain of Custody. When discrepancies occur between the Chain of Custody and the sample container labels, it is noted and the appropriate Account Manager is notified. The Account Manager then notifies the client. The client decides what information is correct. Corrections are noted in the discrepancy section of the Cooler Inspection Form. Corrected data is logged into the LIMS system.

6.3.6 Sample ID, date and time of collection is checked with the Chain of Custody versus sample container label. The login assistant will check the pH of all preserved water samples, with the exception of volatile organics and method 1664 (OG-HEM). These are checked at the bench by the analyst. In addition, the pH of unpreserved water samples submitted for the analyses listed in Table 7 will also be checked in order to assure that they were not inadvertently preserved. The pH for unpreserved samples must be 2<pH<10 and samples logged for method 608.3 must be within the pH range of 5-9. The pH is checked by inserting a pipet into the sample and placing a drop of the sample onto pH paper of the appropriate range (see Section 3.2). A glass pipet is used for checking pH of organic parameters and plastic pipets are used to check inorganic parameters. The assistant will verify that the pH is acceptable. The LIMS will create and update the pH record for each sample container checked in the sample delivery group (L#). If there are pH exceptions to the default acceptance criteria, the assistant/analyst will edit the pH data in the LIMS Container Records, and forward the exceptions/discrepancies to the client representative. If additional preservative is added to the container, the amount, concentration, and adjusted pH shall be recorded in the comments field in Container Records table. If the pH is out of range, the sample ID and product of the sample are recorded in the ROR System sample discrepancy section of the Cooler Inspection Form as a discrepancy by login personnel. Prior to the adjusting and storing of the samples, approval must be determined from the client through the Account Manager. The approval is noted, as well as how much, which type and lot number of the preservative was for the adjustment. Metals also requires date and time of the preservation to be recorded on the bottle and documented.

6.3.7 If a sample is received out of hold, or is improperly preserved, the client is notified and the sample is analyzed according to the client's request. The discrepancy is noted in the Cooler Inspection Form (Document Control #1957- see Figure 4) and in the LIMS system along with the client instructions. Minimum volume, container type, preservation and hold time are listed in Table 1-6. VOA Samples which are indicated on the COC as being unpreserved must have the “VOA-Unpreserved” product logged on the relevant samples with the analysis products.

6.3.8 If a single sample container of soil is received and multiple analyses including VOA are requested, a sub-sample for VOA analysis is removed by the VOA laboratory and placed in an appropriate sample container. This sub-sample for VOA analysis shall be taken prior to the sample container being opened for any other reason. Care is taken to eliminate as much headspace as possible in the new VOA sample container. This sub-sample is then handled, stored and otherwise treated the same as any other volatile sample.

6.3.9 The custodian will inspect all water samples collected in VOA vials for the acceptable levels of headspace. If any containers contain bubbles larger than 6mm, this information must be noted on the Cooler Inspections Form as a discrepancy.

6.3.10 Trip Blank hold times

Microbac Marietta – Trip Blank Collection Date Policy
The collection date and time of trip blank(s) should be the same as the last sample collected on the chain of custody with which the trip blank(s) is associated. Microbac records the date and time the trip blank(s) are prepared at the laboratory, this date and time should not be used as the collection date and time on the chain of custody. If the prepared date and time are mistakenly entered on the chain of custody for the trip blank, we will edit the date and time of collection of the trip blank to coincide with the last sample listed on the chain of custody. If the collection date and time listed on the chain of custody for the trip blank is within the collection date and time of the first and last sample on the chain of custody we will use the collection date and time as presented for hold time evaluation.

This policy has been established at the recommendation from the MICE interpretation regarding hold times for trip blanks and is consistent with EPA guidance "… a trip blank has the same "life" as a sample with which they are sent. Trip blanks are the same age as the sample set and are used to determine if the sample MAY have been contaminated in transit."

This policy may be superseded by project specific or state specific requirements. Compliance with this policy will contribute to the production of valid data.

6.3.11 When all information is correct, the samples are logged into the LIMS system. The LIMS automatically assigns a unique login number. See Sections 7.0 and 8.0 for logging procedures.

6.4 Electronic Checklist – Procedures for Using the PDA / Laptop / Notebook

This section describes the use of a PDA / Laptop or equivalent, (Section 3.8) to automate many of the cooler and sample checking procedures presented in Section 6.3. The system incorporates a barcode reader and a wireless connection to the LIMS, allowing the checklist to be completed in paperless mode. The screen displays an electronic facsimile of Figure 1, and the user is prompted to enter the information in a logical, step-wise manner. Staff must not attempt these procedures until they have been trained in the use of the PDA / Laptop or equivalent.

6.4.1 Turn the unit on and open a new receipt. The system will automatically assign a unique number for later tracing of the cooler and samples to a specific delivery group (B, P and final L number(s)).

6.4.2 Select the mode of delivery by pressing the appropriate radio button.

6.4.3 Go to “Add cooler information”

6.4.4 Scan the barcode that identifies the carrier’s airbill number.

6.4.5 Scan the barcode that identifies the cooler’s tracking number.

6.4.6 Remove the COC(s) and scan or record the COC number(s). (This can also be done later in the sequence if there are multiple COCs.). This scan of the COC will be included in the final report to our customer(s). It is important the scan be an accurate reflection of the COC as received. Therefore, maintenance of the scanning device is critical. No markings must be allowed to be introduced by the scanning process. For example, lines introduced by dust or debris on the scanner’s internal parts are not permitted. Careful and timely maintenance of the scanner is important. See Figure 2 for scanner maintenance and cleaning instructions.

6.4.7 Determine the cooler temperature with the IR Gun and enter temperature.

6.4.8 Complete the remaining checklist items using the keypad.

6.4.9 Note each exception or problem in the discrepancy files, and the preservation form. In addition, if no problems are found, note this on the form along with the pH paper lot number. (Document Control #1957, Figure 4)

6.4.10 Some samples will require priority due to short hold time or turnaround time. Use the “Priority” drop-down menu to select appropriate priority need. The short hold time may not be readily determined by information on the chain of custody. Tables 1 through 6 list hold times for each analysis. An abbreviated list is presented in Figure 3; this list is posted at the cooler inspection areas.

6.4.11 Proceed as in Section 6.3.5.

6.4.12 When you have finished this process, you may edit any checklist entry, add comments, or address discrepancy details at the login computer keyboard.

6.5 Sample Labeling

Labels for containers and mailing reports are then printed, label bottles, and put mailing report labels along with chain of custody form in folder.

6.6 Sample Storage

Samples are stored according to analyses. In the walk-in cooler (W-1) shelves are designated by departments. These identify the sample storage location for easy retrieval by the laboratory. Volatile samples (V-1) are stored in a separate refrigerator with the exception of waste samples. These are kept in the walk-in cooler or on a holding shelf in archive until analyses can be performed.

6.7 Internal Chain of Custody Procedures

If a client requests samples to be tracked throughout the lab, an ICOC form is generated through a computer program. “ICOC” prints out on the label. This label also contains a unique bar code. The analyst is responsible for scanning out the samples using his/her bar coded badges. The samples are then relinquished by the appropriate personnel in the login area. Other information as to the location of the sample, which department the sample is going to can be scanned from a bar coded template. When the analyst is ready to return the samples, it is scanned back into the computer by the relinquishing employee using his/her bar coded badges, one login personnel’s badge and the location to which the sample is being returned (walk-in/archive/disposal). It is not always possible to have a custodian present when samples are removed from storage. The analyst will scan a special barcode designated for all “after hours” removal of samples from the login area storage unit.

6.8 Sample Disposal

After all analyses have been completed, the sample custodians will move the sample residuals to the archive storage units, where they will remain for the time specified in the client agreement. At regular intervals the sample custodian or other trained staff member will dispose of aqueous, solid, and organic-matrix samples in accordance with Microbac SOP 33 (Laboratory Waste Management). Alternatively, the laboratory may return selected sample residuals to the client.

6.9 Saturday Receipt of Short Hold Time Samples

It is the responsibility of the Account Managers and their assistants to notify the laboratory and the sample custodians if samples with short hold times (Figure 3) are to be received on Saturdays. The notification will be in the form of an email addressed to “OVD-Headsup” which reaches all of the relevant personnel. Samples for which the laboratory has been notified of shipment do not require any specials actions on the part of the sample custodian receiving the cooler(s). In the case that unannounced short hold time samples are received on Saturday, it is the responsibility of the sample custodian to notify the affected department supervisor or designee by telephone so that the appropriate action can be taken to process the samples within the holding time.

6.10 After Hours Receipt from Clients

When a client cannot drop off sample(s) to the lab during normal business hours, we provide a locked drop box at the shipping/receiving area. The client can contact their Account Manager to notify them that they need to use the drop box; the box will be left unlocked for the client to drop off their cooler. Once they drop off the cooler, they will lock the box. If needed, the cooler will be received later that night or first thing the next morning by the login personnel. If the project is an ongoing event, the client will be provided a key to unlock and lock, on an as needed basis during their project.

7.0 OVERVIEW OF LOGGING PROCESS

This section describes the duties of the sales/service team, specifically the Account Managers and their assistants, as they pertain to logging of project and sample information into the LIMS. These duties are summarized below:

7.1 The sales/service department must enter account and project information into the LIMS as a prerequisite to preparing quotations and work-orders or to the actual logging of samples. The LIMS assigns unique serial numbers for each account and for the associate project.

7.2 Quotations (Q number)

Quotations are used to enter special pricing in the LIMS and are often included as part of the sales proposal. The LIMS assigns a unique serial number for each quotation. (Q-number)

7.3 Work-orders (B number)

The service team creates a work order upon new project award, or when sample containers are requested for an existing project. The work order includes sample, matrix and product information in sufficient detail to generate a packing list for sample kits and for the efficient logging of samples once received at the laboratory and to create templates for repetitive sampling events. The LIMS assigns a unique serial number (B number) for each work order.

7.4 Sample Pre-logging (P number)

Pre-logging is the preliminary process of logging samples into the LIMS either upon receipt of the samples, or when chain of custody forms are provided to the lab in advance of sample receipt. The LIMS assigns a unique serial number

(P number) for each sample in the pre-log status, and information is subject to review and editing by the sales/service teams.

7.5 Final Logging (L number)

After the information in the pre-log number is reviewed and deemed accurate, the Sample Custodian or designated client representative will perform the final login procedure. In this step the LIMS assigns a unique serial number (L number) and generates sample labels for each container in the sample delivery group.

7.6 Other Data Entry

Most of the analytical data is entered into the LIMS via automatic data upload from the laboratory instrumentation, or through other LIMS tools such as electronic bench sheets used by the analyst. The custodian or Account Manager must employ manual data entry procedure for a few methods, primarily field data provided by the samplers. Examples include pH, dissolved oxygen, and conductivity.

7.7 Login Folder Review and Client Communication

The Client Representative or team chemist is responsible for accuracy of the information entered into LIMS for accounts, projects, and login numbers. This review must occur prior to release of the samples to the laboratory and is normally performed after the pre-log step of the process. The service team is also responsible for communication and resolution of any discrepancies identified at the time of sample receipt and inspection. Other duties of the service teams are presented in Microbac SOP 44 and Microbac SOP MISDATA01.

8.0 DETAILED LOGGING PROCEDURE

8.1 Log into the LIMS.

8.2 Go to Sample Management; Login; Login ID – enter the correct work order (B number) or template (T number); Check Pre-Login and click OK.

8.3 Check all products in the matrix for each client ID. **DO NOT CHANGE ANY INFORMATION IN THE B# SCREEN.** Check all projects/products, etc. in this screen to make sure they match the chain of custody. **Read Login information in the top right corner for specific instructions.**

8.4 Go to Copy; Copy Template; Source Template B number; Pre-Login; Collect Date (Change date if needed); then click OK.

8.5 The pre-log (P number) Screen will come up at this time. This is the screen you edit if necessary. For example: If unpreserved VOA samples were received and the B number does not include the “VOA-Unpreserved” code, it can be added to samples on this screen.

8.6 Place your cursor on the Client ID. Check the matrix below to see if it is correct against the chain of custody and the bottles lined up. If the matrix matches the chain of custody and the bottles, go back to the client ID.

- You may have to change the client ID to match the bottle or chain of custody ID.
- Tab over to the received date; enter 0 and tab for the current date and add the time received from the printed barcode label that the ROR system generates.
- Tab over to the collect date; the date should be filled in but you will need to add the time. If no time is given, default to 00:01.
- Tab over to the TAT; do not change this number; if the TAT is different from the chain of custody, put this information in the “Prelim” button, not the TAT.
- Tab to the end of the line checking for any errors and also to check comments and QC tags.

8.7 Move your cursor down to the next fraction (line) and start over with these instructions from Section 8.6. When tabbing to the receive and collect dates/times use the F3 key and the dates/times will copy from the above fraction ***or*** you can also “Copy Duplicate Fractions” or “Copy Products” by going to the Copy tab on the Toolbar, and clicking on one or the other. To delete fractions or products, shift F6.

8.8 If nothing else needs added or deleted go to Copy; order fractions; click on the Auto Calc due dates button and the F10 to save. This will automatically fill in the due dates and client dates. Click on the add prods button at the bottom of the page. Be sure to add prods on LAST fraction.

8.9 At this point, your folder which is now a P number needs to go through Peer Review or given to the client representative for review. When the folder is returned to you after review, you may make corrections if needed and then take it to an L number. Be sure to take care of discrepancies if needed.

8.10 In order to take a P number to an L number go to copy; source template P# _____; Login.

8.11 The L number screen will come up at this time. If a green button comes up at the top of the screen, click on it at this time.

8.12 Click on Reports; The L number will come up automatically at this time in the Login Reports screen; go to Login Labels; Printer; Go and your labels will print with address labels attached. Watch for the ICOC on label. Use pen to color labels for help with archiving.

8.13 Label the bottles and put them away in their appropriate walk-in, refrigerator or freezer.

8.14 Place the client Chain of Custody form, and the extra client address labels in a manila master folder.

8.15 Place the client address label on the folder tab and in the bottom right hand side, on the front of the folder, facing out (sideways).

8.16 If the TAT is less than 7 days or these are short hold, make a note on the outside of the master folder to help in prioritizing review.

8.17 Folders are then taken to the Service team.

9.0 CALIBRATION AND QUALITY CONTROL

9.1 IR Gun Calibration

9.1.1 The IR Temperature Guns are calibrated once a year by Cole-Parmer and a certificate is supplied and are maintained in the QA office. The guns are calibrated quarterly (every 3 months) by Wet Lab personnel.

9.1.2 The calibration of the IR temperature guns are checked once daily, in the morning before use against the ROR system Quality Control probe thermometer in the 1005/WI walk-in cooler by Support Service personnel. Readings are recorded in the temperature log books. The IR gun must read within 0.5° C of the probe reading. If this is unsuccessful, the IR Temperature Gun is returned to the manufacturer for maintenance.

9.2 Coolers are received into the Login area. A temperature blank is removed and held near the IR Temperature Gun. (If a temperature blank is not available, any size container can be used.) A temperature reading is taken for each cooler or bottle if required, see 6.3.4.

9.2.1 The IR Temperature Gun is pointed at the bottom of the bottle. The trigger on the gun is pulled immediately and a reading appears on the readout of the gun. The temperature is then recorded in the Cooler Inspection section of the ROR.

9.2.2 If the temperature exceeds 6° C, the Account Manager is notified so that the client may be advised that their samples were received with the temperature out of range. All sample containers in a cooler with a temperature exceeding the 6ºC when required or received frozen must be listed in the Discrepancy section of the inspection report and on Form #1957(Figure 4). Clients will then decide if the samples are to be analyzed or not. (Acceptance criteria can be adjusted at the request of the client). If the samples are received frozen, then this is noted in the discrepancy section of the Cooler Inspection Form and the Account Manager is notified.

9.3 Procedure for Tracking When Cooler Temperature is not Within Guidelines

9.3.1 Login Staff

When cooler or bottle temperature is determined to be out of the regulatory guidelines:

1. Label each container from the cooler with a “Cooler Temp Out” or “Bottle Temp Out” sticker.
2. If the cooler is to be unpacked at a later time, label the cooler with a “Cooler Temp Out” sticker.
3. Place a “Cooler Temp Out” sticker on the front of the project folder to notify project management.
4. When bottle temperature is out for WV samples, NOTE EACH BOTTLE on the form and label each bottle that is out with “Bottle Temp Out” sticker.

The temperature discrepancy still needs noted in the receipt and inspection forms.

9.3.2 Analysts

When analyzing a sample with a container labeled with a “Cooler Temp Out” or “Bottle Temp Out” sticker.

1. Indicate on your bench sheets and extraction logs the sample being analyzed was received out of regulatory guidelines with “CT1” in the comment section.

9.3.3 Data Reviewers and Supervisors

1. Data must be qualified at the analyte level for samples received in coolers with the temperatures outside of regulatory guidelines.
2. Address the temperature out of regulatory guidelines in the case narrative

using the appropriate phrase below.

9.3.4 Case Narrative Comments (Helpful Hints)

1. The temperature at receipt was XX C, but samples were received within 15 minutes of collection.
2. The temperature at receipt was XX C, exceeding the regulatory guidelines for testing.
3. Although samples were on ice, the temperature at receipt was XXXC, exceeding the regulatory guidelines of 0°-10°C for microbiological testing.
4. Although samples were received on ice, the temperature at receipt was XX C, exceeding the regulatory guidelines of 0°-6°C for chemical testing.

9.4 Temperature of Storage Units

The temperatures of the walk-in cooler, archive walk-in, V1 storage refrigerator, and the F-1 freezer are checked every four hours via electronic temperature probes. This system sends an email alert to the login supervisor and staff if a temperature is out of range. In the event of a temperature excursion for the walk-in coolers, Microbac notes the discrepancy and takes appropriate actions to relocate the samples if the problem persists.

10.0 REFERENCES

10.1 Microbac SOP LQAP “Laboratory Quality Assurance Plan”

10.2 Microbac SOP RADSAFETY “Radiation Safety Program Manual”

10.3 Microbac SOP33 “Laboratory Waste Management”

10.4 Microbac SOP44 “Project Management, Technical Service and Subcontracting”

10.5 Microbac SOP MISDATA01”Data Entry, Data Review and Reporting”

Table 1
Sample Containers, Preservation and Hold Times
CONVENTIONALS - WATER

PARAMETER	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
Acidity	100	P, G	Cool, ≤ 6° C	14 Days
Alkalinity	100	P, G	Cool, ≤ 6° C	14 Days
Total Solids	50	P, G	Cool, ≤ 6° C	7 Days
Ash Content @ 750° C	25	P, G	Cool, ≤ 6° C	---
Biochemical Oxygen Demand	500	P, G	Cool, ≤ 6° C	48 Hours
BTU	10	P, G	Cool, ≤ 6° C	---
Formaldehyde	20	G	Cool, ≤ 6° C	3 Days
Chloride	25	P, G	Cool, ≤ 6° C	28 Days
Chloride, Total Residual	100	P, G	Cool, ≤ 6° C	6 Hours
Cyanide (midi)	50	P, G	Cool, ≤ 6° C, NaOH, pH>12	14 Days
Cyanide, Amenable to Chlorination (midi)	100	P,G	Cool, ≤ 6° C, NaOH, pH>12	14 Days
Chemical Oxygen Demand	25	P, G	Cool, ≤ 6° C, H_2SO_4, pH<2	28 Days
Color, Platinum-Cobalt	50	P, G	Cool, ≤ 6° C	48 Hours
Coliform, Fecal	120	Sterile P, G	Cool, < 10° C, $Na_2S_2O_3$	8 Hours
Coliform, Total	100	Sterile P, G	Cool, < 10° C, $Na_2S_2O_3$	8 Hours
Specific Conductance	100	P, G	Cool, ≤ 6° C	28 Days
Corrosivity (pH)	50	P, G	Cool, ≤ 6° C	---
Chromium, Trivalent (calc)	-	P, G	Cool, ≤ 6° C	---
Chromium, Hexavalent	150	P, G	Cool, ≤ 6° C	24 Hours
Dissolved Oxygen	300	G	Cool, ≤ 6° C	6 Hours
Fluoride	25	P, G	Cool, ≤ 6° C	28 Days
Ignitability	75	P, G	Cool, ≤ 6° C	28 Days
Fluoride, Total (Distilled/Non-Distilled)	200	P, G	Cool, ≤ 6° C	28 Days
Hardness	100	P, G	Cool, ≤ 6° C, HNO3, pH<2	6 Months
Surfactants (MBAS)	100	P, G	Cool, ≤ 6° C	48 Hours
Coliform Fecal (MPN)	100	Sterile P, G	Cool, < 10° C, $Na_2S_2O_3$	8 Hours
Nitrogen, Ammonia (Distilled/Non-Distilled)	100	P, G	Cool, ≤ 6° C, H_2SO_4, pH<2	28 Days
Nitrogen, Nitrite	50	P, G	Cool, ≤ 6° C	48 Hours
Nitrogen, Nitrate	75	P, G	Cool, ≤ 6° C	48 Hours
Nitrogen, Nitrate-Nitrite	25	P, G	Cool, ≤ 6° C, H_2SO_4, pH<2	28 Days
Nitrogen, Organic (calc)	100	P, G	Cool, ≤ 6° C, H_2SO_4, pH<2	28 Days
Oil and Grease	1000	G	Cool, ≤ 6° C, HCl, pH<2	28 Days

1. P = Polyethylene (preferred when acceptable)
2. G = Borosilicate glass with Teflon lined cap
3. For more current list of method and preservations, see LIMS tables, Products/Containers

Table1 (continued)
Sample Containers, Preservation and Hold Times
CONVENTIONALS - WATER

PARAMETER	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
Phenolics, Total	100	Amber, G	Cool, ≤ 6° C, H_2SO_4, pH< 2	28 Days
Phosphorus, Total	50	P, G	Cool, ≤ 6° C, H_2SO_4, pH< 2	28 Days
pH Lab	50	P , G	Cool, ≤ 6° C	6 Hours
Orthophosphate	50	P, G	Cool, ≤ 6° C	48 Hours
Reactivity, Cyanide	10	P, G	Cool, ≤ 6° C	---
Reactivity, Sulfide	10	P, G	Cool, ≤ 6° C	---
Sulfite	50	P, G	Cool, ≤ 6° C	6 Hours
Settleable Solids	1000	P, G	Cool, ≤ 6° C	48 Hours
Sulfate	25	P, G	Cool, ≤ 6° C	28 Days
Specific Gravity	50	P, G	Cool, ≤ 6° C	---
Total (Organic) Sulfur	10	P, G	Cool, ≤ 6° C	---
Sulfide	500	P, G	Cool, ≤ 6° C, Zinc Acetate, NaOH, pH> 9	7 Days
Total Dissolved Solids	50	P, G	Cool, ≤ 6° C	7 Days
Total Suspended Solids	200	P, G	Cool, ≤ 6° C	7 Days
Turbidity	50	P, G	Cool, ≤ 6° C	48 Hours
Volatile Dissolved Solids	50	P, G	Cool, ≤ 6° C	7 Days
Total Volatile Solids	50	P, G	Cool, ≤ 6° C	7 Days
Volatile Suspended Solids	200	P, G	Cool, ≤ 6° C	7 Days
UCMR4 546	40	Amber, G	Cool, ≤ 10° C Sodium thiosulfate	14 Days

1. P = Polyethylene (preferred when acceptable)
2. G = Borosilicate glass with Teflon lined cap
3. For more current list of method and preservations, see LIMS tables, Products/Containers

Table 2
Sample Containers, Preservation and Hold Times
VOLATILE ORGANICS (VOA) - WATER

PARAMETER	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
Gasoline Range Organics	40 mL	G, Septa Caps	Cool, ≤ 6° C, HCl, pH< 2	14 Days
Volatile Aromatics	40 mL	G, Septa Caps	Cool, ≤ 6° C, HCl, pH< 2	14 Days
Volatile Organics (VOA)	40 mL	G, Septa Caps	Cool, ≤ 6° C, HCl, pH< 2	14 Days
VOA – Method 624.1	40 mL	G, Septa Caps	Cool, ≤ 6° C	7 Days
VOA – Method 624.1 (chlorinated)	40 mL	G, Septa Caps	Cool, ≤ 6° C, $Na_2S_2O_3$	7 Days

*Provided upon client request when samples contain chlorine.

Table 3
Sample Containers, Preservation and Hold Times
SEMIVOLATILE ORGANICS - WATER

PARAMETER	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
Diesel Range Organics	1000 mL	G	Cool, ≤ 6° C	7 Days
Pesticides/PCBs	1000 mL	G	Cool, ≤ 6° C	7 Days
Polyaromatic Hydrocarbons	1000 mL	G	Cool, ≤ 6° C	7 Days
Herbicides	1000 mL	G	Cool, ≤ 6° C	7 Days
EDB/DBCP	3.40 mL	G	Cool ≤ 6° C	7 Days
Semivolatile Organics	1000 mL	G	Cool, ≤ 6° C	7 Days
PFAS by LCMS Compliant with QSM.1 Table B-15	250 mL	HDPE bottle With unlined HDPE screw cap	Cool ≤10°C when received; store at ≤6°C	14 Days
537 Drinking Water	250 mL	Polypropylene Bottle with an Polypropylene Screw-cap	Trizma 5.0g/L; Cool ≤ 10°C when received; Store at ≤ 6°C	14 Days
UCMR4 544	500 mL	Amber, G	Cool ≤ 10°C Trizma, 2-chloroacetamide, Ascorbic acid, EDTA Trisodium salt	28 Days
UCMR4 545	60 mL	Amber, G	Cool ≤ 10°C Sodium Bisulfate, Ascorbic acid	28 Days

* Sodium thiosulfate is added for DE chlorination when Method EPA 608 is requested.

1. P = Polyethylene (preferred when acceptable)
2. G = Borosilicate glass with Teflon lined cap
3. For more current list of method/preservatives, see LIMS tables, containers and product

Table 4
Sample Containers, Preservation and Hold Times
METALS - WATER

PARAMETER	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
All Metals (26)	500 mL	P, G	HNO_3, pH< 2	6 Months*
Mercury	50 mL	P, G	HNO_3, pH< 2	28 Days
Furnace Metals	100 mL	P, G	HNO_3, pH< 2	6 Months

Table 5
Sample Containers, Preservation and Hold Times
TCLP - WATER

PARAMETER	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
TCLP Volatiles	100 mL	G	Cool, ≤ 6° C	14 Days
TCLP Semi-Volatiles	100 mL	G	Cool, ≤ 6° C	14 Days
TCLP Pesticides	100 mL	G	Cool, ≤ 6° C	14 Days
TCLP Herbicides	100 mL	G	Cool, ≤ 6° C	14 Days
TCLP Metals	100 mL	P, G	Cool, ≤ 6° C	6 Months*

* For (1) TCLP parameter 100 mL required; for full TCLP (2) 1000g
* Mercury is 28 days

NOTE:
1. P = Polyethylene (preferred when acceptable)
2. G = Borosilicate glass with Teflon lined cap
3. Triple the volumes above for MS/MSD samples

Table 6
Sample Containers, Preservation and Hold Times
SOIL

METHOD	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
Coliform Fecal	1g	G	Cool, < 10° C	8 Hours
Chromium, Hexavalent	50g	G	Cool, ≤ 6° C	24 Hours
5035	5 g	P, G	Cool, ≤ 6° C	48 Hours
TCLP-VOA	105g	G	Cool, ≤ 6° C	14 Days
TCLP-SV	105g	G	Cool, ≤ 6° C	14 Days
TCLP-Pest/Herb	105g	G	Cool, ≤ 6° C	14 Days
TCLP-Metals	105g	G	Cool, ≤ 6° C	6 Months *
Total Metals (except Hg)	3g	G	N/A	6 Months
Hg	2g	G	Cool, ≤ 6° C	28 Days
DRO	30g	G	Cool, ≤ 6° C	28 Days
Semi-Volatiles	30g	G	Cool, ≤ 6° C	14 Days
Herbicides	50g	G	Cool, ≤ 6° C	14 Days
Volatiles	1g	G	Cool, ≤ 6° C	14 Days
Conventionals (where applicable)	1g – 100g	G	Cool, ≤ 6° C	14 Days
Petroleum Hydrocarbons	30g	G	Cool, ≤ 6° C	14 Days
Percent Moisture	25 g	P, G	Cool, ≤ 6° C	---
Percent Solids	25 g	P, G	Cool, ≤ 6° C	---
Paint Filter Liquids Test	100 g	P, G	Cool, ≤ 6° C	---
TPH 9071	100 g	G	Cool, ≤ 6° C	28 Days

Table 7
Analyses Requiring Unpreserved pH Checks

Test	Method
Alkalinity	SM 2320B
Alkalinity, Automated	EPA 310.2
Acidity	SM 2310B
Chloride	SM 4500CL E
Ferrous Iron	SM 3500FE B
Sulfate	SM 4500S04 E
	EPA 375.4
Solids, Total Dissolved, TDS	SM 2540C
Residue, Volatile	EPA 160.4
Residue, Total TSS	SM 2540B
Residue, nonfilterable TSS	SM 2540D
Reside, Settleable	SM 2540F
IC Anions	EPA300.0
	EPA 9056
Conductivity	SM 2510
	EPA 120.1
MBAS	SM 5540C
Turbidity	SM 2130B
	EPA 180.1
Fluoride, Electrode	SM 4500FC
Chlorine	SM 3400CL G
Perchlorate	EPA 6850
Acetate/Formate	SOP- HPLC12
Fluroborate	SOP-K9305
Organic Analysis of Pesticides	EPA 608.3

Figure 1

Microbac

Lab Report #: L13080127
Lab Project #: ZZ84.033
Project Name:
Lab Contact: Stephanie Mossburg

Record of Sample Receipt and Inspection

Comments/Discrepancies

This is the record of the shipment conditions and the inspection records for the samples received and reported as a sample delivery group (SDG). All of the samples were inspected and observed to conform to our receipt policies, except as noted below.

There were no discrepancies.

Discrepancy	Resolution

Coolers

Cooler #	Temperature Gun	Temperature	COC #	Airbill #	Temp Required?
00110885	H	5.0			X

Inspection Checklist

#	Question	Result
1	Were shipping coolers sealed?	NA
2	Were custody seals intact?	NA
3	Were cooler temperatures in range of 0-6?	Yes
4	Was ice present?	Yes
5	Were COC's received/information complete/signed and dated?	Yes
6	Were sample containers intact and match COC?	Yes
7	Were sample labels intact and match COC?	Yes
8	Were the correct containers and volumes received?	Yes
9	Were samples received within EPA hold times?	Yes
10	Were correct preservatives used? (water only)	Yes
11	Were pH ranges acceptable? (voa's excluded)	NA
12	Were VOA samples free of headspace (less than 6mm)?	NA

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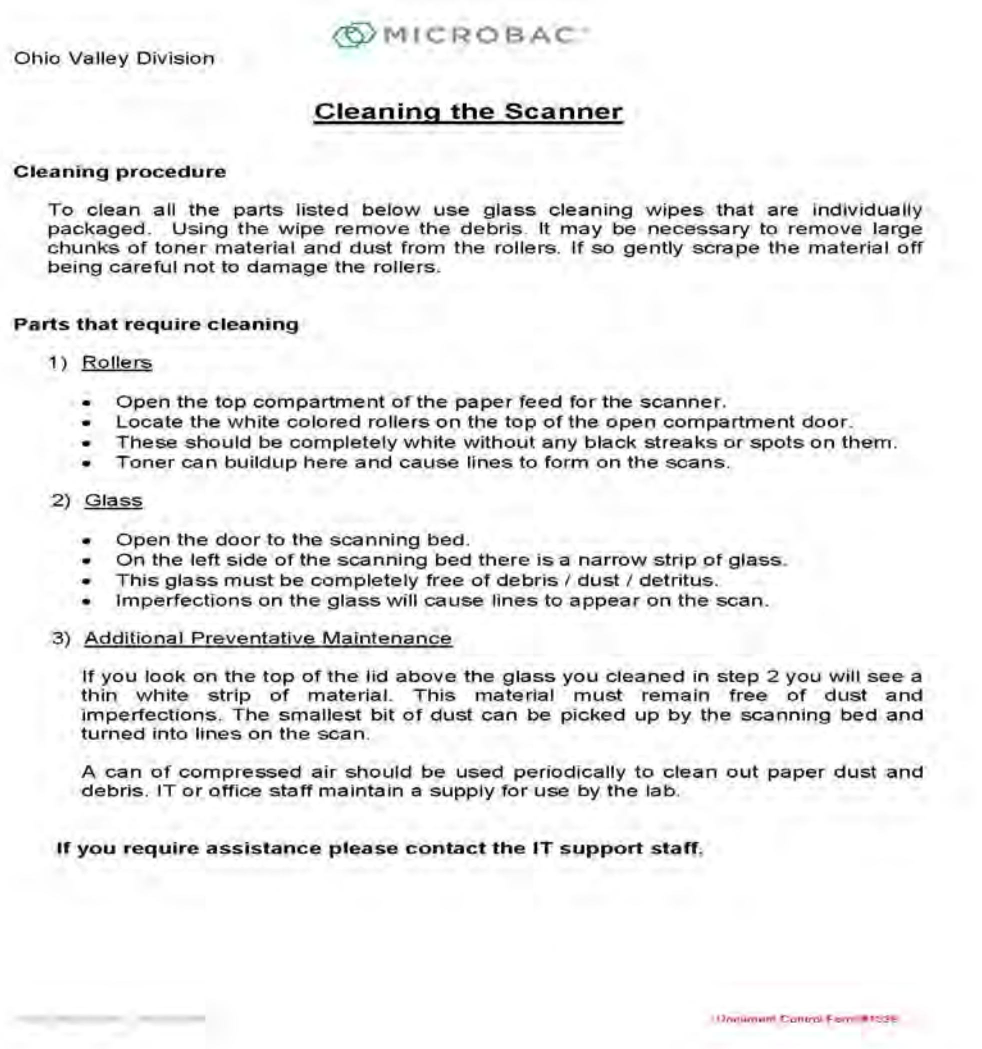
Figure 2



Ohio Valley Division

MICROBAC

Cleaning the Scanner

Cleaning procedure

To clean all the parts listed below use glass cleaning wipes that are individually packaged. Using the wipe remove the debris. It may be necessary to remove large chunks of toner material and dust from the rollers. If so gently scrape the material off being careful not to damage the rollers.

Parts that require cleaning

1) Rollers

- Open the top compartment of the paper feed for the scanner.
- Locate the white colored rollers on the top of the open compartment door.
- These should be completely white without any black streaks or spots on them.
- Toner can buildup here and cause lines to form on the scans.

2) Glass

- Open the door to the scanning bed.
- On the left side of the scanning bed there is a narrow strip of glass.
- This glass must be completely free of debris / dust / detritus.
- Imperfections on the glass will cause lines to appear on the scan.

3) Additional Preventative Maintenance

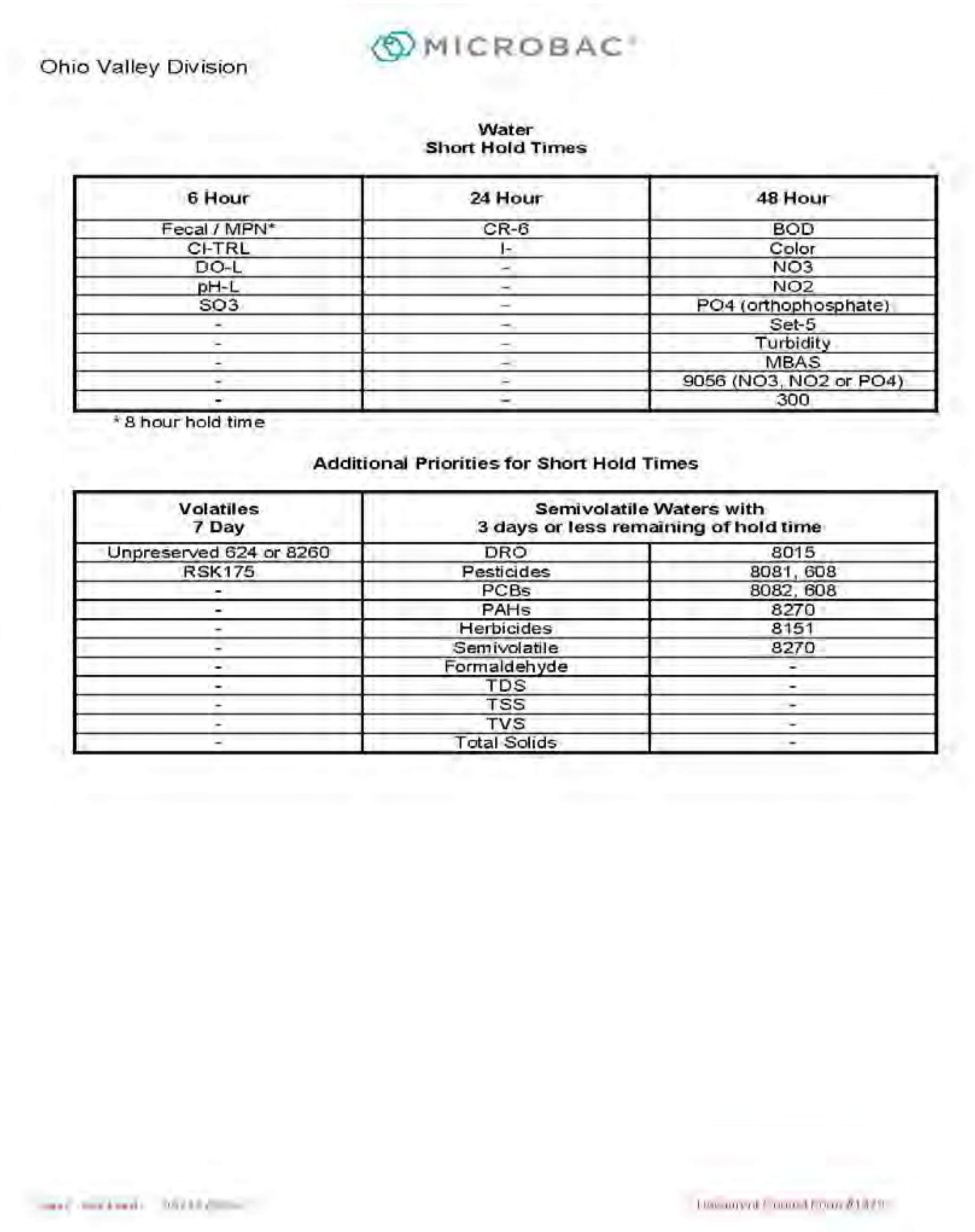
If you look on the top of the lid above the glass you cleaned in step 2 you will see a thin white strip of material. This material must remain free of dust and imperfections. The smallest bit of dust can be picked up by the scanning bed and turned into lines on the scan.

A can of compressed air should be used periodically to clean out paper dust and debris. IT or office staff maintain a supply for use by the lab.

If you require assistance please contact the IT support staff.

Document Control Form#1536

Figure 3



Ohio Valley Division

Water
Short Hold Times

6 Hour	24 Hour	48 Hour
Fecal / MPN*	CR-6	BOD
Cl-TRL	I-	Color
DO-L	-	NO3
pH-L	-	NO2
SO3	-	PO4 (orthophosphate)
-	-	Set-5
-	-	Turbidity
-	-	MBAS
-	-	9056 (NO3, NO2 or PO4)
-	-	300

* 8 hour hold time

Additional Priorities for Short Hold Times

Volatiles 7 Day	Semivolatile Waters with 3 days or less remaining of hold time	
Unpreserved 624 or 8260	DRO	8015
RSK175	Pesticides	8081, 608
-	PCBs	8082, 608
-	PAHs	8270
-	Herbicides	8151
-	Semivolatile	8270
-	Formaldehyde	-
-	TDS	-
-	TSS	-
-	TVS	-
-	Total Solids	-

Figure 4

MICROBAC

COOLER TEMP >6° C LOG

Cooler ID______

	Bottle 1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6
SAMPLE ID	°C	°C	°C	°C	°C	°C

pH Exceptions

pH Lot #________

SAMPLE ID	Bottle 1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6

Document Control # 1957
Last 10-07-2016

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L3 - Volatile Organic Compounds by GC/MS – SW 846 Method 8260B/C

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 Phone: 908 789 8900 Fax: 908 789 8922

QA Control Code : A2040038

SOP Name :	Volatile Organics by method 8260
SOP Id :	M8260B-C-SWGCMSVOA-23
Revision# :	23
Date Created :	
Effective Date :	09/11/2017
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Approvals :

John Carlone	01/23/2018
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Supervisor	Date
Himanshu Prajapati	01/23/2018
QA/QC Director	Date
Emanuel Hedvat	02/12/2018
Technical Director	Date

VOLATILE ORGANIC COMPOUNDS BY GC/MS

1. TEST METHOD

1.1 Determination of Volatile Organic Compounds by using SW-846 Method 8260B/C using SW-846 Method 5030B-Purge and Trap for Aqueous Samples and SW-846 Method 5035A – Closed System Purge and Trap and Extraction for Volatile Organics in Soil and Waste Samples.

2. APPLICABLE MATRICES

2.1 Ground and surface water, wastewater, aqueous sludges, soils and sediments.

3. DETECTION LIMITS

3.1 MDL is verified quarterly.

4. SCOPE AND APPLICATION

4.1 This SOP outlines the procedure used to determine volatile organic compounds by Gas Chromatography/Mass Spectrometer (GC/MS). This SOP is used for both aqueous and non-aqueous samples, with method variations described where applicable to the different matrices.

4.2 The compounds determined by this method can be found in Table 1.

5. SUMMARY OF TEST METHOD

5.1 <u>Water Samples</u>

5.1.1 Helium is bubbled through a 5mL/25mL portion of the sample in a purge chamber at 30 to 40mL/min at ambient temperature.

5.1.2 The purgeables are transferred from the aqueous to the vapor phase and are passed through a sorbent trap.

5.1.3 After purge time is complete, the trap is heated and backflushed with helium to desorb the purgeables onto the gas chromatographic (GC) column.

5.1.4 The GC is temperature programmed to separate the purgeables, which are then detected with a mass spectrometer.

5.1.5 The peaks detected are identified by retention time and characteristic ion patterns.

5.1.6 Quantitation is done using the internal standard technique along with response factors generated by running known amounts of standards.

5.2 <u>Soil Samples: Low Level</u>

5.2.1 A small diameter soil core-sampling device is used to collect about 5g of soil sample.

5.2.2 The sample is either extruded into a tared sample container supplied by the laboratory, either containing 5mL organic-free water and magnetic stir bar, or 1g sodium bisulfate in 5mL water with magnetic stir bar, or magnetic stir bar, or the samples may be shipped in EnCore samplers.

5.2.3 If samples are received in EnCore samplers, either analyze the samples within 48 hours or transfer them to tared 40mL glass sample containers and note the weight of the sample and the date and time of transfer.

5.2.4 Add 5mL organic free reagent water to soil samples received without the reagent water or sodium bisulfate.

5.2.5 Analyze by purge and trap GC/MS, under a heated curve.

5.3 Soil Samples: High Level Methanol Preserved

5.3.1 A small diameter soil core-sampling device is used to collect about 5g of soil sample.

5.3.2 The sample is extruded into a tared sample container supplied by the laboratory, containing 10mL of purge and trap grade methanol.

5.3.3 Analyze 100µL of methanol extract in 5mL of organic free reagent water and analyze by purge and trap GC/MS, under a non-heated curve.

6. DEFINITIONS

6.1 Calibration**:** To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurement. (NELAC)

6.2 Internal standards**:** A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.

6.3 Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

6.4 Matrix Spike (spiked sample or fortified sample)**:** A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of Target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

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

6.6 Method Blank**:** A sample of a matrix similar to the batch of associated samples (when available) that is free form the analytes of interest, which is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations the impact the analytical results for sample analyses.

6.7 Method Detection Limit**:** The minimum concentration of a substance (an analyte) that can be measured and reported with 99 % confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

6.8 Quantitation Limits**:** The maximum or minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be quantified with the confidence level required by the data user.

6.9 Trip Blank**:** Organic-free reagent water that is place in a 40mL vial and carried through sampling and handling to serve as a check on the contamination of volatiles by diffusion.

6.10 Volatile Organic Compound**:** Any compound containing carbon and hydrogen or containing carbon and hydrogen in combination with any other element which has a vapor pressure of 1.5 psi absolute (77.6 mm Hg) or greater under actual storage conditions.

6.11 Verification**:** Confirmation by examination and provision of evidence that specified requirements have been met.

7. INTERFERENCES

7.1 Common interferences with this method include impurities in the purge or carrier gas; leaks within the purge and trap unit or the GC/MS system; and solvent vapors (particularly methylene chloride) within the laboratory.

7.2 All plumbing materials used in connection with the purge and trap unit and the GC are stainless steel, copper, or Teflon rather than non- polytetrafluoroethylene (PTFE) or plastic tubing since this type of material may out-gas organic compounds.

7.3 Analyze laboratory reagent blanks after each calibration to show that the system is free of contamination.

7.4 Contamination by carry-over can occur when a low-level sample is analyzed immediately after a high level sample.

- In this case, the system must be proven clean with the analysis of a blank, and the low-level sample must be reanalyzed.

8. SAFETY

8.1 The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined, therefore treat each chemical compound as a potential health hazard.

8.2 Wear appropriate safety clothing and eye protection to minimize the exposure.

8.3 Use protective gloves when handling corrosive chemicals.

8.4 Read Material Safety Data Sheets (MSDS) for the chemicals used in the laboratory for the identity of the ingredients, the physical and chemical characteristics of the substance, the physical hazards, safe handling and safety precautions.

9. EQUIPMENT AND SUPPLIES

9.1 Sample containers

9.1.1 40mL glass VOA vials with screw cap, Greenwood Catalog#340C1251443, or equivalent.

9.2 Syringes

9.2.1 5mL glass gas-tight with shut-off valve – SGE Catalog #008760 or equivalent.

9.2.2 10µL (Hamilton Catalog #80000), 25µL (Hamilton Catalog #80200), 50µL (Hamilton Catalog #80900), 100µL (Hamilton Catalog #81000) and

1mL (Hamilton Catalog #81330) or equivalent glass gas-tight microsyringes.

9.3 Volumetric flask

9.3.1 Class "A" glassware only. 5mL, 10mL, 50mL and 100mL sizes used to prepare stock standards.

9.4 Balances

9.4.1 Top loading balance (Mettler PE300 or equivalent) capable of reading to ±0.01g.

9.5 pH paper

9.5.1 pH paper – EMD Cat # EM9580 or equivalent.

9.6 Purge and Trap System

9.6.1 See Table 5, 6 and 7

9.6.2 The desorber is capable of rapidly heating the trap as required by this method. The temperature program begins at the purge temperature, continues to the desorb temperature, and ends with the bake temperature.

9.6.3 Purging chambers are designed to accept a 5mL/25mL sample size with a water column at least 3 cm deep.

- The purge gas flows through the sample in finely divided bubbles.

9.7 Gas Chromatograph

9.7.1 GCs used for analysis are Hewlett Packard 5890s or equivalent.

9.7.2 Different GC columns are used based on analytical method and target compound separation.

9.7.3 For instrument specifications, see Table 8, 9 and 10.

9.8 Mass Spectrometer

9.8.1 Hewlett Packard 5971/5972 mass selective detectors or equivalent are used for this procedure. See Table 8.

9.9 Data Systems

9.9.1 Hewlett Packard MSD Chemstation Software is used to view, evaluate, quantitate and print the data.

9.9.2 Hewlett Packard MSD Chemstation Software Version:
MSD Chemstation E.02.02.1431, MSD Chemstation C.00.07
MSD Chemstation G1701BA Version B.01.00,
MSD Chemstation D.01.00
MSD Chemstation G1034 Version C.01.05
MSD Chemstation D.03.00.611

9.9.3 Mass spectral library from HP Analytical, NIST02 MS Spectral Database is used in tentative identification of unknown peaks.

9.9.4 Store all GC/MS data on magnetic media for five years, so that it may be retrieved as needed once the hard disk has been cleared.

10. REAGENTS AND STANDARDS

10.1 Reagents

10.1.1 DI Water - analyte free, generated by boiling de-ionized water and transferring the hot water to a clean glass jar for cooling before use.

10.1.2 Methanol - purge and trap grade. Used in the preparation of stock standards, and for extraction of soils. JT Baker Catalog #9077-02 or equivalent.

10.1.3 p-BromoFluoroBenzene (BFB) *Supplier subject to change

10.1.4 Trip Blank: Prepare Trip Blank with 5mL analyte-free water in 40mL vials, acidified by 1:1 HCl to pH < 2. Label the trip blank vial with the initial of the preparer and the date and time that the trip blank was prepared.

10.2 Standards

10.2.1 Prepare fresh standards as needed, store them in glass vials with Teflon faced septa. Replace after 6 months. For standard preparation see table 11

10.2.2 The initial verification standards are purchased from a second source or a different lot number from the same supplier is used.

11. SAMPLE COLLECTION, PRESERVATION, SHIPMENT AND STORAGE

11.1 Water Samples

11.1.1 Sample containers used for this method are glass bottles with Teflon faced septa or Teflon faced lid-liners.

11.1.2 Collect at least two vials for each sample to allow for possible re-runs or dilutions.

11.1.3 Collect a third volatile vial to ensure the sample is properly preserved.

- After analysis, record in the instrument logs the pH of the sample.

11.1.4 Collect extra sample if site specific matrix spike and matrix spike duplicate (MS/MSD) are required.

Note: Care should be taken when sampling such that no air bubbles or headspace is present in the sample containers.

11.1.5 Preserve water samples to be analyzed for aromatics with 1:1HCl to pH<2.

11.1.6 Samples are iced at 2-6°C upon sampling and delivered to the laboratory.

11.1.7 Samples are stored at 2-6°C from the time of receipt until analysis.

11.1.8 Analyze preserved samples within 14 days from sampling and unpreserved samples within 7 days from sampling.

11.2 Soil Samples: High Level Closed-System vials (preserved with Methanol)

11.2.1 Sample vials are provided by the laboratory containing 10mL of Methanol.

11.2.2 Weigh bottles before they leave the laboratory.

11.2.3 Add sample using a special device that will deliver approximately 5g of sample directly into the vial.

11.2.4 Seal vial immediately, ice at 2-6°C and deliver to the lab.

11.2.5 Upon receipt, weigh samples and record weight for use in final sample calculations.

11.2.6 Store samples at 2-6°C until analysis.

11.2.7 Analyze 100uL of the methanol extract in 5mL organic-free water or equivalent, within 14 days from sampling.

Note: A separate container is required for percent moisture determination.

11.3 Soil Samples: Low Level using EnCore Samplers

11.3.1 The laboratory provides EnCore samplers for sample collection.

11.3.2 Collect at least 3 EnCore samples.

11.3.3 Ice samples at 2-6°C or freeze at -7 to -15°C and deliver to laboratory.

Note: A separate container (4oz or 8oz jar) is required for percent moisture determination purposes.

11.3.4 Upon receipt, the whole EnCore kit sample (about 5.0g) is transferred into 40ml vial within 48 hours.

11.3.5 Record the date and time of sample transfer.

11.3.6 Seal vial immediately, and either analyze immediately with 5mL organic-free water within 48 hours or freeze at -7 to -15°C, within 48 hours from sampling, for analysis with 5mL organic-free water within 14 days from sampling.

11.4 Soil Samples: Low Level Closed-System vials (no chemical preservation)

11.4.1 Collect about 5g soil sample in 40mL labeled, tared vial with stir bar.

11.4.2 Collect at least 3 vials for analysis, and another vial for determination of percent solids.

11.4.3 Ice samples at 2-6°C or freeze at -7 to -15°C and deliver to the laboratory.

11.4.4 Upon receipt, weigh samples and record weight for use in final sample calculations.

11.4.5 Store samples at 2-6°C or freeze at -7 to -15°C and analyze with 5mL organic-free water within 48 hours or freeze at -7 to -15°C, within 48 hours from sampling, for analysis with 5mL organic-free water within 14 days from sampling.

11.5 Soil Samples: Low Level Closed-System vials (no chemical preservation) with organic-free water

11.5.1 Collect about 5g soil sample in 40mL labeled, tared vial with 5mL organic-free water and stir bar.

11.5.2 Collect at least 3 vials for analysis, and another vial for determination of percent solids.

11.5.3 Ice samples at 2-6°C or freeze at -7 to -15°C and deliver to the laboratory.

11.5.4 Upon receipt, weigh samples and record weight for use in final sample calculations.

11.5.5 Store samples at 2-6°C or freeze at -7 to -15°C and analyze with 5mL organic-free water within 48 hours or freeze at -7 to -15°C, within 48 hours from sampling, for analysis within 14 days from sampling.

11.6 Soil Samples: Low Level Closed-System vials preserved with sodium bisulfate

11.6.1 Collect about 5g soil sample in 40mL labeled, tared vial with 1g sodium bisulfate in 5mL organic-free water and stir bar.

11.6.2 Collect at least 3 vials for analysis, and another vial for determination of percent solids.

11.6.3 Ice samples at 2-6°C and deliver to the laboratory.

11.6.4 Upon receipt, weigh samples and record weight for use in final sample calculations.
11.6.5 Store samples at 2-6°C for analysis within 14 days from sampling.

Note: This preservation technique may result in destruction or creation of certain volatile organic compounds. Use this preservation technique only if Vinyl Chloride, Trichloroethene, Styrene, 2-Chloroethyl vinyl ether, Trichlorofluoromethane, cis-1,3-Dichloropropene, trans-1,3-Dichloropropene and Acetone are not contaminants of concern or the soil does not contain carbonaceous material.

11.7 Soil Samples: Low Level
11.7.1 Samples are collected in 4oz or 8oz jars with no headspace and iced at 2-6°C.
11.7.2 Collect a separate jar for percent solids determination.
11.7.3 Samples are stored at 2-6°C.
11.7.4 If samples are analyzed within 48 hours of sampling, analyze about 5g well-mixed sample with 5mL organic-free water in a 40mL glass vial. Sample received in 4 oz jar can be preserved within 48 hours into Terracores. Preserved samples then can be analyzed within 14 days.
11.7.5 If samples cannot be analyzed within 48 hours from sampling, preserve by adding about 5g well mixed sample to 10mL methanol in a 40mL glass vial. This preserved sample must be analyzed within 14days of sampling. Analyze 100uL of the methanol extract with 5mL organic-free water.

Note: This technique may be used for waste characterization, unknown or oily wastes, where chemical reaction with freezing or preservative is not known. The sample must be mixed very quickly with a spatula or equivalent device and added to 5mL organic-free water to minimize the loss of volatile organic compounds.

Any vial that is frozen must be laid on its side to prevent breakage, and thawed before analysis.

12. QUALITY CONTROL

12.1 BFB - MS Tuning Check Compound
12.1.1 Analyze every 12 hours.
12.2 Initial Calibration
12.2.1 Analyze a minimum of five concentration levels, for e.g.: 1, 5, 20, 50, 100, 150, 200μg/L. (Concentration levels are subject to change based on instrument sensitivity and/or saturation, and project requirements, certain ketones and other compounds are added at an elevated concentration).
12.2.2 Assure that relative response factors (RRFs) and % Relative Standard Deviation (%RSD) criteria are met.
12.2.3 A new initial calibration is required when continuing calibrations do not pass required criteria. A new initial calibration is required after 31 days.

12.2.4 Set the retention time window using the midpoint standard of the curve when ICAL is performed.

12.3 Continuing Calibration

12.3.1 Analyze a calibration check solution from the primary every 12 hours immediately after the BFB.

12.3.2 Solution is used to verify instrument performance as compared to the initial calibration.

12.3.3 Assure that RRFs and % Difference (%D) criteria are met.

12.3.4 Retention for CCC, Samples and QC is updated using mid-point of ICAL. Retention is not updated using CCV check samples.

12.4 Method Blanks

12.4.1 Prepare specifically for each matrix type.

12.4.2 Analyze immediately after the calibration standards each day to ensure that the system is free from carry-over or any other interferences.

12.5 Surrogates (S)

12.5.1 Monitor and report for all blanks, samples, and spikes.

12.5.2 Assure that recoveries are within limits.

12.6 Matrix Spike/Matrix Spike Duplicate and Blank Spike

12.6.1 Choose a representative sample to be used for MS/MSD.

12.6.2 MS/MSD is required for each matrix type. For water samples, MS/MSD is analyzed only if the client provides extra sample volume. Otherwise, a Blank Spike and Blank Spike Duplicate are analyzed.

12.6.3 MS/MSD and LCS are required for every group of samples run as a batch or every 20 samples.

12.6.4 Calculate % Recovery and Relative Percent Difference (RPD).

12.7 Internal Standards (IS)

12.7.1 Monitor the integrated area and the retention time of the quant ion of the IS for all standards, blanks, samples and spikes.

12.8 Accuracy and Precision

12.8.1 Each analyst must perform an initial, one time demonstration of accuracy and precision. Documentation must be delivered to the QA officer for inclusion in personnel folder.

12.8.2 Prepare four aliquots of LCS sample from a source other than that used for calibration.

12.8.3 Analyze these four aliquots under the same conditions used for sample analysis.

12.8.4 IDOC must be performed every time there is a significant change in the method, personnel, instrument type, or sample matrix.

12.8.5 All of the IDOCs are kept in the employee's training files.

12.9 Method Detection Limits

12.9.1 Determine the MDLs by analyzing seven replicate standards each containing analytes at a concentration of 1 / 5 μg/L.

12.9.2 After analysis, down load the data to a personal computer and use standardized MDL templates to perform the statistical calculations in excel.

12.9.3 Calculate the MDL by determining the standard deviation of the values and multiplying by the "t" value.

12.9.4 The calculated MDL must be below the quantitation limits for the method. If they are not, the data is reviewed again for possible sources of error and the procedure will be repeated.

12.9.5 Perform an MDL study initially for all normally targeted compounds or when conditions change.

12.9.6 Perform an MDL study for extra targeted compounds as required.

12.9.7 Perform an MDL study on one instrument for each type of test being performed. (Low Soil, High Soil, Water 5 mL and 25 mL purge).

12.10 Manual Integration

12.10.1 At times, manual integration will be necessary due to incomplete or incorrect integration by the automated analytical system.

12.10.2 Manual integration cannot be used to satisfy Quality Control Criteria.

12.10.3 Do not include baseline background noise; include only the area between where the beginning and end of the peak intersects with the baseline.

12.10.4 Any time a compound is integrated in the calibration standard it must then be consistently integrated in the samples per professional judgment.

12.10.5 When a manual integration is performed, the hardcopy of the quantitation report will flag the compound with an “m”.

12.10.6 Print the before and after manual integration chromatograms with the raw data.

12.11 Limit of Detection (LOD)

12.11.1 Establish LOD by spiking a quality system matrix at approximately 1-4X detection limit.

12.11.2 LOD is specific to each combination of analyte, matrix, method (including sample preparation) and instrument configuration.

12.11.3 LOD must be verified quarterly.

12.11.4 LOD must be verified on each instrument used, and every time the method is modified.

12.12 Limit of Quantitation (LOQ)

12.12.1 LOQ must be greater than the LOD.

12.12.2 LOQ must be verified quarterly for each quality system matrix, method and analyte, by analyzing QC sample containing the analytes of concern in each quality system matrix 1-2X the claimed LOQ.

12.12.3 LOQ must be performed if the method is modified.

12.13 Initial Calibration Verification (ICV)

12.13.1 Analyze a second source initial calibration verification standard at mid level concentration immediately following the initial calibration curve.

13. CALIBRATION AND STANDARDIZATION

13.1 GC/MS Tuning and Performance Check

13.1.1 Analyze the BFB solution every 12 hours to verify acceptable instrument performance.

13.1.2 Retune the MS and reanalyze the BFB if the spectrum does not meet criteria.

13.1.3 Tune the mass axis and abundance scales such that the analysis of the instrument performance check solution (BFB) meets the criteria outlined in Table 2.

13.1.4 Once an acceptable BFB has been acquired, instrumental conditions must remain the same throughout the calibration and sample analyses.

13.1.5 Prior to the analysis of Initial calibration standards, tune the GC/MS system using perfluorotributylamine (PFTBA).

13.2 Initial Calibration

13.2.1 After tuning criteria have been met, analyze an initial calibration consisting of a minimum of five calibration standards; e.g. at the following concentration levels: 1, 5, 20, 50, 100, 150 and 200µg/L (The standard concentrations may be subject to change based on instrument sensitivity and/or saturation, and project requirements. Ketones and certain other compounds are added at elevated concentrations).

13.2.2 Analyze an initial calibration verification standard from a second source.

Note: The lowest standard analyzed must be equal to the reporting limit.

13.2.3 Tabulate the area response of the characteristic ions against the concentration for each target analyte and internal standards using MS Chemstation software.

13.2.4 The RRF is calculated as follows:

$$RRF = \frac{A_s \text{ x } C_{is}}{A_{is} \text{ x } C_s}$$

Where A_s = Peak area of the analyte or surrogate
A_{is}= Peak area of the internal standard
C_s = Concentration of the analyte or surrogate
C_{is}= Concentration of the internal standard

13.2.5 Calculate the %RSD for all target analytes from the initial calibration.

$$\%RSD = \frac{\text{Standard Deviation of RRF}}{\text{Mean of RRF}} \text{ x } 100$$

Where: $\text{mean of RRF} = \frac{\text{sum of RRF}}{n}$
n = number of calibration standards used

13.2.6 The %RSD should be $\leq$15% for each target analyte for Method 8260B and $\leq$20% for each analyte for Method 8260C.

13.2.6.1 System performance check compounds (SPCCs) (For Method 8260B): Minimum Average RRF for Chloromethane, 1,1-Dichloroethane and Bromoform must be 0.10; Minimum Average RRF for Chlorobenzene and 1,1,2,2-Tetrachloroethane must be 0.30.

13.2.6.2 Calibration Check Compounds (CCCs) (For Method 8260B): The RSD for each individual CCC must be $\leq$ 30%. The CCC include 1,1-Dichloroethene, Chloroform, 1,2-Dichloropropane, Toluene, Ethylbenzene, Vinyl Chloride.

13.2.6.3 1,4-Dioxane minimum RRF requirement is 0.05 and <50% RSD.

13.2.6.4 For DOD, Each analyte must meet one of the three options, Option 1: RSD for each analyte ≤ 15%, Option 2: linear least squares regression for each analyte: r2 ≥ 0.99, Option 3: non-linear least squares regression (quadratic) for each analyte: r2 ≥ 0.99.

13.2.7 When the %RSD of all target analytes meet criteria, the curve is assumed to be constant over the calibration range, and the average response factor is to be used for quantitation.

13.2.8 When the client requests extra target compounds, a curve for these compounds will be deemed acceptable only when a ±30% RSD is achieved between the five initial responses factors.

13.2.9 When the %RSD exceeds criteria, perform a linear regression (five-point curve) or quadratic regression (six-point curve) of the instrument response versus the concentration of the standards. Make certain that the instrument response is treated as the dependent variable (y) and the concentration as the independent variable (x). The regression will produce the slope and intercept terms for a linear equation in the form

$$y = ax + b,$$

Where y = instrument response (peak area or height)
a = slope of the line(also called the coefficient of x)
x = concentration of the calibration standard
b = intercept

13.2.9.1 The use of linear regression may not be used as a rationale for reporting results below the calibration range demonstrated by the analysis of the standards.

13.2.9.2 The regression calculation will generate a correlation coefficient(r).

13.2.9.3 In order to be used for quantitative purposes, the correlation coefficient must be greater than or equal to 0.990.

13.2.9.4 Inspect the curve to determine if the linearity fits all the standards.

13.2.9.5 If the criteria cannot be met, recalibrate the instrument again or report the failures in the case narrative and/or non-conformance sheet.

13.2.10 Establish the retention time window position for each analyte and surrogate, once per initial calibration, at the midpoint standard of the initial calibration curve.

13.2.11 The relative retention time (RRT) is established by calculating the ratio of retention time of analyte over retention time of its associated internal standard.

13.2.12 The RRT of each target analyte must be within ±0.06RRT units. If criteria are not met, then correct the problem by performing instrument maintenance, and then rerun the initial calibration curve.

13.2.13 If the height of the valley between two isomer peaks < 25% of the sum of the two peak heights, then the isomers are reported as individual compounds. Otherwise, structural isomers are identified as isomeric pairs. E.g. m/p-Xylenes.

13.3 Continuing Calibration

13.3.1 Analyze a BFB. Make sure it meets criteria listed in Table 2.

13.3.2 Analyze a continuing calibration check standard and compare it to the mean RRF of the initial curve rather than running an entire initial calibration curve every 12 hours.

13.3.3 Calculate %D for all target analytes.

$$\%D = \frac{RRF_C - RRF_I}{RRF_I} \times 100$$

Where RRF_C = Relative Response factor from continuing calibration
RRF_I = Mean Relative Response factor from initial calibration

13.3.4 If continuing calibration passes criteria listed in Section 18.3, proceed with analysis of blanks and samples.

13.4 Method Blank and Blank Spike

13.4.1 Prepare specifically for each matrix type.

13.4.2 Analyze immediately after the calibration standards each day.

13.4.3 If the method blank passes criteria listed in Section 18.4 and Blank Spike passes criteria in Section 18.6, proceed with analysis of samples.

13.5 Initial Calibration Verification

13.5.1 Analyze second source ICV immediately after the initial calibration standards.

14. PROCEDURE

14.1 Allow all standards to warm to ambient temperature prior to use.

14.2 Rinse all syringes to be used with purge and trap quality methanol.

Note: Analyze samples using a 12-hour sequence.

- *The 12-hour period begins with the injection time of the BFB.*

Convention for Data File Naming

- *Subdirectories are named according to the department name, than instrument name, month, date, and lastly the file number E.g. VA091702*

Where Department = VOA
Instrument = A
Month = September
Date = 17th
Year = 2002

- *Data File is named as: department name – instrument name – sequentially. E.g. VA000001, VA000002 etc.*

14.3 BFB Tuning

14.3.1 Add 2µl of 25µg/mL BFB solution to 5mL/25mL reagent water and purge.

14.3.2 Use the same conditions for the BFB as for all blanks, standards, samples and spikes.

14.3.3 Analyze the BFB as follows:

- Click on the instrument icon.
- Edit sequence to run BFB
- Click on OK
- Click on run sequence
- Wait for instrument to complete the run

14.3.4 Use the MSChemStation software to acquire the spectrum of BFB in the following manner:

- Integrate m/z 95 (the major ion of BFB) to find the max scan or apex of the peak.
- Average three scans; the max scan and the scans immediately before and after the max.

Note: Background subtract, must be a scan chosen before the elution of the BFB peak but no more than 20 scans from the beginning of the BFB peak.

14.3.5 Check the resulting spectrum; it must meet the ion abundance criteria outlined in Table 2.

14.4 Initial Calibration

14.4.1 After tuning criteria have been met, initially calibrate the GC/MS system at a minimum of five concentration levels. See Table 12 for water working standard preparation and Table 13 for soil working standard preparation.

Note: Calibration standards for water matrix are made in 40ml vial and for soil matrix in 5ml syringe.

- *Aqueous samples and high level soils are purged at ambient temperature, and low-level soils are purged at 40°C.*
- *Therefore, calibrations for waters and high level soils must use an unheated purge, while calibrations for low level soils require a heated purge at 40°C.*

14.4.1.1 Analyze all standards, blanks, and samples under the following instrumental conditions:

- Click on the instrument icon.
- Click on Edit sequence to run the curve
- Click on OK
- Click on run sequence
- Wait for instrument to complete the run

Note: The GC column separates the analytes that are then detected by the mass spectrometer.

14.4.2 Acquire data for each of the five calibration points.

- Compare the data using a METHOD FILE set up for the target, internal standard, and surrogate compounds, containing expected retention times, and ion ratios for each analyte.

- A quant ion and one or two secondary ions have been chosen (Table 3) for each analyte and make up a characteristic ratio used to identify each compound.
- The quant ion for each compound is integrated and these areas are used to generate RFs.

14.4.3 Create a calibration file inside the METHOD from the data points run for the initial curve.

- The METHOD shows a RF for each analyte at each concentration level.
- The average RF, the relative retention time (each analyte's distance from the internal standard), and the Relative Standard Deviation (RSD) are calculated.

14.4.4 Once a valid initial curve is run and evaluated, run ICV and then proceed with the analysis of blanks, spikes and samples if there is time remaining in the 12-hour period.

- Update the average response factors from the curve into the METHOD and they will be used for quantitation for all blanks and samples that follow.
- If there is no time remaining, begin a new 12-hour sequence with the analysis of a BFB.
- If the BFB passes criteria, analyze a continuing calibration check standard.

14.5 Continuing Calibration

14.5.1 Analyze a BFB.

14.5.2 If the BFB passes criteria, analyze a continuing calibration check standard.

14.5.3 If the continuing calibration meets criteria, proceed with the analysis of blanks and samples.

14.5.4 If continuing calibration does not meet criteria (Section 18.3), analysis must stop. See section 19.3.

14.5.5 A continuing calibration must be performed every twelve hours. Monitor internal standard areas and retention times for the continuing calibration verification.

- The extracted ion current profile (area of the quantitation ion) must not change by more than a factor of 2 in either direction from the midpoint of the initial calibration.
- The retention time for any internal standard must not change by more than 30 seconds.

14.5.6 Should either of these two items be out of limits, the GC/MS system must be inspected for potential problems and corrections made as needed.

14.6 Method Blank and Blank Spike

14.6.1 Analyze a method blank immediately following either the initial or continuing calibration of the GC/MS system, and prior to analyzing any samples.

14.6.2 For Method Blank preparation, see Table 4.

14.6.3 Purge the water blank and methanol soil blank at ambient temperature and the soil blank at heated purge.

14.6.4 Analyze the method blank after the calibration standards to ensure that the system is free from carryover or any other interferences that may be present.

- *Note: No analytes may be present in the blank above the RL with the following exceptions: Methylene Chloride and Acetone are allowed to be present at a level of 2x RL. These compounds are routinely found in the air in the laboratory. Identification of these compounds in a sample at or above the RL have to be flagged with a B on the result page for the sample and a discussion in the case narrative needs to be included about the positive identification of these compounds in the sample.*

14.6.5 The method blank must meet the same QC requirements as the samples for that particular matrix type.

- Surrogate recovery limits and internal standard area criteria must be met for a blank to be valid.

14.6.6 If the blank does not meet criteria, the system must be checked for problems and action may need to be taken.

- The system may need to be baked out to remove residue from previous samples. Heat oven to 220^{o}C for one hour and bake the trap. Increase the temperature of the transfer line.
- A new blank must be run and criteria met before analysis of samples can begin.

14.7 Sample Analysis

Note: Samples may only be analyzed once the tune, calibration, and blank have all met criteria except in cases where samples must be loaded on the instrument overnight, in which case, the QC and calibration samples are checked after analysis.

- *Before loading the sample, rinse the 5mL syringe with reagent water 3 times.*
- *Allow all samples to warm to ambient temperature before loading.*

14.7.1 Water Samples prepared manually

- 40ml sample vial is prepared by adding surrogates and internal standards as described in Table 4.
- The vial is loaded on Autosampler.
- Autosampler takes 5ml/25ml in to the sparge tube.
- Determine the pH of each water sample and record it on the Analysis Run log page.
- Test the pH by dipping the pH paper into the sample vial after analysis is complete.
- Record the pH of each sample.

14.7.2 Water Samples loaded on the Autosampler

- Load the vial onto the ARCON auto-sampler where the robotic mechanisms move the sample through steps that include:

- collection of 25mL/5ml of water,
- add surrogate or internal standard as described in Table 4
- 11minute purge

14.7.3 High Level Soil Analysis of Methanol preserved samples

- Add 100µL of the methanol extract to a 40mL vial containing 40mL of reagent water.
- Add internal standards and surrogates as described in Table 4.

14.7.4 Low-level Closed-System Soil Analyses for samples containing Sodium Bisulfate preservative or organic-free water

- Load the vial onto the ARCON auto-sampler where the robotic mechanisms move the sample through steps that include:
- addition of internal standards and surrogates as described in Table 4
- heating for 1.5 minutes at 40°C
- stirring the sample and maintaining 40°C during the 11minute purge time.

14.7.5 Low-level Soil Analysis for samples without preservative or organic-free water

- using a 5mL syringe, add 5mL of organic-free reagent water with addition of surrogate and internal standards as described in Table 4
- Load vial to Arcon Autosampler

14.7.6 Analyze the sample as follows:

- Click on the instrument icon
- Click on Edit sequence, add samples to sequence
- Click on OK
- Click on run sequence
- Wait for instrument to be ready

Note: The auto-sampler unit goes through the same sequence for all samples, blanks, and standards.

- *Purge the sample with helium for 11 minutes.*
- *Heat low level soils to 40°C during this purge time, water and high level samples are purged at room temperature.*
- *The sample is desorbed while rapidly heating the trap and back-flushed with helium.*
- *The trap is then baked to remove any residue remaining on the trap.*
- *The trap is allowed to cool down to room temperature, and is then ready to accept the next sample.*

Note: Any analyte that exceeds the calibration range requires a dilution.

14.7.7 Sample Dilutions

- If any target compound exceeds the initial calibration range in a sample, the sample must be diluted.
- The dilution factor must get the largest analyte peak in the upper half of the initial calibration range.

- All dilutions must meet the same QC requirements as non-diluted samples.

14.7.7.1 Water samples:

  - For water samples requiring a 10x dilution, take 1mL aliquot sample with a gas tight 5mL syringe and add it to 9 mL reagent water in a Class A 10 mL volumetric flask.
  - Invert the flask three times before adding contents to a 5mL gastight syringe.
  - Add surrogate and internal as described in Table 4
  - Further dilutions may be made in a similar manner depending upon the level of dilution required.

14.7.7.2 Low Level Soils:

  - For low level soil samples, the smallest amount of sample allowed to be weighed is 0.1 g.
  - Any sample requiring a more dilute analysis must be treated as a high level soil and extracted with methanol.

14.7.7.3 High Level Soils:

14.7.7.3.1 For high level soils, dilutions are done by injecting less amount of methanol extract into the 5mL syringe. Example: inject 50uL for a 2x dilution.

14.8 Matrix Spike/Matrix Spike Duplicate and Blank Spike

14.8.1 With each group of samples analyzed as a batch, analyze a blank spike, matrix spike and matrix spike duplicate.

14.8.2 The purpose of these matrix spikes is to determine whether the sample matrix contributes to the analytical results.

14.8.3 Spike a representative sample with the target compounds.

14.8.4 Calculate the % recovery and relative % difference (RPD) between the recoveries and ensure that they meet the criteria for the MS/MSD.

14.8.4.1 Calculate the % recovery for the Blank Spike.

14.8.5 To calculate Spike recoveries:

$$\frac{SSR-SR}{SA} \quad X \quad 100$$

Where:
SSR = spiked sample result
SR = sample result (for MS/MSD calculation only)
SA = spike added

14.8.6 Prepare water and low level soil matrix spikes and blank spike as described in Table 4

14.8.7 For high level soil matrix spikes, add spiking solution/internal standard/surrogate as described in Table 4 to 5g soil.

14.8.8 Extract the matrix spike and blank spike sample and analyze as any other high level sample.

14.8.9 Field or trip blanks may <u>not</u> be used for MS/MSD purposes.

14.8.10 One MS/MSD and Blank Spike is required for every group of samples run as a batch or at least one set of spikes per 20 samples and if MS/MSD is not given for water samples run blank spike and blank spike duplicate.

14.9 Analytical Sequence (Subject to change)

Initial Analytical Run	Continuous Analytical Run
• BFB0501	• BFB0502
• VSTD001 ppb	• VSTD0502
• VSTD005 ppb	• VBLK02
• VSTD020 ppb	• Samples
• VSTD050 ppb	• LCS
• VSTD100 ppb	• MS
• VSTD200 ppb	• MSD
• ICV	
• VBLK01	
• Samples	
• LCS	
• MS	
• MSD	

14.10 Manual Integration

Note: At times manual integration will be necessary due to incomplete or incorrect integration by the automated analytical system. This normally occurs when there is matrix interference, baseline noise or compound co-elution.

Manual integration cannot be used in order to solely satisfy Quality Control Criteria. It should also not be used as a substitute for corrective action on the chromatographic system. All manual integrations must be noted in the case narrative.

14.10.1 Integrate the area of the quantitation ion of the compound of interest.
14.10.2 Do not include baseline background noise, and include only the area between where the beginning and end of the peak intersects with the baseline.
14.10.3 Integrate the compound in the sample any time it is integrated in the calibration standard using professional judgment.
14.10.4 Flag the compound with an “m” in the hardcopy (quantitation report) when a manual integration is performed.
14.10.5 Print out the EICP for all compounds that have been manually integrated. Print out the spectrum of the manually integrated compound before and after the manual integration is done.

14.11 Data Interpretation

- Maintain all GC and mass spectral data generated with each run of the instrument within a data file.
- Store data files on the computer hard drive, and archive on the server for retrieval as needed once the hard drive has been cleared.

- For quantitation, send data files through MSChemstation Software, where the computer compares known information about target compounds to what is present in each data file.
- Information contained in the Method File used by the program includes:
  The relative retention time of each analyte
  The ion to be used for quantitation and one or two secondary ions, which are characteristic to each compound (Table 3).
  The response factor for each analyte to be used in determining the concentration.

14.11.1 Procedure

Naming Methods: Method prefix, instrument name, matrix, month, date, e.g., 82BS0104.M

14.11.1.1 Sequence log pages are maintained electronically for each instrument

14.11.1.2 Click the MSChemstation icon on the processing PC.

14.11.1.3 Load the method by using the pull down menu top left choice and click on select method.

14.11.1.4 Load the first BFB Data File from the first instrument log using the pull down menu top left choice and click on select data file.

14.11.1.5 Find the BFB peak on the chromatogram and click on the max scan (max ion 95).

- Note the scan number.

14.11.1.6 Determine where the scan to the left and the scan to the right are located by clicking slightly to the right and left of the max scan noting the scan numbers.

14.11.1.7 Drag the cursor from the max scan –1 to the max scan +1.

- Click on a background scan directly to the left of the BFB peak and click on subtract in the pull down menu called Tuner.

14.11.1.8 Click on “evaluate BFB”.

Note: If all ion ratios pass, save the information in a file.

- *The Autofind options under the Tuner pull down menu does the same thing as steps 14.11.1.6 – 14.11.1.10.*

14.11.1.9 Click on Save BFB to Forms File under the Tuner pull down menu.

14.11.1.10 Click on Print BFB under the Tuner menu.

- The criterion is listed in Table 2.

14.11.1.11 Load the midpoint file from the initial calibration.

14.11.1.12 Click on quantitate to screen

14.11.1.13 Click on clear all calibration responses

14.11.1.14 Click on calibrate

- Add new level

- Enter standard level and 50 for internal standard concentration.

14.11.1.15 Load the next initial calibration data file.

- Repeat steps 14.11.1.12 – 14.11.1.15
- Do this for all five initial calibration points (5, 20, 50, 100, and 200μg/L).

14.11.1.16 Print out the initial calibration using the pull down menu, click on response factors to printer.

14.11.1.17 Carefully review all information on the printout.

- Look for isomeric pairs that separate chromatographically and have the same retention time and response factors (ethylbenzene, o-xylene & m/p-xylene).
- Verify that all compounds are picked up. Check to see if the initial calibration meets criteria.

14.11.1.18 Qarea using the pull down menu, each point that needs editing and repeat step 14.11.1.15 choosing recalibrate.

14.11.1.19 Load the second BFB.

14.11.1.20 Pass it by repeating steps 14.11.1.5 – 14.11.1.9.

14.11.1.21 Load the check standard data file.

- Send to quant using the pull down menu.
- Click on View Results on screen and verify that all of the compounds are being picked up by the program correctly. If not, Qarea using pull down menu.

14.11.1.22 Retention time for CCV, samples and QC is evaluated using the mid-point of ICAL. Retention time is not updated using the CCV check samples.

14.11.1.23 Verify that Quantitate using Initial Calibration is clicked on.

14.11.1.24 Load next data file (blank), quantitate it and review in qarea, checking surrogate recoveries, correct integration of peaks, internal standard area recoveries and any necessary dilutions of target compounds.

14.11.1.25 Repeat step 14.11.1.24 for each blank, sample and spike that is associated with the SDG maintaining the order of steps 14.11.1.20 – 14.11.1.26 when you get to the next BFB. See Section 14.11.2 for Data Interpretation.

14.11.1.26 Send each blank and sample to the tentative identified program using the software pull down menus. Use information from the summary discussion to review the non-target data.

14.11.1.27 Print out each run, standards and spikes in medium format (quant report and chromatogram), blanks and samples in full format (quant report + Chromatogram + spectra).

14.11.1.28 Put the reports in data file order with the BFB report first. Put the instrument logs with each set of reports.

- Data is now ready for **EISC forms.**

14.11.2 Data Interpretation for MS Chemstation Software

14.11.2.1 Examine all spectra for all possible "hits" or matches made to target compounds from printed out file by an analyst trained in the interpretation of mass spectra by doing the following:

14.11.2.2 Generate a reference spectrum for each analyte by running known standards (QREF from pull down menu).

14.11.2.3 Compare this reference to the spectrum of the peak found in the sample.

14.11.2.4 Compare the criteria required for positive identification of an analyte as follows:

- The analyte in the sample must elute at the same relative retention time as in the daily calibration standard (±0.06 RRT units).
- All ions present in the reference spectrum >10% of the largest ion must be found in the sample spectrum.
- The ratio of the ions found in the sample must agree within ±20% of the ions found in the reference spectrum.
- Ions >10% in the sample spectrum but not found in the reference spectrum must be accounted for.
- Quantitative analysis is done once a target compound is identified by the internal standard method using the equations below. The relative response factor from the initial calibration standard is used to calculate the concentration of the sample.

14.11.2.5 Send all samples and blanks through a library search program in an effort to identify up to 30 non-target compounds, upon client's request.

14.11.2.6 Do <u>not</u> report the following compounds:

- Compounds less than 10% of the nearest internal standard area,
- Compounds which elute earlier than 30 seconds before the first target compound or three minutes after the last purgeable compound,
- Carbon dioxide, and
- Semi volatile target compounds.

14.11.2.7 The computer software provides a mass spectral library for comparison to unknown compounds found in samples. Criteria for making tentative identifications are:

- Ions >10% of the largest ion in the reference spectrum must be present in the sample spectrum.
- The relative intensities of major ions should agree within ±20%.
- Molecular ions present in the reference spectrum must be present in the sample spectrum.
- Ions present in the sample spectrum, but not the reference spectrum should be reviewed for possible

background contamination or presence of co-eluting compounds.

- Ions present in the reference but not the sample should be verified by performing manual background subtraction to remove interferences.
- If after review, the analyst is at a loss to identify the compound use the following method:
  - If the computers match probability is 85% or greater report that compound.
  - If the computer match probability is <85%, try to classify the compound and give it a name like "unknown chlorinated hydrocarbon" if it can be determined.

14.11.2.8 Do the quantitation of tentatively identified compounds based on comparison of the total ion area of an unknown peak to the total ion area of the nearest internal standard:

- Do not identify peaks that have an area <10% of the nearest internal standard.
- Since no calibrations are run for these unknown peaks, use response factor of 1 to calculate concentrations.

14.11.2.9 Identify 15 of the largest alkane peaks if they are in the sample.

- Also provide the library search information for each peak.

14.12 Documentation Requirements

14.12.1 Assure that GC and GC/MS Instrument log contains the following:

- CHEMTECH sample ID
- pH of water sample
- Dilution details
- All standards, samples, blanks, etc., run on the instrument in the order they were analyzed
- Date and time of injection of each sample and standard
- Computer data file number
- Analyst signature
- Supervisor signature

14.12.2 Label all chromatograms as follows:

- CHEMTECH and/or client sample number
- Volume/weight injected
- Date and time of injection
- GC column ID
- GC Instrument ID
- Identified compound names

14.12.3 The following quant reports and chromatograms and data system printouts must be included in the data package:

- All standards and blanks from initial and continuing calibrations
- All samples, blanks, blank spikes and MS/MSD

14.13 Instrument Maintenance

14.13.1 See Maintenance P255 SOP

14.14 % Moisture

14.14.1 All soil results are reported on a dry weight basis. The % moisture is determined for all of the samples in the laboratory by the metals department.

14.15 Record in the logbook if there are any instrument errors.

- Rerun the samples.

Note: Errors include

- *Leaked samples*
- *Electric shutdown*

15. CALCULATIONS

15.1 Water Calculation in ug/L

$$\frac{(A_x)(I_s)(Df)}{(A_{is})(RRF)(V_0)}$$

Where
A_x = Area for the compound to be measured
A_{is} = Area for the specific internal standard
I_s = Amount of internal standard added in nanograms (ng)
RRF = Relative response factor of the initial calibration curve standard.
V_o = Volume of water purged in milliliters (mL)
Df = Dilution factor.

15.2 Low Level Soil Calculation in ug/Kg dry weight basis

$$\frac{(A_x)(I_s)(Df)}{(A_{is})(RRF)(W_s)(D)}$$

Where
A_x = Area for the compound to be measured
A_{is} = Area for the specific internal standard
I_s = Amount of internal standard added in nanograms (ng)
RRF = Relative response factor of the initial calibration curve standard.
Df = Dilution factor
W_s= Weight of sample
$D = \frac{100 - \%moisture}{100}$

15.3 High Level Soil Calculation in ug/Kg dry weight basis

$$\frac{(A_x)(I_s)(V_t)\,1000\,(Df)}{(A_{is})(RRF)(V_a)(W_s)(D)}$$

Where
A_x = Area for the compound to be measured
A_{is} = Area for the specific internal standard
I_s = Amount of internal standard added in nanograms (ng)
RRF = Relative response factor of the initial calibration standard.
V_t = Total volume of methanol extract in milliliters (mL), (usually 10 mL)
V_a = Volume of aliquot in microliters (uL) (usually 100 uL)
Df = Dilution factor

W_s= Weight of sample

$$D = \frac{100 - \%\text{moisture}}{100}$$

Note: If there are interferences to the quant ion caused by either high background or co-eluting compounds with similar ions, use a secondary ion for quantitation. A list of the target analytes and their primary and secondary ions is found in Table 3.

16. METHOD PERFORMANCE

16.1 Analysis is performed in accordance with the method. All quality control and quality assurance procedures are followed. Refer to P203-IDOC,MDL SOP for further information.

16.2 Each analyst will make a one-time demonstration of the ability to generate acceptable accuracy and precision with this method. Refer to P203-IDOC, MDL SOP for further information.

17. POLLUTION PREVENTION

17.1 Use only the amounts of chemicals required. Do <u>not</u> make large quantities of solutions.

17.2 Use hood when working with solvents.

17.3 Keep the area clean and clutter free in the extractions lab and around the instruments in order to avoid any mishaps.

17.4 Trap exhaust from vacuum pumps.

17.5 Keep chemicals away from drains.

17.6 Properly collect and dispose of waste according to Chemtech's Waste Disposal SOP.

17.7 Laboratory is properly equipped with spill cleanup equipment and laboratory personnel trained. Depending upon the size and type of spill, it may be handled by the individual or department creating the spill or by specially trained personnel.

17.8 Small spills may occur routinely and shall be handled by the individual person or department creating the spill. Spill kits are stored in a blue basket or blue cover bin located in each laboratory and chemical storage area. The spill kits can handle water based, solvent and mercury spills. Specially trained personnel handle larger spills, which may pose a threat to health or environment involves a large volume not easily contained.

17.9 A detailed description of the procedure for handling a spill or accident is covered in the CHEMTECH Emergency and Contingency Plan.

17.10 The Safety Coordinator is responsible for implementing the Chemical Hygiene and the CHEMTECH Emergency and Contingency Plans. It is the responsibility of various company personnel to assist in implementing the different aspects of the Plan. These include: Laboratory Coordinator, Technical Director, Operations Manager, Department Managers and Supervisors.

18. DATA ASSESSMENT AND ACCEPTANCE CRITERIA FOR QC

18.1 <u>BFB-MS Tuning Check Compounds</u>

18.1.1 Spectrum produced must meet the criteria outlined in Table 2.

18.2 Initial Calibration

18.2.1 All Criteria in section 13.2 must be satisfied.

18.3 Continuing Calibration

18.3.1 The %D for each analytes & surrogates must be ≤20% for opening Continuous Calibration for 8260B/C and DOD. For DOD, End Continuous Calibration % D for each analytes and surrogates must be ≤50%.

18.3.2 The SPCC and CCC criteria must be met for Method 8260B.

18.3.3 1,4-Dioxane must meet 0.05 minimum RRF and < 50% D.

18.3.3 If the analyte is failing biased high, with no positive hits in the samples analyzed under this calibration check sample for that analyte, then no further corrective action is taken. The failure is documented in the case narrative/ non-conformance.

18.4 Method Blank

18.4.1 No analyte should be present in the blank at a concentration greater than the reporting limit except for Acetone and Methylene Chloride, which can be present up to 2X the reporting limit.

18.4.2 If the analyte is present greater than the above criteria, all associated sample results must be flagged with the B qualifier.

18.4.3 For DoD work – No analyte must be detected at >1/2RL and >1/10 the amount measured in any sample or >1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes should be detected at > RL.

18.5 Surrogates

18.5.1 Surrogate recovery limits must be within the limits specified for each matrix.

18.6 MS/MSD and Blank Spike

18.6.1 The %recovery for all analytes must be within control limits.

18.6.2 2-Chloroethylvinyl ether recovery may not meet criteria for water MS/MSD due to acidification of the sample for preservation. Mention this in the case narrative/non-conformance.

18.7 Internal Standard

18.7.1 Monitor all samples, blanks, and spikes for retention time shift and fluctuation of extracted ion areas.

18.7.2 Make sure that the GC retention time is within ±30 seconds of the corresponding internal standard in the midpoint standard of the initial calibration.

18.7.3 Verify that the areas of the internal standard do not change by more than a factor of 2 (-50% to +100%) from the areas in the midpoint standard of the initial calibration. On days when ICAL is not performed, the daily initial CCV can be used.

18.7.4 Monitor all continuing calibration verification standards for retention time shift and fluctuation of extracted ion areas.

18.7.5 Verify that the retention time is within ±30 seconds of the corresponding internal standard in of the initial calibration.

18.7.6 Verify that the areas of the internal standard do not change by more than a factor of 2 (-50% to +100%) from the areas of the corresponding internal standard in the midpoint standard of the initial calibration. On days when ICAL is not performed, the daily initial CCV can be used.

18.8 Initial Calibration Verification

18.8.1 The ICV standard recoveries must be within the 70-130% range. Up to 10% of the compounds may be allowed to fail marginally.

18.8.2 For DoD work, all project analytes must be within ±20% of true value.

18.9 Limit of Detection

18.9.1 All analytes spiked should be positively identified.

18.10 Limit of Quantitation

18.10.1 Analysis must meet the acceptance criteria for the laboratory control sample.

19. CORRECTIVE ACTION FOR OUT-OF-CONTROL DATA

19.1 BFB-MS Tuning Check Compounds

19.1.1 Rerun the BFB tune.

19.1.2 If it still fails, re-tune the instrument and run again. If it still fails, clean the source.

19.2 Initial Calibration

19.2.1 After the system performance check has met the criteria, CCCs are used to check the validity of the initial calibration.

19.2.2 If the QC criterion is not met for any CCC, take a corrective action prior to sample analysis.

19.2.3 If the problem cannot be corrected, generate a new calibration or report the failures in the case narrative and/or non-conformance sheet.

19.3 Continuing Calibration

19.3.1 If the criteria for continuing calibration are not met, rerun the continuing calibration.

19.3.2 If the continuing calibration fails again, acquire a new initial calibration or report the failures in the case narrative and/or non-conformance sheet.

19.4 Method Blank

19.4.1 Rerun the method blank if it fails the first time.

19.4.2 If it fails second time, evaluate the system and contact the department supervisor.

19.4.3 For DoD work – Reprocess the failing blank with the associated samples in a subsequent preparation batch, except when the sample analysis results in a non-detect.

19.5 Surrogates

19.5.1 Should any injection fail to meet the required limits, reanalyze the sample.

19.5.2 If the second injection is acceptable, report only the second set of data.

19.5.3 If the second injection also fails, report both sets of data.

19.5.4 In the case of high level soils, first reanalyze the original methanol extract.

19.5.5 If this fails, re-extract the sample, then analyze the new extract.

19.6 Laboratory Control Sample

19.6.1 If recovery of the LCS is outside the control limits, re-analyze the LCS.

19.6.2 If the recovery is above the control limits, and the affected compound is not detected above the LOQ in any associated client sample, the data may be reported with a "Q" flag applied to the compound and the failure documented in the case narrative/ non-conformance.

19.6.3 If the recovery is below the control limits, or the affected compound is detected above the LOQ in any associated client sample, the LCS and affected samples must be re-extracted.

19.6.3.1 If the samples cannot be re-extracted, the results must be reported with a "Q" flag, and the failure documented in the case narrative/ non-conformance.

19.6.3.2 If the data will be reported associated with the failed LCS, for DOD projects, the client must be informed of the failure and consulted for corrective actions.

19.7 MS/MSD

19.7.1 No corrective action is required if limits are exceeded for MS/MSD analysis but the blank spike meets the criteria. However if more than 50% of the recoveries or 50% of the %RPD's are out, find the cause of this and reanalyze one or both of the spikes.

19.8 Internal Standards

19.8.1 If any sample fails to meet criteria, re-analyze the sample.

19.8.2 If the reanalysis is within limits, then report only the second set of data.

19.8.3 If the re-analysis also fails, report both sets of data.

19.8.4 If the continuing calibration verification standard fails criteria, a new initial calibration needs to be performed.

19.9 Limit of Detection

19.9.1 If LOD verification fails, then repeat the detection limit determination and LOD verification at a higher concentration and set the LOD at the higher concentration.

19.10 Limit of Quantitation

19.10.1 Reevaluate the LOD and the LOQ.

19.11 Initial calibration verification (ICV)

19.11.1 If criteria are not met, rerun ICV once. If criteria still not met, then verify whether failed compounds are required for associated samples or not. If failed compounds are not required for associated samples then continue with the analysis otherwise reanalyze a new initial calibration curve.

20. Contingencies for handling out-of-control or unacceptable data

20.1 Following are the result qualifiers used for out-of-control and unacceptable data:

- **U**: Indicates the compound was analyzed but not detected.
- **J**: Indicates an estimated value, the result reported is below the initial calibrations lowest point.
- **B**: Indicates the analytes were found in the blank as well as the sample.
- **E**: Indicates the analyte concentrate exceeds the calibrated range of the GC instrument.
- **D**: Indicates all compounds identified in an analysis at a secondary dilution factor.

- **N**: Indicates presumptive evidence of a compound. This is used for all non-target results where identification is made.
- **Q**: Indicates a QC (LCS) failure associated with the compound

20.2 Issue a corrective action form any time there is a deviation from the SOP or the client requirements are not met.

20.3 If a sample or extract is damaged, broken, or spilled, contact the project manager and issue a corrective action.

20.4 For more details regarding corrective action procedure, please refer to Corrective Action Report SOP.

20.5 For **DOD** work- use DOD QSM flagging criteria.

21. WASTE MANAGEMENT

21.1 Keep samples for 30 days after analysis and dispose them off according to the procedures explained in the SOP for waste disposal.

22. REFERENCES

22.1 USEPA Test Methods for Evaluating Solid Wastes, SW-846, Method 5030B-Purge and Trap for Aqueous Samples, Revision 2, December 1996.

22.2 USEPA Test Methods for Evaluating Solid Wastes, SW-846, Method 5030C-Purge and Trap for Aqueous Samples, Revision 3, May 2003.

22.3 USEPA Test Methods for Evaluating Solid Wastes, SW-846, Method 5035A – Closed System Purge and Trap and Extraction for Volatile Organics in Soil and Waste Samples. Revision 1, July 2002.

22.4 USEPA Test Methods for Evaluating Solid Wastes, SW-846, Method 8000B – Determinative Chromatographic Separations. Revision 2, December 1996

22.5 USEPA Test Methods for Evaluating Solid Wastes, SW-846, Method 8260B – Volatile Organic Compounds by GC/MS, Revision 2, December 1996.

22.6 USEPA Test Methods for Evaluating Solid Wastes, SW-846, Method 8260C – Volatile Organic Compounds by GC/MS, Revision 3, August 2006.

22.7 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.0, July 2013 & Version 5.1 January 2017.

23. LIST OF TABLES/ATTACHMENTS

TABLE 1
TARGET COMPOUND LIST

COMPOUND NAME	COMPOUND NAME
1,1,1,2-Tetrachloroethane	Carbon disulfide
1,1,1-Trichloroethane	Carbon Tetrachloride
1,1,2,2-Tetrachloroethane	Chlorobenzene
1,1,2-Trichloroethane	Chloroethane
1,1,2-Trichlorotrifluoroethane	Chloroform
1,1-Dichloroethane	Chloromethane
1,1-Dichloroethene	cis-1,2-Dichloroethene
1,1-Dichloropropene	cis-1,3-Dichloropropene
1,2,3-Trichlorobenzene	Cyclohexane
1,2,3-Trichloropropane	Dibromochloromethane
1,2,4-Trichlorobenzene	Hexachloroethane
1,2,4-Trimethylbenzene	Dibromomethane
1,2-Dibromo-3-Chloropropane	Dichlorodifluoromethane
1,2-Dibromoethane	Ethyl Benzene
1,2-Dichlorobenzene	Hexachlorobutadiene
1,2-Dichloroethane	Isopropylbenzene
1,2-Dichloropropane	m/p-Xylenes
1,3,5-Trimethylbenzene	Methyl Acetate
1,3-Dichlorobenzene	Methyl tert-butyl Ether
1,3-Dichloropropane	Methylcyclohexane
1,4-Dichlorobenzene	Methylene Chloride
2,2-Dichloropropane	Naphthalene
2-Butanone	n-Butylbenzene
2-Chloroethyl vinyl ether	N-propylbenzene
2-Chlorotoluene	o-Xylene
2-Hexanone	p-Isopropyltoluene
Diethyl ether	Sec-butylbenzene
4-Chlorotoluene	Styrene
4-Methyl-2-Pentanone	t-1,3-Dichloropropene
Acetone	Tert butyl alcohol
Acrolein	tert-Butylbenzene
Acrylonitrile	Tetrachloroethene
Benzene	Toluene
Bromobenzene	trans-1,2-Dichloroethene
Bromochloromethane	Trichloroethene
Bromodichloromethane	Trichlorofluoromethane
Bromoform	Vinyl Acetate
Bromomethane	Vinyl chloride
Allyl chloride	Ethyl acetate
Ethyl methacrylate	Isobutyl alcohol
Methacrylonitrile	1,4-Dioxane

TABLE 2
BFB TUNING CRITERIA

Mass	**Ion Abundance Criteria**
50	15.0-40.0 percent of mass 95
75	30.0-60.0 percent of mass 95
95	Base peak, 100 percent relative abundance
96	5.0-9.0 percent of mass 95
173	Lass than 2.0 percent of mass 174
174	Greater than 50.0 percent of mass 95
175	5.0-9.0 percent of mass 174
176	95.0-101.0 percent of mass 174
177	5.0-9.0 percent of mass 176

TABLE 3
CHARACTERISTIC IONS FOR VOLATILE TARGET COMPOUNDS

Analyte	Primary Ion*	Secondary Ion(s)	Internal Standard for Quantitation
Dichlorodifluoromethane	85	87	IS1
Chloromethane	50	52	IS1
Vinyl chloride	62	64	IS1
Bromomethane	94	96	IS1
Chloroethane	64	66	IS1
Trichlorofluoromethane	151	101,153	IS1
1,1-Dichloroethene	96	61, 63	IS1
Carbon disulfide	76	78	IS1
Methylene Chloride	84	49, 86	IS1
Acetone	58	43	IS1
t-Butyl alcohol	59	74	IS1
trans-1,2-Dichloroethene	96	61, 98	IS1
Acrolein	56	55,58	IS1
Acrylonitrile	53	40,39	IS1
t-Butyl methyl ether	73	57	IS1
1,1-Dichloroethane	63	65, 83	IS1
2-Butanone	72	43	IS1
2,2-Dichloropropane	77	97	IS1
cis-1,2-Dichloroethene	96	61, 98	IS1
Bromochloromethane	128	49,130	IS1
Chloroform	83	85	IS1
1,1,1-Trichloroethane	97	99, 61	IS1
Carbon tetrachloride	117	119	IS2
1,1-Dichloropropene	75	110,77	IS2
Benzene	78	76,77	IS2
1,2-Dichloroethane	62	98	IS2
Trichloroethene	95	97, 130, 132	IS2
1,2-Dichloropropane	63	112	IS2
Bromodichloromethane	83	85, 127	IS2
Dibromomethane	174	95,174	IS2
cis-1,3-Dichloropropene	75	77, 39	IS2
Vinyl Acetate	43	86	IS2
trans-1,3-Dichloropropene	75	77, 39	IS2
1,1,2-Trichloroethane	83	97, 85	IS3

TABLE 3
CHARACTERISTIC IONS FOR VOLATILE TARGET COMPOUNDS

Analyte	**Primary Ion***	**Secondary Ion(s)**	**Internal Standard for Quantitation**
2-Chloroethyl vinyl ether	63	65,106	IS3
1,3-Dichloropropane	76	78	IS3
Dibromochloromethane	129	127	IS3
Bromoform	173	175, 254	IS3
4-Methyl-2-pentanone	100	43, 85	IS3
Toluene	92	91	IS3
Tetrachloroethene	164	129, 131, 166	IS3
Isopropylbenzene	105	120	IS3
1,1,2,2-Tetrachloroethane	83	131, 85	IS3
2-Hexanone	43	58, 57, 100	IS3
1,2-Dibromoethane	107	109,188	IS3
Chlorobenzene	112	77, 114	IS3
1,1,1,2-Tetrachloroethane	131	133,119	IS3
Ethylbenzene	91	106	IS3
o- Xylene	106	91	IS3
m+p- Xylene	106	91	IS3
Styrene	104	78	IS3
Bromobenzene	156	77,158	IS4
1,2,3-Trichloropropane	75	77	IS4
n-Propylbenzene	91	120	IS4
2-Chlorotoluene	91	126	IS4
1,3,5-Trimethylbenzene	105	120	IS4
4-Chlorotoluene	91	126	IS4
tert-Butylbenzene	119	91,134	IS4
1,2,4-Trimethylbenzene	105	120	IS4
sec-Butylbenzene	105	134	IS4
p-Isopropyltoluene	119	134,91	IS4
1,3-Dichlorobenzene	146	111,148	IS4
1,4-Dichlorobenzene	146	111,148	IS4
n-Butylbenzene	91	92	IS4
1,2-Dichlorobenzene	146	111,148	IS4
1,2-Dibromo-3-Chloropropane	75	155,157	IS4
1,2,4-Trichlorobenzene	180	182,145	IS4
Hexachlorobutadiene	225	223,227	IS4
Naphthalene	128	--	IS4
1,2,3-Trichlorobenzene	180	182,145	IS4
Cyclohexane	56	69, 84	IS1
Methyl acetate	43	74	IS1
Methyl cyclohexane	83	59, 98	IS2

TABLE 3
CHARACTERISTIC IONS FOR VOLATILE TARGET COMPOUNDS

Analyte	**Primary Ion***	**Secondary Ion(s)**	**Internal Standard for Quantitation**
Trichlorotrifluoroethane	101	103	IS1
Diethyl ether	74	45	IS1
Hexachloroethane	117	201	IS4
Allyl chloride	41	39, 76	IS1
Ethyl acetate	43	61, 70	IS1
Ethyl methacrylate	69	41, 39	IS2
Isobutyl alcohol	43	41, 42	IS2
Methacrylonitrile	41	39, 67	IS2
1,4-Dioxane	88	43, 58	IS2
Surrogate Compounds (System Monitoring Compounds)			
Dibromofluoromethane	113	--	IS1
1,2-Dichloroethane-d4	65	102	IS2
Toluene-d8	98	70, 100	IS3
4-Bromofluorobenzene	95	174, 176	IS4
Internal Standards			
Pentafluorobenzene (IS 1)	168	--	IS1
1,4-Difluorobenzene (IS 2)	114	68, 88	IS2
Chlorobenzene-d5 (IS 3)	117	82, 119	IS3
1,4-Dichlorobenzene-d4 (IS 4)	152	115, 150	IS4

*The primary ion should be used unless interferences are present, in which case, a secondary ion may be used.

**m/z 43 is used for quantitation of 2-Butanone, but m/z 72 must be present for positive identification.

TABLE 4
QC/Sample Preparation (concentrations are subject to change)

QC/Samples	Matrix	Internal Std (ul) 50ppm	Surrogate (ul) 50ppm	MeOH Added (ul)	Final volume (ml)
50 ppb CCC	Water	40.0	40.0	NA	40mL
20 ppb CCC	Water	40.0	40.0	NA	40mL
Method Blank	Water	40.0	40.0	NA	40mL
High Level Soil Blank	Water	800.0	800.0	100	40mL
Blank Spike/MS/MSD	Water	40.0	40.0	NA	40mL
Sample	Water	40.0	40.0	NA	40mL
50 ppb CCC	Soil	5.0	5.0	NA	5mL
20 ppb CCC	Soil	5.0	5.0	NA	5mL
Method Blank	Soil	5.0	5.0	NA	5mL
Blank Spike/MS/MSD	Soil	5.0	5.0	NA	5mL
Sample	Soil	5.0	5.0	NA	5mL

Note: Follow the above table if surrogate and internal standard solutions are added manually. If surrogate and internal standard solutions are added by the auto sampler, then the same stock solution is used to add these solutions using the auto sampler loop. The same technique and amount of solution is added to all calibration standards and samples following an initial calibration curve.

TABLE 5
Purging Conditions (subject to change)

Instrument Name	Purge Flow	Purge Temp.	Purge Time	Dry Purge Time	Desorb Temp.
MSVOAD	40mL/min	35°C	11 Min.	3 Min	250°C
MSVOAF	40 mL/min	35°C	11 Min.	3 Min	190°C
MSVOAH	40 mL/min	35°C	11 Min.	1 Min.	190°C
MSVOAK	40 mL/min	35°C	11 Min.	0 Min.	190°C
MSVOAI	40 mL/min	35°C	11 Min.	0.5Min.	190°C

TABLE 6
Purge & Trap System (subject to change)

Instrument Name	Auto-sampler	Concentrator	Sample Heater
MSVOAD	OI-4552 Arcon	Tekmar 2000	Yes and Stirrer
MSVOAF	OI-4552 Arcon	OI 4660 Eclipse	Yes and Stirrer
MSVOAH	Arcon Dynatech	OI 4660 Eclipse	---
MSVOA K	OI 4552 Arcon	OI 4560	Yes and Stirrer
MSVOA I	EST Arcon	OI 4660 Eclipse	Yes and Stirrer

TABLE 7
Purge & Trap system (subject to change)

Instrument Name	Desorb Time	Bake Temp.	Bake Time.	2016 Line and Valve Temp.
MSVOAD	6 Min.	260^{o}C	10 Min.	110^{o}C
MSVOAF	2 Min.	210^{o}C	6 Min.	110^{o}C
MSVOAH	2 Min.	210^{o}C	6 Min.	110^{o}C
MSVOAK	3 Min.	210^{o}C	5 Min.	110^{o}C
MSVOAI	2 Min.	210^{o}C	5 Min.	110^{o}C

Trap = Vocarb 3000 from Supelco Catalog # 21066-U and OI#10 Trap or equivalent

TABLE 8
Instrument Specifications (subject to change)

Instrument Name	Column	Supplier	Catalog #	Model of GC	Model of MS
MSVOAD	RTX-VMS 20M x 0.18mm ID x 1um film thickness	Restek	49914	HP5890	HP5971
MSVOAF	RTX-VMS 20M x 0.18mm ID x 1um film thickness	Restek	49914	HP5890	HP5972
MSVOAH	RTX-VMS 20M x 0.18mm ID x 1um film thickness	Restek	49914	HP5890	HP5971
MSVOAK	RTX-VMS 20M x 0.18mm ID x 1um film thickness	Restek	49914	HP5890	HP5972
MSVOAI	RTX-VMS 60M x 0.25mm ID x 1.4um film thickness	Restek	19916	HP5890	HP5971

TABLE 9
Instrument Temperature and Flow Conditions (or equivalent) (subject to change)

Instrument Name	Injector Temperature	Detector B Temperature Mass Spectrometer	Carrier Flow
MSVOAD	220^{o}C	280^{o}C	30mL/Minute
MSVOAF	220^{o}C	260^{o}C	30mL/Minute
MSVOAH	220^{o}C	280^{o}C	30mL/Minute
MSVOAK	220^{o}C	280^{o}C	30mL/Minute
MSVOAI	220^{o}C	280^{o}C	30mL/Minute

TABLE 10
Instrument Temperature Conditions (or equivalent) (subject to change)

Instrument Name	Initial Temperature	Initial Hold	Temperature Ramp	Final Temperature	Final Hold
MSVOAD	50°C	4 Minutes	18 °C /Minute Ramp A = 25 °C /Minute	100°C Final A = 210 °C	0 Minute Final A = 5.0 Minutes
MSVOAF	42°C	1 Minutes	10 °C /Minute Ramp A = 25 °C /Minute	100°C Final A = 220 °C	0 Minute Final A = 3.0 Minutes
MSVOAH	40°C	2 Minutes	10 °C /Minute Ramp A = 25 °C /Minute	100°C Final A = 220 °C	2 Minutes Final A = 2.20 Minutes
MSVOAK	42°C	1 Minutes	10 °C /Minute Ramp A = 25 °C /Minute	100°C Final A = 220 °C	0 Minute Final A = 3.0 Minutes
MSVOAI	42°C	1 Minutes	10 °C /Minute Ramp A = 25 °C /Minute	100°C Final A = 220 °C	0 Minute Final A = 7.0 Minutes

TABLE 11
Standards and Solutions (or equivalent)

Standard Name	Supplier	Catalog Number	Concentration of stock	Preparation Details	Final Concentration of working solution
8260 Internal Standard	Restek	555581	25,000 ug/mL	20uL into 10mL Volumetric QS DI water	50ug/mL
Arcon 8260 Internal Standard	Restek	555581	25,000 ug/mL	100uL into 10mL Volumetric QS DI water	250ug/mL
Arcon 8260 Surrogate Standard	Restek	555582	25,000 ug/mL	100uL into 100mL Volumetric QS DI water	250ug/mL
8260 Surrogate Standard	Restek	555582	25,000 ug/mL	20uL into 100mL Volumetric QS DI water	50ug/mL
8260 Calibration Working STD Acrolein only	Absolute	91980	5000ug/mL	4.0mL into 25mL volumetric QS DI water	160ug/mL
8260 Calibration working STD Bromochloromethane only	Restek	30225	2,000 ug/mL	4.0mL in 50mL Volumetric QS DI water	160.0ug/mL
BFB	Restek	30067	2500ug/mL	250ul into 25mL volumetric QS DI water	25ug/mL
8260 Calibration working Stock Standard 160ppm	Restek	555408	8000ug/mL	1000uL	160ug/mL for most components
		555406	2000ug/mL	800uL	
		555407	10,000ug/mL	800uL	
		30006	5,000ug/mL	1600uL	
		30489	2000ug/mL	800uL	
		30042	2000ug/mL	800uL	
		30499	10,000ug/mL	800uL	
		30225	2000ug/mL	800uL	
		556166	2000-40,000ug/mL	800uL	
		30470	50,000ug/mL	160uL	
				in 10mL Volumetric QS DI water	
8260 Calibration working Stock Standard 100ppm	-----	-----	160ug/mL	625uL 160ug/mL Stock solution in 325mL DI water	100ppm
8260 Calibration working Stock Standard 20ppm	-----	-----	160ug/mL	125uL 160ug/mL Stock solution in 875mL DI water	20ppm
8260 Calibration working Stock Standard 10ppm	-----	-----	160ug/mL	62.5uL 160ug/mL Stock solution in 937.5mL DI water	10ppm

TABLE 12
Water Working Standard Preparation

Water Working Standard Level	Stock Solution Std. Concentration (ppm)	Volume used(ul)	Surrogate (ul) 50ppm	Internal std (ul) 250ppm	Final volume (ml)
1 ppb	10ppm	4.0uL	0.8ul	8.0ul	40mL Vial
5 ppb	20ppm	10.0uL	4.0ul	8.0ul	40mL Vial
10 ppb	20ppm	20.0uL	8.0ul	8.0ul	40mL Vial
20 ppb	160ppm	5.0uL	16.0ul	8.0ul	40mL Vial
50 ppb	160ppm	12.5uL	40.0ul	8.0ul	40mL Vial
100 ppb	160ppm	25.0uL	80.0ul	8.0ul	40mL Vial
150 ppb	160ppm	37.5uL	120.0ul	8.0ul	40mL Vial
200 ppb	160ppm	50.0uL	160.0ul	8.0ul	40mL Vial
50 ppb ICV	160ppm	12.5uL	40.0ul	8.0ul	40mL Vial

TABLE 13
Soil Working Standard Preparation

Soil Working Standard Level	Stock Solution Std. Concentration (ppm)	Volume used from stock (ul)	Surrogate (ul) 50ppm	Internal std (ul) 50ppm	Final volume (ml)
5 ppb	10ppm	2.5ul	0.5ul	5ul	5mL Vial
10 ppb	10ppm	5.0ul	1.0ul	5ul	5mL Vial
20 ppb	20ppm	5.0ul	2.0ul	5ul	5mL Vial
50 ppb	100ppm	2.5ul	5.0ul	5ul	5mL Vial
75 ppb	100ppm	3.75ul	7.5ul	5ul	5mL Vial
100 ppb	100ppm	5.0ul	10.0ul	5ul	5mL Vial
200 ppb	100ppm	10.0ul	20.0ul	5ul	5mL Vial
50 ppb ICV	100ppm	2.5ul	5.0ul	5ul	5mL Vial

CHEMTECH 284 Sheffield Street, Mountainside, NJ (908) 789-8900

READ RECEIPT

Employee Name: ________________________

Department: ____________________________

________________________ **M8260B/C-SWGCMSVOA**________________________

Method or Document Read (Include Title, Number, Revision, as applicable)

Employee Statement: I have read and understand the information in the above mentioned method or document.

____________________________________ ___________

Employee Signature Date

Supervisory Statement: I have reviewed this document or method with the employee.

____________________________________ ___________

Supervisory Signature Date

Note: This receipt is to be returned to the Quality Assurance Department for incorporation into employee training record files. If you have questions or would like to review your train record files, please see QA.

L4 - Sample Preparation for Toxicity Characteristics Leachate Procedure

SAMPLE PREPARATION FOR TOXICITY CHARACTERISTICS LEACHATE PROCEDURE

1. Test Method

1.1 Sample preparation for toxicity characteristics leachate procedure by Method SW 846-1311.

2. Applicable Matrices

2.1 Liquid, solid and multiphase waste

3. Method Detection Limit

3.1 NA

4. Scope and Application

4.1 This method determines the mobility of organic and inorganic analytes present in liquid, solid and multiphase wastes.

4.2 Total analysis of a sample that demonstrates individual analytes not present or substantially below the regulatory level need to be determined by TCLP.

4.3 If the analysis for any TCLP extract exceeds the regulatory level, it may not be necessary to analyze the remaining fractions.

4.4 If the analysis of the extract from a bottle extractor shows analyte levels greater than the regulatory level, the ZHE extraction may not be necessary.

5. Summary

5.1 For liquid wastes, those containing less than 0.5% dry solid material, the waste after filtration through a 0.6 to 0.8-micron glass fiber filter, is defined as the TCLP extract.

5.2 For wastes containing greater than or equal to 0.5% solids, the liquid, if any is separated from the solid phase and stored for later analysis. The solid phase is extracted with an amount of extraction fluid equal to 20 times the weight of the solid phase. A special extractor vessel is used when testing for volatile analytes. Following extraction the liquid extract is separated from the solid phase by filtration through a 0.6 to 0.8-micron glass fiber filter.

5.3 For multiphase samples the initial liquid phase of the waste is added to the liquid extract, and these are analyzed together, if compatible. If not compatible, the liquids are analyzed separately and the results are mathematically combined to yield a volume-weighted average concentration.

6. Definitions

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

6.2 Batch: Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents.

6.2.1 Preparation Batch: is composed of one to 20 environmental samples of the same matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours.

6.2.2 Analytical Batch: is composed of prepared environmental samples (extracts, digestates or concentrates), which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

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

6.4 Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

6.5 Duplicate Analyses: The analysis or measurements of the variable of interest performed identically on two sub-samples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.

6.6 Holding Times (Maximum Allowable Holding Times): The maximum times that samples may be held prior to analysis and still be considered valid or not compromised.

6.7 Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest, which is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations tat impact the analytical results for sample analyses.

6.8 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample.

6.9 Pure Reagent Water: Water (defined by national or international standard) in which no target analytes or interferences are detected as required by the analytical method.

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

6.11 Standard Operating Procedures (SOPs): A written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive task.

6.12 Test Method: An adoption of a scientific technique for a specific measurement problem, as documented in a laboratory SOP.

7. Interferences

7.1 Potential interferences that may be encountered during analysis are discussed in the individual analytical methods.

8. Safety

8.1 Wear appropriate safety clothing and eye protection.
8.2 Use protective gloves when handling corrosive chemicals.
8.3 Always use safety carts when transporting large bottles of chemicals.
8.4 Read material safety data sheet (MSDS) for the chemicals used in the laboratory for the identity of the ingredients, the physical and chemical characteristics of the substance, the physical hazards, and safe handling and safety precautions.

9. Equipment and Supplies

9.1 Rotary agitator, 30 ± 2 rpm, for 2 & 3
9.2 Zero-headspace Extraction Vessels (ZHE), internal volume of 500-600mL, for volatile.
9.3 Bottle Extraction Vessels, plastic for metals, borosilicate glass for semivolatile organic
9.4 Pressure Filter, (to 50 psi), stainless steel
9.5 Filters for 2 and 4, borosilicate glass fiber, containing no binder materials, pore sizes 0.6 to 0.8 um.
9.6 Gas tight syringe to collect extracts form ZHE
9.7 Mettler balance AE100
9.8 Beakers- 500 ml or Erlenmeyer Flask

10. Reagents and Standards

10.1 1.0 N HNO_3 = 64 ml concentrated HNO_3 /1000 ml
10.2 1.0 N HCl = 83 ml concentrated HCl / 1000 ml
10.3 1.0 N NaOH = 40.0 g NaOH pellets/ 1000ml

Extraction Fluid # 1	Extraction Fluid # 2
500 ml DI water	500 ml DI water
5.7 ml Glacial Acetic Acid	5.7 ml Glacial Acetic Acid
64.3 ml 1.0 N NaOH solution	Dilute to 1000 ml
Dilute to 1 liter	(pH should be 2.88 +/- 0.05)
(pH should be 4.93 +/-0.05)	

11. Sample Collection, Shipment, and Storage

11.1 Refrigerate at 4^0C until extraction. Do not add preservatives prior to extraction. If organic are to be analyzed for, use glass containers with teflon lined septa. Preserve extracts according to the guidance given in the individual; analytical methods. The general chemistry department will immediately acidify extracts for metallic aanalytes with nitric acid to pH <2 unless precipitation occurs.

SAMPLE MAXIMUM HOLDING TIMES (days) For Non-CLP Methods:

Analysis Type	From Field Collection to 1311 Extraction	From 1311 Extraction to Preparative Extraction	From Preparative Extraction to Determinative Analysis
Volatile Soil	14	NA	14
Volatile Water	14	NA	14
Semi-Volatile Soil	14	7	40
Semi-Volatile Water	14	7	40
Pesticide Soil	14	7	40
Pesticide Water	14	7	40
Mercury Soil	28	NA	28
Mercury Water	28	NA	28
Cyanide Soil	14	NA	14
Cyanide Water	14	NA	14
Metals Soil (except Mercury)	180	NA	180
Metals Water (except Mercury)	180	NA	180

SAMPLE MAXIMUM HOLDING TIMES (days) For ISM/SOM CLP methods:

Analysis Type	From VTSR to 1311 Extraction	From 1311 Extraction to Preparative Extraction	From Preparative Extraction to Determinative Analysis
Volatile Soil	10	NA	7
Volatile Water	5	NA	7
Semi-Volatile Soil	10	7	40
Semi-Volatile Water	5	7	40
Pesticide Soil	10	7	40
Pesticide Water	5	7	40
Mercury Soil	26	26	26
Mercury Water	26	26	26
Cyanide Soil	12	12	12
Cyanide Water	12	12	12

Metals Soil (except Mercury)	180	180	180
Metals Water (except Mercury)	180	180	180

VTSR= Validated Time of Sample Receipt

12. Quality Control

12.1 Laboratory Reagent Blank

12.1.1 Analyze a minimum of one blank (using the same extraction fluid as used for the samples) daily or for every batch of 20 or fewer extractions (whichever is more frequent) that have been conducted in an extraction vessel.

14.3.2 Rotate ZHE extractor every time which is used for Blank Extraction.

12.2 Spike Sample

12.2.1 Perform a matrix spike for every waste type. A minimum of one matrix spike must be analyzed daily or for each analytical batch (20 or less samples). As a minimum, follow the matrix spike addition guidance provided in each analytical method.

12.2.2 Matrix spikes are added after filtration of TCLP extract and before preservation. Matrix spikes are not added prior to TCLP extraction of the sample.

13. Calibration and Standardization

13.1 NA

14. Procedure

14.1 Procedure for all tests other than Volatile

14.1.1 Room temperature must be constant (21-25^{0}C). Record the temperature in the temperature log twice a day. If the temperature is outside control limits contact the supervisor.

14.1.2 If the sample is a soil or other solid with no free liquid, proceed to section 14.2

14.1.3 If the sample is a liquid, or has a phase which appears to be fluid, proceed to section 14.3.

14.1.4 Determine whether or not the waste requires particle size reduction. Any particles, which are too large to pass through a 9.5 mm sieve, should be crushed to a small enough size to pass through the sieve.

14.1.5 Take a 5.0 gram subsample of the waste and place it into a 500 ml beaker or Erlenmeyer flask. Add 96.5-ml DI water to the beaker, cover with a watch glass and stir for 5 minutes using a magnetic stirrer. Measure and record the pH. If the pH is less than 5.0 use extraction fluid #1. If the pH is greater than 5.0, add 3.5 ml 1.0 N HCl, mix briefly and heat to 50^{0}C.

14.1.6 Hold at 50^{0}C for ten minutes, cool to room temperature, and record the pH. If the pH is less than 5.0, use extraction fluid #1; if the pH is greater than 5.0, use extraction fluid # 2. (pHs should be taken using multirange pH paper since only a less than or greater than 5.0 result needs to be measured. The probe may be damaged from the type of samples routinely encountered in TCLP analysis.)

14.1.7 Weigh a 100.0 gram aliquot of sample into a 2000 ml plastic jar and combine it with 2000 ml of the appropriate extraction fluid. If sufficient sample is not available, weigh as much as is available and combine the sample with 20X the amount of extraction fluid. If semivolatiles organic are to be determined a glass jar must be used, but a plastic jar is suitable for metals only.

14.1.8 Place the sample into the rotary agitator and rotate for 18 +/- 2 hours. Be sure to counterbalance the agitator when odd numbers of samples are extracted.

14.1.9 When the rotation period is completed, remove the sample from the agitator and allow it to settle. Check and record the pH. Samples in which the solids do not easily separate may be centrifuged. Do not use prefilters to aid in filtration. Only sufficient sample to support the analysis needs to be filtered (500 mls). In cases where the filtrate may need to be combined with a previously separated phase, filter the entire sample.

14.1.10After insertion into the filtration device, rinse all the filters with 1000 ml 1.0 N HNO3 followed by two 1000-ml volumes of DI water. Filter the extract or prefiltered extract through a 0.8u glass fiber filter. The filtrate can now be transferred to sample bottles appropriate for the required analysis. The general chemistry department will immediately acidify extracts for metallic analytes with nitric acid to pH <2 unless precipitation occurs. Store samples at 4^0C until the time of analysis.

14.2 Assemble the pressure filtration device and place a pre-weighed filter on the support screen. Record the weight of the filter. Rinse the filter with 1000 ml 1.0 N HNO_3 followed by two 1000 ml volumes of DI water.

14.2.1 Weigh out a 100-gram subsample of waste and add it to the filtration device. Apply pressure gradually and increase to 10 psi until air or pressurizing gas moves through the filter. If this point is reached under 10 psi, and if no additional liquid has passed through the filter in any 2-minute interval, slowly increase the pressure in 10-psi increments to a maximum of 50 psi. NOTE: Instantaneous application of high pressure can degrade the filter or when the liquid flow has ceased at 50 psi for a period of 2 minutes, stop the filtration. If the sample fails to yield any filtrate during the pressure filtration procedure, treat it as 100% solid and proceed as described in Section A.

***NOTE**: Some wastes will obviously contain some materials that appear to be liquid, i.e.-oily wastes. If after filtration the material does not filter it is defined as a solid. Do not replace the original filter with a fresh filter under any circumstances. Use only one filter.*

14.2.2 Weigh any filtered liquid (filtrate) and record the weight.

14.2.3 Determine the weight of the solid phase of the waste by subtracting the weight of the filtrate from the weight of the original sample. Calculate and record the percent solids using the formula:

$$\text{Percent Solids} = \frac{\text{wt. of solid}}{\text{total wt. of waste}} \text{ X } 100$$

14.2.4 If the percent solids are less than 0.5% then the filtrate is the sample extract. More sample may be filtered if necessary.

14.2.5 If the percent solids are greater than 0.5% remove the solid phase along with the filter and dry at 100 +/- 200C to a constant weight. Determine the % dry solids using the formula:

$$\text{\% Dry Solids} = \frac{\text{(wt. of dry waste \& filter) - (tared wt. of filter)}}{\text{initial wt. of waste}} \text{ X } 100$$

14.2.6 If the percent dry solids is less than 0.5% then the filtrate is the extract as described previously.

14.2.7 If the percent dry solids is greater than 0.5% then filter another sample of waste, retaining both the solids and the filtrate. Using the percent solids result from the initial filtration, calculate the volume of extraction fluid needed using the formula:

$$\text{Wt. of ext. Fluid} = \frac{20 \text{ X percent solids X wt. of waste filtered}}{100}$$

14.2.8 Treatment of the solid portion of waste from this point on is the same as that which is described in Section A. It may be necessary to filter two portions of the waste to determine the type of extraction fluid to use and to perform the actual extraction. The test to determine the type of extraction fluid to use may need to be modified (scaled down) if only a small amount of solid materials is available.

14.2.9 It should be noted that the filtered solids along with the entire filter are added to the extractor.

14.2.10 After obtaining the final filtered extract, it may be combined with the initial sample filtrate if physically compatible. If the two phases are not compatible they should be analyzed separately and the results combined mathematically using the formula:

$$\text{Final analyte concentration} = \frac{(V1)\ (C1) + (V2)\ (C2)}{V1 + V2}$$

V1 = Volume of the first phase

C1 = Concentration of analyte in the first phase
V2 = Volume of the second phase
C2 = Concentration of the analyte in the second phase

14.3 Procedure for Volatile

14.3.1 Room temperature must be constant (21-25^{0}C). Record the temperature in the temperature log twice a day. If the temperature is outside control limits contact the supervisor.

14.3.3 If the percent solids or percent dry solids is <0.5% the filtrate is defined as the TCLP extract. Store in VOA vials and refrigerate until analysis.

14.3.4 Determine whether or not particle size reduction is required as per Section 14.1.

14.3.5 Weigh 25 gram of sample into Zero-Headspace Extractor (ZHE). Apply gentle pressure to 10 psi to force any liquid phase through the filter and into a tared collection container. Gradually increase the pressure in 10-psi increments to a maximum 50 psi, continuing to collect any liquid expelled. Reweigh the collection container. Store the filtrate at 4^{0}C under minimal headspace conditions.

14.3.6 Calculate and add to the ZHE the required amount of extraction fluid #1 (EF#1):

Weight (g) EF #1 = 20 (25-g. of filtrate)

14.3.7 Expel all air from the ZHE and pressurize to 5 to 10 psi. Place it in the rotary agitator and rotate for 18 +/- 2 hrs.

14.3.8 Express the aqueous leachate through the ZHE filter and collect. This filtrate plus the original filtrate (14.25) are collectively defined as the TCLP extract. If miscible, they are combined and analyzed. If immiscible, they are analyzed separately and the results are combined mathematically as in Section 14.2.

14.3.9 Rotate ZHE extractor every time which is used for Blank Extraction.

15. Calculations

15.1 Calculate results as per the specific method.

16. Method Performance

16.1 NA

17. Pollution Prevention

17.1 Use amount of chemicals as required. Do not make large quantities of solutions.
17.2 Use the hood when working with strong chemicals or fumes.
17.3 Keep the work area clean and clutter free to avoid any mishaps.

18. Data Assessment and Criteria for QC

18.1 Laboratory Reagent Blank
  18.1.1 The value of blank must be <MDL
18.2 Spike Samples
  18.2.1 The control limits are 75-125% recovery.

19. Corrective Actions for Out-of-Control Data

19.1 Laboratory Reagent Blank
  19.1.1 If the blank is outside the limit, verify that there is no contamination.
  19.1.2 Use fresh clean glassware.
  19.1.3 Verify that the laboratory water is of good quality.
  19.1.4 Prepare fresh reagents and standard if necessary.
19.2 Spike sample: If spike sample is outside control limits:
  19.2.1 Try a dilution (eliminate interference)
  19.2.2 Check technique (pipetting, homogeneity)
  19.2.3 If spike still fails - contact supervisor, technical director for assistance.

20. Contingencies for Handling Out-of-Control and Unacceptable Data

20.1 When all the above mentioned (Section 19) corrective measures have been taken and data remain outside the QA criteria set forth above, immediately contact your supervisor.
20.2 Document the situation clearly in your laboratory notebook and place a copy of the information in the case narrative of the final data report.
20.3 The supervisor must contact the QA/QC Director, Laboratory Manager, and Technical Director and notify them of the situation.
20.4 A corrective action plan must be developed in order to solve the problem.

21. Waste Management

21.1 Keep sample for 180 days after analysis and dispose of them according to the procedures explained in the SOP for waste disposal.

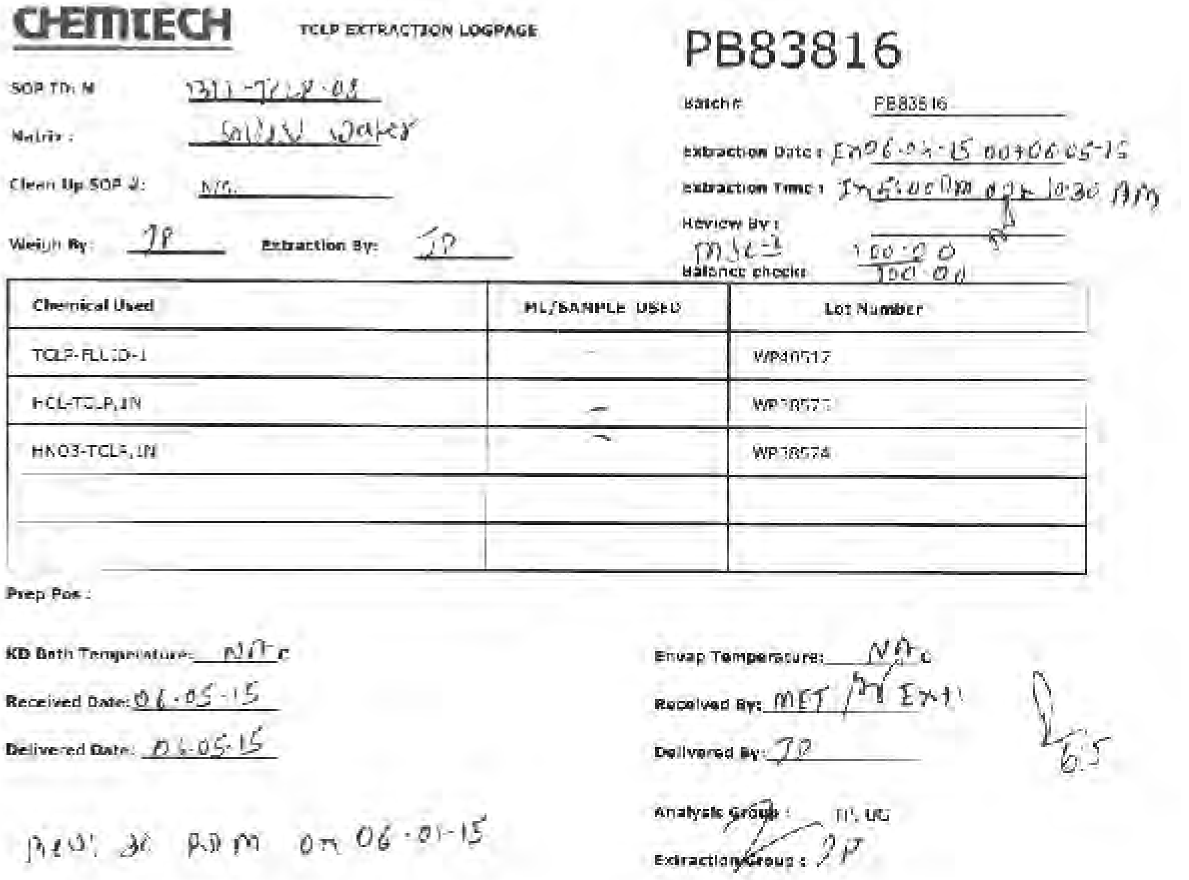
22. References

22.1 Test Method for Evaluating Solid Wastes, SW 846, 3 rd Edition, Method 1311, Revision 0, July 1992 - Toxicity Characteristics Leaching Procedure Federal Register, Volume 57, No. 227, 55114-55117.

23. Tables, appendix, attachments

23.1 Extraction Log

Appendix



CHEMTECH TCLP EXTRACTION LOGPAGE

PB83816

SOP ID: M 1311-TCLP-08

Matrix : Solid Waste

Clean Up SOP #: N/A

Weigh By: JP Extraction By: JP

Batch #: PB83816

Extraction Date : Ext 06-04-15 out 06-05-15

Extraction Time : In 5:00 PM out 10:30 AM

Review By :

MJC-3

Balance check: 100.00 100.00

Chemical Used	ML/SAMPLE USED	Lot Number
TCLP-FLUID-1	–	WP40517
HCL-TCLP,1N	–	WP38573
HNO3-TCLP,1N	–	WP38574

Prep Pos :

KD Bath Temperature: NA C

Received Date: 06-05-15

Delivered Date: 06-05-15

Evap Temperature: NA C

Received By: MET / M Ext

Delivered By: JP

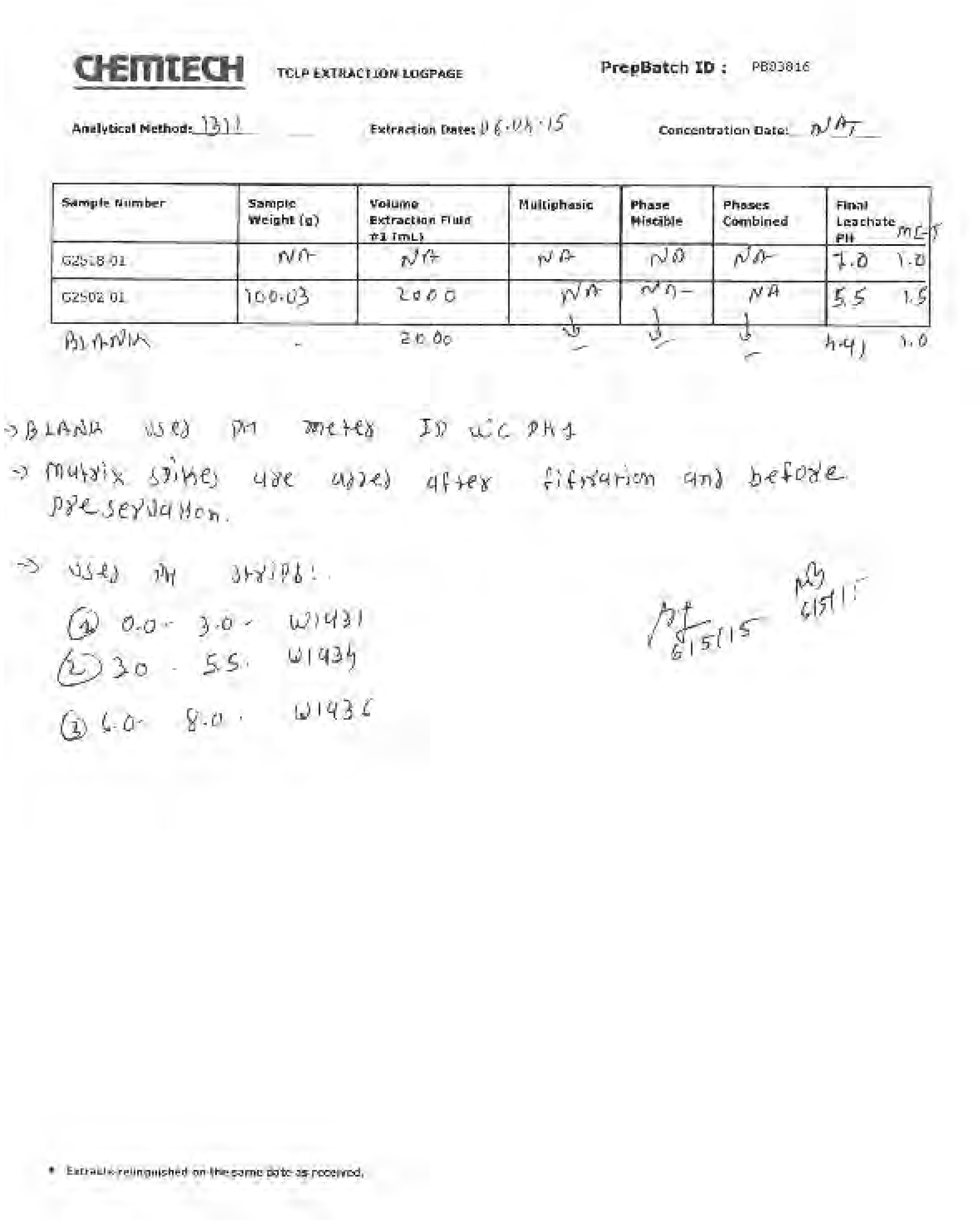
6.5

Analysis Group : TP, UG

Extraction Group : JP

Mev: 30 RPM on 06-01-15

Appendix



CHEMTECH TCLP EXTRACTION LOGPAGE **PrepBatch ID :** PB83816

Analytical Method: 1311 **Extraction Date:** 06.04.15 **Concentration Date:** NA

Sample Number	Sample Weight (g)	Volume Extraction Fluid #1 (mL)	Multiphasic	Phase Miscible	Phases Combined	Final Leachate PH	MS-S
G2518 01	NA	NA	NA	NA	NA	7.0	1.0
G2502 01	100.03	2000	NA	NA	NA	5.5	1.5
BLANK	-	20.00	↓	↓	↓	4.41	1.0

→ BLANK used pH meter ID WC PH1

→ Matrix spikes are added after filtration and before preservation.

→ used pH strips:

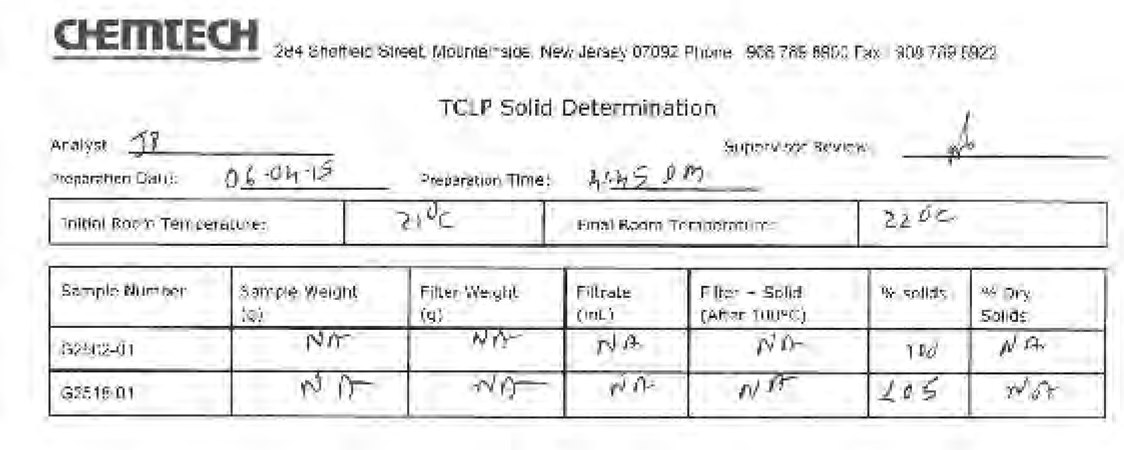
① 0.0 - 3.0 - W1431
② 3.0 - 5.5 W1434
③ 6.0 - 8.0 W1436

6/5/15

6/5/15

* Extracts relinquished on the same date as received.

Appendix



CHEMTECH 284 Sheffield Street, Mountainside, New Jersey 07092 Phone 908 789 8900 Fax 908 789 8922

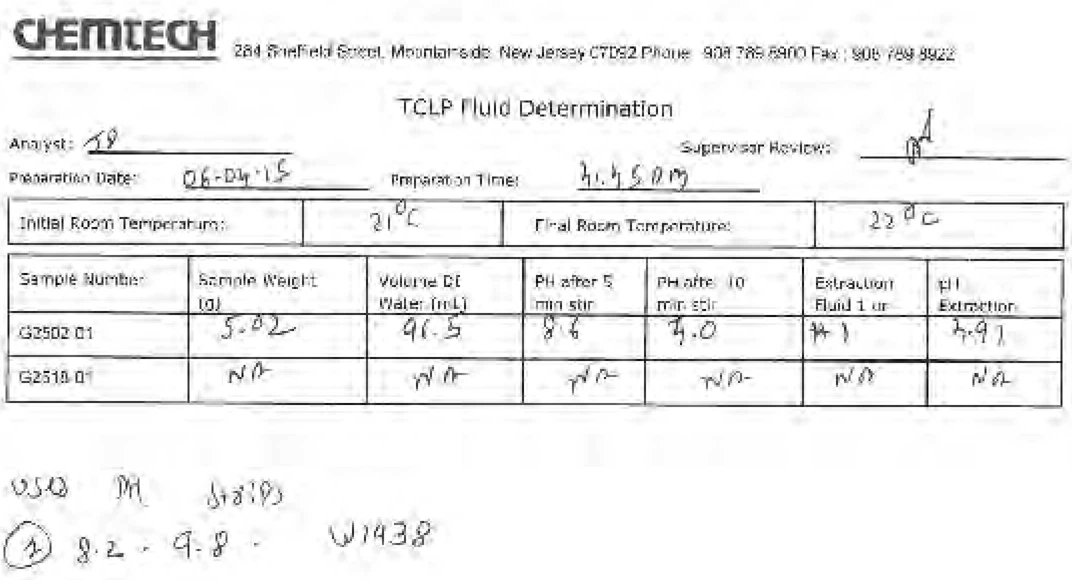
TCLP Solid Determination

Analyst: JJ Supervisor Review:
Preparation Date: 06-04-15 Preparation Time: 4:45 pm

Initial Room Temperature:	21°C	Final Room Temperature:	22°C

Sample Number	Sample Weight (g)	Filter Weight (g)	Filtrate (mL)	Filter + Solid (After 100°C)	% solids	% Dry Solids
G2502-01	NA	NA	NA	NA	100	NA
G2518-01	NA	NA	NA	NA	205	NA

Appendix



CHEMTECH 284 Sheffield Street, Mountainside, New Jersey 07092 Phone: 908 789 8900 Fax: 908 789 8922

TCLP Fluid Determination

Analyst: JP
Supervisor Review:
Preparation Date: 06-04-15
Preparation Time: 4:45 pm

Initial Room Temperature:	21 °C	Final Room Temperature:	22 °C

Sample Number	Sample Weight (g)	Volume DI Water (mL)	PH after 5 min stir	PH after 10 min stir	Extraction Fluid 1 or	pH Extraction
G2502 01	5.02	96.5	8.6	4.0	#1	4.91
G2518 01	NA	NA	NA	NA	NA	NA

Use pH strips
② 8.2 - 9.8 - W1438

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 (908) 789-8900

READ RECEIPT

Employee Name: ______________________________

Department: ______________________________

______________________ **M1311-TCLP** ______________________
Method or Document Read (Include Title, Number, Revision, as applicable)

Employee Statement: I have read and understood the information in the above mentioned method or document.

____________________________________ __________________
Employee Signature Date

Supervisory Statement: I have reviewed this document or method with the employee.

____________________________________ __________________
Supervisor Signature Date

Note: This receipt is to be returned to the Quality Assurance/Quality Control Department for incorporation into employee training record files. If you have questions or would like to review your train record files, please see QA/QC Director.

L5 - Sample Receipt, Sample Acceptance Policy, Sample Login, Sample Identification, and Sample Storage

SAMPLE RECEIPT, SAMPLE ACCEPTANCE POLICY, SAMPLE LOG-IN, SAMPLE IDENTIFICATION, & SAMPLE STORAGE

1. Scope and Application

1.1 Procedures for sample handling, receipt, acceptance, login, and storage are defined in this SOP.

1.2 Defining sample acceptance and handling practices is critical to ensure the validity of the laboratory data.

2. Purpose and Responsibility

2.1 This SOP defines the procedures that Sample Management staff must utilize whenever receiving and logging in samples.

2.2 The SOP instructs the staff to use checklists to ensure sample integrity and provides the resources to electronically track samples through the laboratory.

3. Definitions

3.1 Document Control Officer (DCO)**:** The person who is to contact the people at the SMO or region when there are questions about the SDG.

3.2 Sample Management Office (SMO)**:** Federal contractor run department responsible for making sure that the contract laboratory receives the sample correctly. SMO also handles scheduling the work.

3.3 Sample Delivery Group (SDG)**:** A set of samples that can come in all at once or over a maximum of seven days for the same site.

- There are to be no more than twenty samples per SDG.
- If more than twenty samples come in for the same project, then the set is split up so that no more than twenty samples are grouped together.

3.4 Sample Management Technician**:** The individual responsible for correctly receiving and logging samples in for the laboratory.

3.5 Chain of Custody (COC)**:** An unbroken trail of accountability that ensures the physical security of samples & extracts, and includes the signatures of all who handle the samples.

3.6 SM Login Order Test Detail**:** A form that must be completed with every set of samples that is received. This form documents the condition in which the samples were received.

3.7 Preservation**:** Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample.

3.8 Pure Reagent Water**:** Water (defined by national or international standard) in which no target analytes or interferences are detected as required by the analytical method.

3.9 Record of Communication**:** A form that documents the communication between the client and laboratory personnel.

3.10 Standard Operating Procedures (SOPs)**:** A written document which details the method of an operating, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive task.

3.11 Test Method**:** An adoption of a scientific technique for a specific measurement problem, as documented in a laboratory SOP.

3.12 Trip Blank**:** Organic-free reagent water that is place in a 40ml vial and carried through sampling and handling to serve as a check on the contamination of volatiles by diffusion.

3.13 Validation**:** The process of substantiating specified performance criteria.

4. Procedure

4.1 *Sample Acceptance Policy*

4.1.1 Sample storage locations are unique. Upon receipt of sample coolers at the laboratory, examine the coolers for damage or broken custody seals. Note the condition of the seals and cooler(s) on the Chain of Custody and follow Section 4.2.1. Send the COC to the Project Manager and obtain the Login Guidance (See Appendix K). Samples are logged into separate SDGs based on the analyses to be done.. If custody seals and coolers are intact, begin the sample acceptance procedure. If they are not intact, immediately notify the appropriate Laboratory Project Manager by email and request that they contact the client.

4.1.2 After the Test Detail, Lab Chronicle and labels are received, remove the samples from the shipping containers under the hood, and set them up on the bench according to the Field Chain of Custody (COC). See SOP P204-COC for information regarding field COCs'. See Appendix B for a copy of the Field COC. Make sure that all sample labels are legible, written in indelible ink, and water- resistant.

4.1.3 Check the COC/Test Detail and ensure that all sample containers listed on the COC are present. Any deviation from the number of sample containers, and/or sample damage or contamination must be listed on the SM Login Order Test Detail. Inform the Laboratory Project Manager of the non-conformances by raising the ticket.

4.1.4 Examine the field (COC) for completeness and correctness. Use the Sample Acceptance Checklist, Appendix A, as a guideline whenever accepting samples. Check the following:

4.1.4.1 Check the client name and address, and make sure that it is legible.

4.1.4.2 Ensure that the client has clearly written the project sampling location and identification, and that the client has indicated the name of the firm that has collected the samples. Verify the sample collector's name. Check that the billing information is also completed. If any information is missing, request the information from the client, if the client is present. If not, make a note on the SM Login Order Test Detail.

4.1.4.3 Now check the sample information. Check the individual sample identification, the sample location, date and time of sample collection, matrix, number of containers, analysis request, and indication that the proper preservatives were used. See Appendix

C for a listing of the correct preservative for each test performed. Check for any special remarks concerning the samples. List any non-conformances on the SM Login Order Test Detail.

4.1.4.4 Pay close attention to the sample holding time and sample volume requirements. See Appendix C for a list of test holding times and sample volumes. If any sample holding times are less than 3 days, notify the appropriate supervisor of the situation. If holding times have been exceeded or the client did not provide sufficient volume, immediately inform the appropriate Laboratory Project Manager by raising a ticket and list the non-conformant samples on the SM Login Order Test Detail. The Laboratory Project Manager will contact the client and give instructions to proceed with the acceptance or the Project Manager will indicate whether you should ship the non-conformant samples back to the client.

4.2 _Sample Receipt_

4.2.1 Check the cooler for the presence of a temperature blank. If the cooler has a temperature blank, check the temperature and record. If a temperature blank is not provided, check the temperature of the samples utilizing the Wahl Infrared Thermometer-Model DHS 100X or equivalent. Aim the gun at the sample and press the measure temperature button. Record the cooler temperature on the COC and the SM Login Order Test Detail. See Appendix C for proper sample preservation.

4.2.1.1 All samples that require thermal preservation shall be considered acceptable if the arrival temperature is 2-6°C of the required temperature.

Note: Refer to Appendix C for the required preservation.

4.2.1.2 Samples that are brought to the laboratory soon after collection may not meet this criterion. These samples are acceptable if there is evidence (the samples are packed in a cooler with ice) that the sample collection personnel have initiated the chilling process.

4.2.1.3 Copy of the COC sent to PM to make log-in guidance via e-mail.

4.2.1.4 The Laboratory Project Manager and the Client should resolve all discrepancies between the AR & TRP and the COC prior to sample login.

4.2.1.5 Make sure to keep the samples cool at 4°C.

4.2.1.6 Proceed to Sample Login if there are no discrepancies and/or sample non-conformances. Sign the COC and enter the date and time of receipt.

4.2.1.7 If there are discrepancies and/or non-conformances, proceed to Sample Login once the client has given us clarifications and/or instructions to proceed.

4.2.1.7.1 Once all discrepancies and/or non-conformances have been resolved, login the samples according to the Record of Communication given to you by the Laboratory Project Manager. See Appendix F for a copy of the Record of Communication.

4.2.1.7.2 If the client does not wish to proceed with the analysis of the non-conformant samples, place the appropriate samples in the disposal area or ship back to the client as per their instructions.

4.2.1.8 Sign the field COC and enter the date and time of receipt.

4.2.2 Take the pH of any samples requiring a preservative using the narrow range pH paper including contingency samples.

4.2.2.5 Collect a portion of the sample in a small plastic cup.

4.2.2.6 Dip the pH paper in the sample.

4.2.2.7 Record the pH of the sample by fraction on the SM Login Order Test Detail.

4.2.2.8 Discard the sample use following the waste disposal guidelines in P205-Waste disposal SOP.

4.2.2.9 Notify the client of any pH discrepancy.

4.2.2.10 If the pH does not comply with the preservative requirement, adjust the pH of the sample to the proper pH and note the pH and the pH adjustment on the SM Login Order Test Detail. Use Appendix C as a guide for the appropriate preservative to use.

Note: Aqueous samples for metals analysis may be collected and shipped without acid preservation. However, acid must be added at least 24 hrs. before analysis to dissolve any metals that adsorb to the container walls.

4.2.3 Check the residual chlorine for all samples that have preservation dependent upon residual chlorine levels, see Appendix C. Samples containing residual chlorine have a preservative added at the time of sampling.

- Determine if sample has residual chlorine using the HACH Test Kit.
- Add contents of one pillow to a portion of the sample.
- If the sample develops a pink/pinkish color, sample has residual chlorine. Follow direction in Appendix C.

Note: Ascorbic acid will be used for Cyanide preservation only if the sampling site is known to be positive for residual chlorine.

4.2.4 Verify that the date and time on the sample container matches the sample date and time on the COC/Test Detail.

4.2.5 Verify that the client sample identification listed on the label of the sample container matches the client sample identification on the COC exactly.

4.2.6 If the sample identifications or sample dates and times do not match, indicate this on the SM Login Order Test Detail and notify the Laboratory Project Manager by raising a ticket.

4.2.7 SM/PM ticket is raised if there is any issue with the shipment or login guidance.

Note: <u>For North Carolina Work</u>*: When aqueous samples received from North Carolina for the Pesticide (By method 8081A/B or EPA 608) or PCB (EPA 608) analysis, Total Residual Chlorine needs to be logged in to find out the presence of Total Residual Chlorine before samples are given to extraction department.*

4.3 *<u>Sample Log- In Procedure</u>*

4.3.1 The Login Module contains mainly 3 sections:

4.3.1.1 <u>Project Management</u>: This section shows the number of orders created by project management department and provides the link for detailed view of the order and login report.

4.3.1.1.1 <u>New Order</u>

4.3.1.1.1.1 The Project Manager creates a new order.

4.3.1.1.1.2 Information for Priority, PO#, Customer ID, Customer Contacts, Billing Contacts, Project ID, EDD Type, Data Package Type and Special Comments are added. Appropriate protocol has been selected from options Regular, DoD, NJDKQP as per clients request.

4.3.1.1.1.3 The Project Manager selects Test Groups and Tests as per the Chain of Custody requirements or pre-defined Statement of Work.

4.3.1.1.1.4 Add the required method, associated bottle type and preservation as per the Chain of Custody.

4.3.1.1.2 <u>Edit Order</u>

4.3.1.1.2.1 Follow same steps as in Section 4.3.1.1.1, to check and edit login. This step allows Project Manager to change, modify or delete any inserted data.

4.3.1.1.3 <u>Copy Order</u>

4.3.1.1.3.1 Provide Order from which all details are copied to the new Order.

4.3.1.1.3.2 Change login as per new requirement if required.

4.3.1.2 <u>Sample Management</u>: After New Project is created by Project Management, Sample Management enters the remaining information for login. This section shows the number of orders created by sample management department and provides the link for detailed view of the order and login report.

4.3.1.2.1 Login

4.3.1.2.1.1 Enter sample information per Matrix for each sample – Lab Sample ID, Sequence, Customer Sample ID, Sample Date, Sample Time, Receive Date, Receive Time, No. of Container, Comment.

4.3.1.2.1.2 Select Test Group or Test for each sample. Compare log in test with Chain of Custody to make sure that all requested test has been logged.

4.3.1.2.1.3 Click on Submit button to approve selected data.

4.3.1.2.1.4 Click on Summary button to review login summary. View and edit data, if required.

4.3.1.2.1.5 Once all correct information is entered, click on Proceed for Signoff.

4.3.1.2.1.6 Status for this Order ID changes to Signoff Pending.

4.3.1.2.1.7 Click on sample number for updating sample priority, Test Group and Test.

4.3.1.2.2 Verification of Shipment

4.3.1.2.2.1 Enter storage location for each test, or all tests.

4.3.1.2.2.2 Enter information on Method of Shipping and Shipping charges.

4.3.1.2.2.3 Click on submit.

4.3.1.2.2.4 View and edit Bottle Type and Preservative for each test.

4.3.1.2.2.5 Click on Update.

4.3.1.2.2.6 Answer questions for Sample receipt.

4.3.1.2.2.7 Click on Update.

4.3.1.2.2.8 View and edit any login information entered.

4.3.1.2.2.9 Click on Update and Transfer data.

4.3.1.3 Other:

4.3.1.3.1 Invoice

4.3.1.3.1.1 Invoice is created by accounting personnel.

4.3.1.3.2 Labels

4.3.1.3.2.1 After data transfer, Enter Order ID to print labels for each sample bottle from Sample Master in Sample Management.

4.3.1.3.2.2 Print SM Login Order Test Detail or Question report or Shipment Verification Detail form and Test Detail from intranet program to perform all sample checks (See Appendix L and M).

4.3.1.3.2.3 Project is signed off, reviewed, scanned and saved on the server by sample management.

4.3.1.3.2.4 If any problems are observed while labeling the samples, communicate to PM to follow up with the client by raising a ticket.

4.3.1.3.3 Report

4.3.1.3.3.1 Login Report: Enter Order ID and Click on View Report button.

4.3.1.3.3.2 Test Detail/ SM Login Order Test Detail: Enter Order ID and select Checkbox as per requirement (Sample Test Report or Question Report).

4.3.1.3.3.3 Click on View Report button.

4.3.1.3.4 Login – Log Additional Samples

4.3.1.3.4.1 Select Order ID.

4.3.1.3.4.2 Samples already logged will be displayed with the test details.

4.3.1.3.4.3 Enter additional samples and click on Submit button.

4.3.1.3.5 Project Track: This section shows the tickets which are under New Login status, Signoff Pending, and Signoff but not Supervised projects, and provides the link for detail data. This section redirects to Project Track Module to reply a ticket or Review and Supervised functionality.

4.3.2 Take folder and label the folder with the order number (with proper project code number), client name, and fax and hardcopy due dates.

4.3.3 Place a copy of the login report in the appropriately colored project folder. Make sure and add the original COC, SM Login Order Test Detail and the Record of Communication (if one was necessary) to the folder.

4.3.4 Add third party carrier information (i.e. Federal Express or UPS receipts) to the project folder. Add the pickup and delivery tickets to the project folder if Chemtech was the sample carrier.

4.3.5 Give the completed project folder to the Laboratory Project Manager. (The Laboratory Project Manager must review each hard copy login summary against the COC for comparability and completeness. He/she must correct any errors, sign and date the login sheet).

4.4 Sample Storage & Security

4.4.1 Sample Custodian: See Appendix I for list of authorized sample custodians.

4.4.1.1 Store the samples in the assigned refrigerator and according to conditions specified in methods or preservative protocols until the samples are requested.

4.4.1.1.1 Check refrigerator temperature daily and record.

4.4.1.1.2 Thermal preservation must be kept ±2ºC of specified preservation temperature.

4.4.1.1.3 Samples that require a 4ºC thermal preservation have an acceptable preservation range of just above freezing for water to 6ºC.

4.4.1.1.4 Do not store volatile samples with any other samples. Place the volatile samples in the refrigerators designated for volatiles only.

4.4.1.1.5 Store any suspected highly contaminated volatile samples in the refrigerator designated for suspected highly contaminated volatile samples.

4.4.1.1.6 Make sure that all volatile refrigerators have storage blanks.

4.4.1.2 Keep the samples locked at all times and release the samples only when samples are requested via the Sample Request Form (work list) by the analyst. See Appendix G for a copy of the Sample Request Form.

4.4.1.3 Obtain the samples listed on the Sample Request Form and sign the appropriate sections of the Sample Retrieval & Return Logbook. See Appendix H for a copy of a logbook page.

4.4.1.4 Ask the analyst, extraction or digestion technician receiving the samples to sign the Sample Retrieval & Return Logbook to acknowledge they have received the samples.

4.4.1.5 The analyst will inform the Sample Custodian when the samples can be returned to storage. All samples must be returned to storage at the by the end of the day. Make sure that the analyst or extraction technician signs the appropriate sample return section of the Sample Retrieval & Return Logbook. See SOP P204-COC-01 for a detailed description of internal chain of custody procedures.

4.4.1.6 Tracking Extracts and Digestates:

4.4.1.6.1 When the extractions or digestions are complete, the extraction or digestion technician will have the appropriate analyst sign the extraction or digestion log that the extracts/digestates have been received.

4.4.1.6.2 When analysts have completed work with the extracts or digestates, sign the extract or digestate log book and place them in refrigerators designated for extracts or digestates.

4.4.1.7 Retain the samples for a two-month period after the report is submitted to the client. The sample custodian in consultation with Sample Management Supervisor decides the samples to be disposed after 30 days.

4.5 <u>Sample Receiving (EPA PE CLP Samples)</u>

4.5.1 Upon receipt of sample coolers at the laboratory, examine the coolers for damage or broken custody seal. Note the condition of the seal(s) and cooler(s) on the TR (Traffic Report)/COC (Chain of Custody) and follow

Section 4.2.1. Note the temperature on the TR. Sign the field TR and enter the date and time of receipt. Send the TR to the project manager.

4.5.2 Follow log-in procedure as per Section 4.3.

4.5.3 Once the log-in procedure is complete, print the DC-1 Form and labels.

4.5.4 Record in the ‘Remarks’ column of the DC-1 form if samples were received on ice.

4.5.5 Take DC-1 form (Appendix J), TR and labels to the place where the samples are lined up. Check all items on the checklist and label all containers. Store them at the assigned location.

4.5.6 Notify SMO if there are any discrepancies between the TR and the samples received (circle on DC-1 Form with ‘*’). Contact SMO if any of the items are missing, e.g. temperature bottle, custody seal, sample tag, air bill, etc. or if there is any sample breakage or MS/MSD is not assigned, etc. Wait for the Record of Resolution and make changes to log-in if required and notify the laboratory. Record cooler temperature in Remark #9.

4.5.7 For aqueous Proficiency testing samples, log each bottle individually and assign separate lab ID #.

4.6 Procedure for relinquishing samples to client

4.6.1 Sample management supervisor or sample management personal will have to verify that “Relinquished by & Date” field is properly filled out before shipping samples back to client.

4.6.2 All signed documents needs to be scanned and saved on server.

4.6.3 Any sample which needs to be shipped with ice must be shipped between Monday to Thursday unless there is a specific instruction from project manager to ship it on Friday, Saturday or Sunday.

4.6.4 Sample cooler must have custody seal and cooler must have tape around it so cooler cannot be tampered.

5. Disposal of Samples

5.1 Samples are retained for 2 months after report submission to clients unless otherwise directed by client.

5.2 Dispose all non-CLP samples according to the Waste Disposal Plan (See Chemtech Chemical Waste Disposal Guidelines SOP P205-Chemical Waste Disposal-02.

5.3 Unused CLP sample volume and used sample containers are kept for 60 days after report submission. After 180 days, the samples are properly discarded utilizing the appropriate waste disposal procedure SOP P205-Chemical Waste Disposal-02.

6. Health and Safety

6.1 The toxicity and carcinogenity of each reagent used in this method has not been fully established. Each chemical should be regarded as a potential health hazard and exposure of these compounds should be minimized.

6.2 Always wear safety glasses for eye protection when working with these reagents.

6.3 Use protective gloves when handling the chemicals.

7. Corrective Action Procedure

7.1 A corrective action report is issued whenever there is damage to a sample (broken or lost) where data quality may be affected. This process is explained in detail in the Corrective Action Procedure SOP P202-CAR-02.

7.2 Issue a corrective action report whenever there is a deviation from the SOP.

8. Personnel Qualifications

8.1 All employees must undergo laboratory health and safety training and ethics training and must read the laboratory QA Manual and all SOPs related to their area of work.

8.2 A signed and dated statement from each technical employee that they have read, understood, and are using the latest version of the laboratory QA Manual and SOPs, and that they have read, acknowledged and understood their personal, ethical and legal responsibilities, is maintained in their training file.

8.3 The Technical Director certifies and documents that all technical employees have the appropriate education and/or technical background to perform the tasks for which the employee is responsible.

9. References

9.1 USEPA Contract Laboratory Program - National Functional Guidelines for Organic Data Review, Office of Emergency and Remedial Response. OSWER 9240.1-05A-P, PB99-963506, EPA540/R-99/008, October 1999.

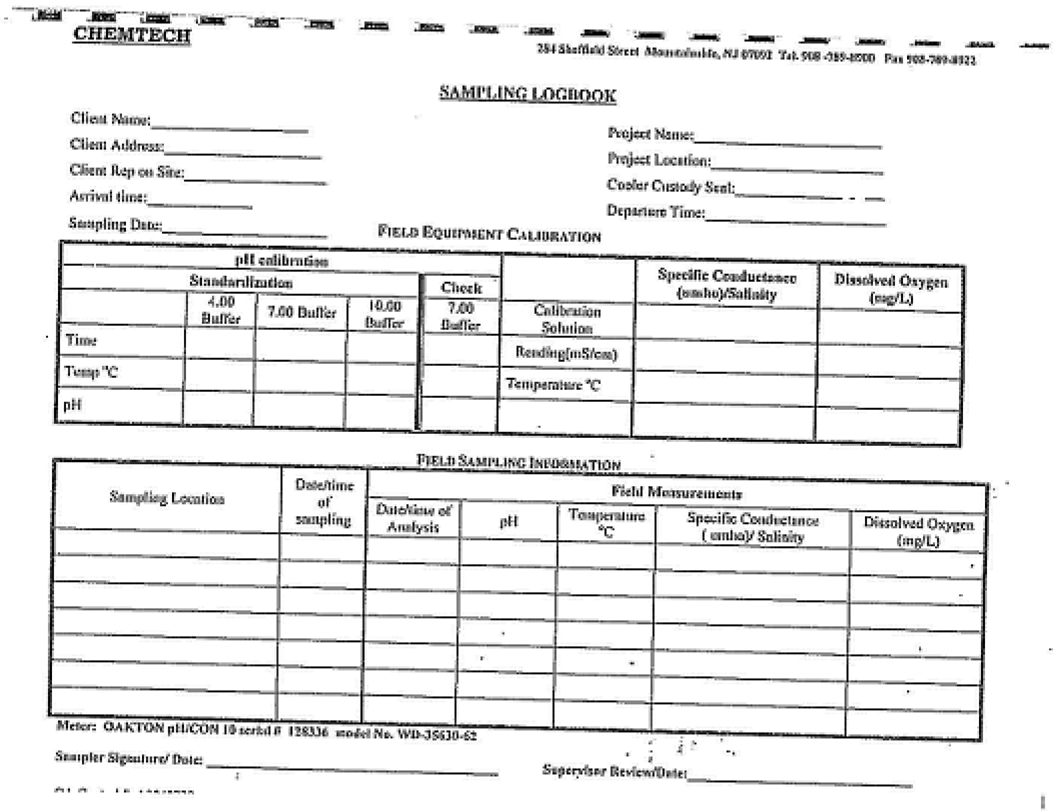
9.2 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 5.0, July 2013 & Version 5.1 January 2017.

10. Appendices

10.1 Appendix B - Field Chain of Custody
10.2 Appendix C - Sample Holding Times, Preservatives, and Volume
10.3 Appendix D - Analytical Request and Test Review Forms
10.4 Appendix E - Rush Approval Form
10.5 Appendix F - Record of Communication
10.6 Appendix G - Sample Request Form
10.7 Appendix H - Sample Retrieval and Return Logbook Page
10.8 Appendix I - Authorized Sample Custodians
10.9 Appendix J – DC-1 form
10.10 Appendix K – Log-in guidance
10.11 Appendix L – SM Login Sample Test Detail
10.12 Appendix M – SM Login Question Report

APPENDIX B

Field Chain of Custody



CHEMTECH

284 Sheffield Street Mountainside, NJ 07092 Tel. 908-789-8900 Fax 908-789-8922

SAMPLING LOGBOOK

Client Name:________________
Client Address:________________
Client Rep on Site:________________
Arrival time:____________
Sampling Date:________________

Project Name:________________
Project Location:________________
Cooler Custody Seal:________________
Departure Time:________________

FIELD EQUIPMENT CALIBRATION

pH calibration						Specific Conductance (umho)/Salinity	Dissolved Oxygen (mg/L)
Standardization				Check			
	4.00 Buffer	7.00 Buffer	10.00 Buffer	7.00 Buffer	Calibration Solution		
Time					Reading(mS/cm)		
Temp °C					Temperature °C		
pH							

FIELD SAMPLING INFORMATION

Sampling Location	Date/time of sampling	Field Measurements				
		Date/time of Analysis	pH	Temperature °C	Specific Conductance (umho)/ Salinity	Dissolved Oxygen (mg/L)

Meter: OAKTON pH/CON 10 serial # 128336 model No. WD-35630-62

Sampler Signature/ Date:____________________ Supervisor Review/Date:________________

APPENDIX C

Water Sampling and Holding Time Information

Parameter	EPA Method	Standard Method and/or SW 846 Method	Preservation	Container	Holding Time	Minimum Volume
Turbidity	180.1	2130B	Cool, 4 deg C	P or G	48 Hrs	100 mL
Nitrate	300	-----	Cool, 4 deg C	P or G	48 Hrs	250 mL
Nitrate-Nitrite	300	-----	Cool to 4 deg C, Conc. H_2SO_4 to pH<2	P or G	28 Days	250 mL
Fluoride	300	4500 F-C	Cool, 4 deg C	P or G	28 Days	300 mL
Cyanide	-----	4500-CN C&E	Cool, 4 deg C 50%NaOH pH>12	P or G	14 Days	500 mL
Sulfate	300	4500-SO4 E	Cool, 4 deg C	P or G	28 Days	50 mL
Total Dissolved Solids	-----	2540C	Cool, 4 deg C	P or G	7 Days	100 mL
Calcium	200.7	-----	1:1 HNO_3 to pH<2	P or G	6 Months	100 mL
Calcium-Hardness	200.7	-----	1:1 HNO_3 to pH<2	P or G	6 Months	100 mL
Alkalinity	-----	2320B	Cool, 4 deg C	P or G	14 Days	100 mL
Bromide	300	-----	None	P or G	28 Days	250 mL
Chloride	300	4500-CL C	Cool, 4 deg C	P or G	28 Days	100 mL
Chlorite	300	-----	1mL EDA to 1L Cool, 4 deg C	P or G	14 Days 10 mins	250 mL
Color	-----	2120B	Cool, 4 deg C	P or G	24 Hrs	100 mL
Foaming Agents (MBAS)	-----	5540C	Cool, 4 deg C	P or G	48 Hrs	250 mL
Odor	-----	2150B	Cool, 4 deg C	G only	24 Hrs	200 mL
Conductivity	120.1	2510B, 9050A	Cool, 4 deg C	P or G	28 Days	100 mL
Silica	200.7	-----	Cool, 4 deg C	P only	7 Days	50 mL
Ortho Phosphate	300	4500 P-E	Cool, 4 deg C	P or G	48 Hrs	50 mL
Chlorine, Residual Disinfectant	-----	4500Cl-G	None	P or G	15 minutes	200 mL
pH, Hydrogen ion	-----	4500-H-B	None	P or G	15 minutes	25 mL
Temperature	-----	2550B	None	P or G	15 minutes	1000 mL
Volatiles (Regulated)	524.2	-----	Cool, 4 deg C 1:1 HCl to pH<2	G, screw cap Teflon faced silicone septum	14 Days	60-120 mL

Parameter	**EPA Method**	**Standard Method and/or SW 846 Method**	**Preservation**	**Container**	**Holding Time**	**Minimum Volume**
Acidity as $CaCO_3$	-----	ASTM D1067-92	Cool, 4 deg C	P or G	14 Days	100 mL
Alkalinity as $CaCO_3$	-----	2320B	Cool, 4 deg C	P or G	14 Days	100 mL
Ammonia	-----	4500-NH3 H	Cool, 4 deg C, Conc. H_2SO_4 to pH<2	P or G	28 Days	400 mL
Biochemical Oxygen Demand	-----	5210B	Cool, 4 deg C	P or G	24 Hrs.	1000 mL
Carbonaceous BOD	-----	5210B	Cool, 4 deg C	P or G	24 Hrs.	1000 mL
Cyanide	-----	9012A	Cool 4 deg C, 50% NaOH to pH>12 0.6 g ascorbic acid if residual chlorine present	P or G	Sulfide absent: 14 Days (Sulfide Present 24 Hrs.)	500 mL
Cyanide, Amenable	-----	4500-CN C,G	Cool 4 deg C, 50% NaOH to pH>12 0.6 g ascorbic acid if residual chlorine present	P or G	Sulfide absent: 14 Days (Sulfide Present 24 Hrs.)	500 mL
Acid Soluble & Insoluble Sulfide	-----	9030B	2N Zn Acetate, 6N NaOH to pH > 9, Cool, 4 deg C	P or G	7 Days	8 oz.
Total Hardness	200.7	-----	HNO_3 to pH<2	P or G	6 Months	100 mL
Total Kjeldahl Nitrogen	-----	4500-N OrgBorC	Cool, 4 deg C Conc. H_2SO_4 to pH<2	P or G	28 Days	500 mL
Oil & Grease	-----	1664A	Cool 4 deg C, 1:1 HCL or conc. H_2SO_4 to pH<2	G	28 Days	1000 mL
Orthophosphate	300	4500-P E	Filter immediately, Cool 4 deg C	P or G	48 Hrs.	50 mL
Phenols	420.1	9065	Cool 4 deg C, Conc. H_2SO_4 to pH<2	G	28 Days	500 mL
Total Phosphorus	365.3	-----	Cool 4 deg C, Conc. H_2SO_4 to pH<2	G	28 Days	50 mL
Total-Residue (TS)	-----	2540 B	Cool, 4 deg C	P or G	7 Days	100 mL
Residue-filtered (TDS)	-----	2540 C	Cool, 4 deg C	P or G	7 Days	100 mL

Residue-non-filtered (TSS)	-----	2540 D	Cool, 4 deg C	P or G	7 Days	100 mL

Parameter	EPA Method	Standard Method and/or SW 846 Method	Preservation	Container	Holding Time	Minimum Volume
Residue-Settleable (SS)	-----	2540 F	Cool, 4 deg C	P or G	48 Hrs.	1000 mL
Residue-Volatile	160.4	-----	Cool, 4 deg C	P or G	7 Days	100 mL
Salinity	-----	2520 C	Cool, 4 deg C	G	28 Days	100 mL
Specific Conductance	120.1	2510B, 9050A	Cool, 4 deg C	P or G	28 Days	100 mL
Sulfate	300	4500-SO4 E	Cool, 4 deg C	P or G	28 Days	50ml
Sulfide	-----	9034	Cool 4 deg C, add 2N Zinc Acetate + 6N NaOH to pH>9	P or G	7 Days	50 mL
Sulfite (SO3)	-----	4500-SO3 B	Fix cooled samples (<50°C) immediately by adding 1mL EDTA soln./100mL sample	G, Bottle and Top	15 minutes	50 mL
Temperature	-----	2550 B	None Required	G, Bottle and Top	15 minutes	1000 mL
Metals	200.7	-----	1:1 HNO_3 to pH<2	G	6 Months	100 mL
Mercury	-----	7470A	Cool, 4 deg C	P or G	28 Days	8 oz.
Organochlorine Pesticides/PCB	608	8081A/N,8082/ 8082A	Cool, 4 deg C 0.008% $Na_2S_2O_3$ if residual chlorine present , Adjust to pH 5-9 with 10N NaOH or 1:1 H2SO4	G, Amber Teflon-lined screw cap	7 days until extraction 40 days after extraction	1000 mL
Volatile Organics	624	8260B/C	Cool, 4 deg C 4 drops 10% $Na_2S_2O_3$ if residual chlorine present 1:1 HCl to pH <2	G, Vial screw cap with center hole Teflon-faced silicone septum	7 days without HCl 14 days with HCl	40 mL
Semi volatile Organics	625	8270C/D	Cool, 4 deg C 0.008% $Na_2S_2O_3$ if residual chlorine present	G, Amber Teflon-lined screw cap	7 days until extraction 40 days after extraction	1000 mL
DRO	-----	8015B	Cool, 4 deg C 0.008% $Na_2S_2O_3$ if residual chlorine present	G, Amber Teflon-lined screw cap	7 days until extraction 40 days after extraction	1000 mL
COD	-----	SM5220D	Cool, 4 deg C H2SO4 to pH<2	P	28 Days	1000 mL
TOC	-----	SW9060	Cool, 4 deg C	P	28 days	1000 mL

		Lloyd Kahn	HCl or H2SO4 to pH<2		14 days	
Herbicide	-----	SW8151	Cool, 4 deg C	G, Amber	7 days until extraction 40 days after extraction	1 L

Parameter	EPA Method	Standard Method and/or SW 846 Method	Preservation	Container	Holding Time	Minimum Volume
GRO	-----	8015B	Cool, 4 deg C 0.008% $Na_2S_2O_3$ if residual chlorine present 1:1 HCl to pH <2	G, Vial screw cap with center hole Teflon-faced silicone septum	7 days without HCl 14 days with HCl	40 mL
Gases	-----	3810	Cool, 4 deg C 0.008% $Na_2S_2O_3$ if residual chlorine present 1:1 HCl to pH <2	G, Vial screw cap with center hole Teflon-faced silicone septum	7 days without HCl 14 days with HCl	40 mL
HPLC (Explosive)	-----	8330A/B	Cool, 4 deg C	G, Amber Teflon-lined screw cap	7 days until extraction 40 days after extraction	1000mL
Hexavalent Chromium	-----	3500 Cr D	Cool, 4 deg C	P	24 Hrs.	100mL
Ferrous Iron	-----	HACH 8146	Cool, 4 deg C	Amber G	24 Hrs.	250mL
RSK 175	-----	RSK 175	Cool, 4 deg C 1:1 H2SO4 or HCl to ph<2	G, Vial screw cap with center hole Teflon-faced silicone septum	14 days	40 mL
Formaldehyde	-----	HACH 8110	Cool, 4 deg C	P	Analyze Immediately within 48hrs	1000mL
Ferrous Iron	-----	HACH 8146 SM3500	Cool, 4 deg C	P	Analyze Immediately within 48hrs	1000mL
Chemical Warfare Agents	-----	8270-modified	Cool, 4 deg C	G, Amber Teflon-lined screw cap	7 days until extraction 40 days after extraction	1000mL
Glycols	-----	Chemtech SOP	Cool, 4 deg C	G	28 days	100mL
Perchlorate	314.0	-----	-----	P or G	28 days	500mL

Container Key:
P = Plastic
G =Glass
DW= Drinking Water

Soil/Hazardous Waste Sampling and Holding Time Information

Parameter	EPA Method	Standard Method and/or SW 846 Method	Preservation	Container	Holding Time	Minimum Volume
Ignitability	-----	1010	None	P or G	None	8 oz.
Ignitability of Solids	-----	1030	None	P or G	None	8 oz.
Corrosivity pH Waste>20% water	-----	9040B	Cool, 4 deg C	P	15 minutes	4 oz.
Corrosivity Toward Steel	-----	1110	Cool, 4 deg C	P	14 Days	4 oz.
Reactivity Cyanide	-----	SW-846 7.3.3.2	Cool, 4 deg C	P	14 Days	8 oz.
Reactivity Sulfide	-----	SW-846 7.3.4.2	Cool, 4 deg C	P	14 Days	8 oz.
TCLP Volatile Organics	-----	1311	Cool, 4 deg C	G	14 Days to TCLP extraction, 14 days to analysis	4 oz.
TCLP Metals	-----	1311	Cool, 4 deg C	G	180 Days to TCLP extraction, 180 days to analysis	16 oz
TCLP Mercury	-----	1311	Cool, 4 deg C	G	28 Days to TCLP extraction, 28 days to analysis	16 oz
TCLP Semi volatiles	-----	1311	Cool, 4 deg C	G	14 Days to TCLP extraction, 7 days to extraction, 40 days to analysis	16 oz
TCLP Pesticides and Herbicides	-----	1311	Cool, 4 deg C	G	14 Days to TCLP extraction, 7 days to extraction, 40 days to analysis	16 oz
PH	-----	9040B, 9041A, 9045C	Cool, 4 deg C	P	15 minutes	4 oz.

Parameter	EPA Method	Standard Method and/or SW 846 Method	Preservation	Container	Holding Time	Minimum Volume
Temperature	-----	2550 B	-----	P	15 minutes	4 oz.
Metals	-----	6010B/C	Cool, 4 deg C	P or G	6 Months	8 oz.
Mercury	-----	7471A	Cool, 4 deg C	P or G	28 Days	8 oz.
Organochlorine Pesticides	-----	8081A/B	Cool, 4 deg C	P or G	14 Days for extraction, 40 days to analysis	8 oz.
PCB's	-----	8082/8082A	Cool, 4 deg C	P or G	14 Days for extraction, 40 days to analysis	8 oz.
Chlorinated Herbicides	-----	8151A	Cool, 4 deg C	G, wide mouth, Teflon liner	14 Days	8 oz.
Volatile Organics	-----	8260B/C	Cool, 4 deg C	G, wide mouth, Teflon liner	14 Days	4 oz.
Semi volatile Organics	-----	8270C/D	Cool, 4 deg C	Amber Glass	14 Days to extraction, 40 days to analysis	8 oz.
Total Cyanide	-----	9012A	Cool, 4 deg C	P or G	14 Days	8 oz.
Amenable Cyanide	-----	9010B	Cool, 4 deg C	P or G	14 Days	8 oz.
Acid Soluble & Insoluble Sulfide	-----	9030B	Cool, 4 deg C No Headspace	P or G	7 Days	8 oz.
Extractable Sulfide	-----	9031	Cool, 4 deg C Fill solid surface with 2N Zinc Acetate until moistened, 4 drops 2N Zinc Acetate/100mL sample, 50%NaOH to pH>9	P or G	7 Days	8 oz.
Sulfate	-----	9038, 9056	Cool, 4 deg C	P or G	28 Days	8 oz.
pH, Soil and Waste	-----	9045C	Cool, 4 deg C	G	15 minutes	8 oz.

Parameter	EPA Method	Standard Method and/or SW 846 Method	Preservation	Container	Holding Time	Minimum Volume
Phenol	-----	9065	Cool 4 deg C	G	28 Days	8 oz.
Oil & Grease (Sludge, Sludge-Hem)	-----	9071B	Cool 4 deg C	G	28 Days	8 oz.
Paint Filter Liquids Test	-----	9095	Cool, 4 deg C	P or G	-----	8 oz.
Nitrate	-----	9056	Cool, 4 deg C	P or G	48 Hrs	8 oz.
Bromide	-----	9056	Cool, 4 deg C	P or G	28 Days	8 oz.
Chloride	-----	9056	None	P or G	28 Days	8 oz.
Fluoride	-----	9056, 9214	None	P	28 Days	8 oz.
Cation-Exchange Capacity	-----	9080, 9081	Cool, 4 deg C	P	-----	8 oz.
DRO	-----	8015B	Cool, 4 deg C	Amber Glass	14 Days to extraction, 40 days to analysis	8 oz.
GRO	-----	8015B	Cool, 4 deg C	G, wide mouth, Teflon liner	14 Days	4 oz.
Gases	-----	3810	Cool, 4 deg C	Amber Glass	14 Days	8 oz.
Hexavalent Chromium	------	3060, 7196A	Cool, 4 deg C	P	30 Days to extraction, 7 days to analysis	4 oz.
Explosives	------	8330A/B	Cool, 4 deg C	Amber Glass	14 Days to extraction, 40 days to analysis	16 oz.
TOC	-----	SW9060 Lloyd Kahn	Cool, 4 deg C	G	28 Days 14 Days	8 oz.
Herbicide	-----	SW8151	Cool, 4 deg C	G	14 Days to extraction, 40 days to analysis	4 oz.
Formaldehyde	-----	HACH 8110	Cool, 4 deg C	G	Analyze Immediately within 48hrs	4 oz.
Ferrous Iron	-----	HACH 8146 SM3500	Cool, 4 deg C	G	Analyze Immediately within 48hrs	4 oz.
Chemical Warfare Agents	-----	8270-modified	Cool, 4 deg C	G	14 days until extraction 40 days after extraction	8 oz.

Grain Size	-----	ASTM D422	-----	P or G	-----	4 oz.

CLP Sampling and Holding Time Information

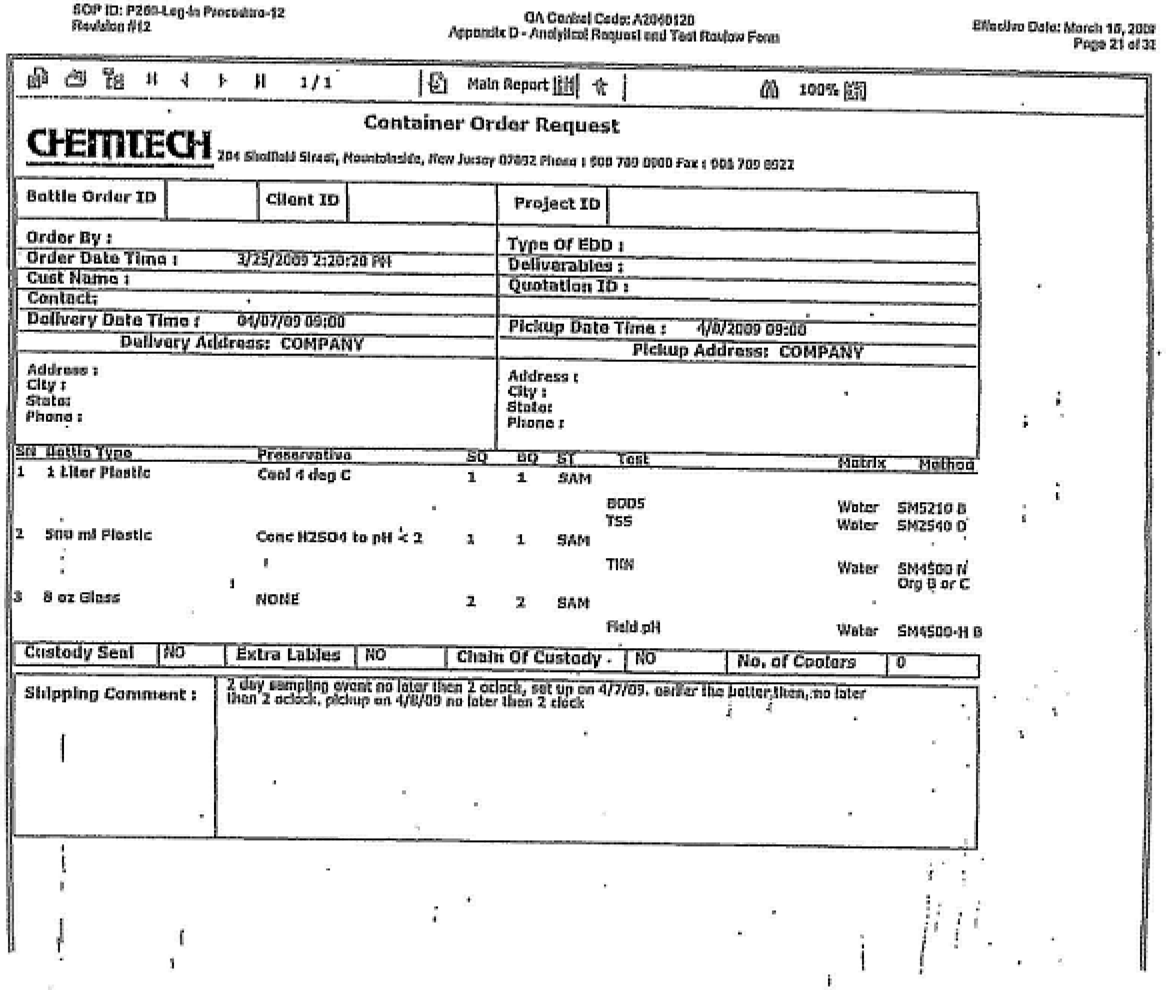
Parameter	EPA Method	Preservation	Container	Holding Time	Minimum Volume
METALS (aqueous)	ISM02.4	HNO_3 to pH<2, Cool 4deg C	P	180 Days from VTSR	1000ml
CYANIDE (aqueous)	ISM02.4	NaOH to pH>12, Cool 4deg C	P	12 Days from VTSR	1000ml
MERCURY (aqueous)	ISM02.4	HNO_3 to pH<2, Cool 4deg C	P	26 Days from VTSR	1000ml
VOLATILE ORGANICS (aqueous)	SOM02.4	HCL pH < 2, Cool 4deg C	G	10 Days from VTSR with preservative, 7 Days from VTSR without preservative	40ml
SEMI-VOLATILE ORGANICS (aqueous)	SOM02.4	Cool 4deg C	G	5 Days from VTSR for extraction 40 Days after extraction	1000ml
PESTICIDES (aqueous)	SOM02.4	Cool 4deg C	G	5 Days from VTSR for extraction 40 Days after extraction	1000ml
PCBs (aqueous)	SOM02.4	Cool 4deg C	G	5 Days from VTSR for extraction 40 Days after extraction	1000ml
METALS (solid/soils)	ISM02.4	Cool 4deg C	G	180 Days from VTSR	8 oz
*CYANIDE	ISM02.4	Cool 4deg C	G	12 Days from VTSR	8 oz
MERCURY (solid/soils)	ISM02.4	Cool 4deg C	G	26 Days from VTSR	8 oz
VOLATILE ORGANICS (solid/soils)	SOM02.4	Cool 4deg C	G	10 Days from VTSR	4 oz
SEMI-VOLATILE ORGANICS (solid/soils)	SOM02.4	Cool 4deg C	G	10 Days from VTSR for extraction 40 Days after extraction	8 oz
PESTICIDES (solid/soils)	SOM02.4	Cool 4deg C	G	10 Days from VTSR for extraction 40 Days after extraction	8 oz
PCBs (solid/soils)	SOM02.4	Cool 4deg C	G	10 Days from VTSR for extraction 40 Days after extraction	8 oz

*When chlorine is present ascorbic acid is used to remove the interference (0.6 g ascorbic acid)

Note: Unpreserved soil samples must be refrigerated at a temperature of –7 degC (±2 degC)

APPENDIX D

Analytical Request and Test Review Form



SOP ID: P250-Log-in Procedure-12
Revision #12
QA Control Code: A2040120
Appendix D - Analytical Request and Test Review Form
Effective Date: March 16, 2009
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Container Order Request

CHEMTECH 284 Sheffield Street, Mountainside, New Jersey 07092 Phone : 908 789 8900 Fax : 908 789 8922

Bottle Order ID		Client ID	
Project ID			

Order By :
Order Date Time : 3/25/2009 2:20:20 PM
Cust Name :
Contact:
Delivery Date Time : 04/07/09 09:00
Delivery Address: COMPANY
Address :
City :
State:
Phone :

Type Of EDD :
Deliverables :
Quotation ID :
Pickup Date Time : 4/8/2009 09:00
Pickup Address: COMPANY
Address :
City :
State:
Phone :

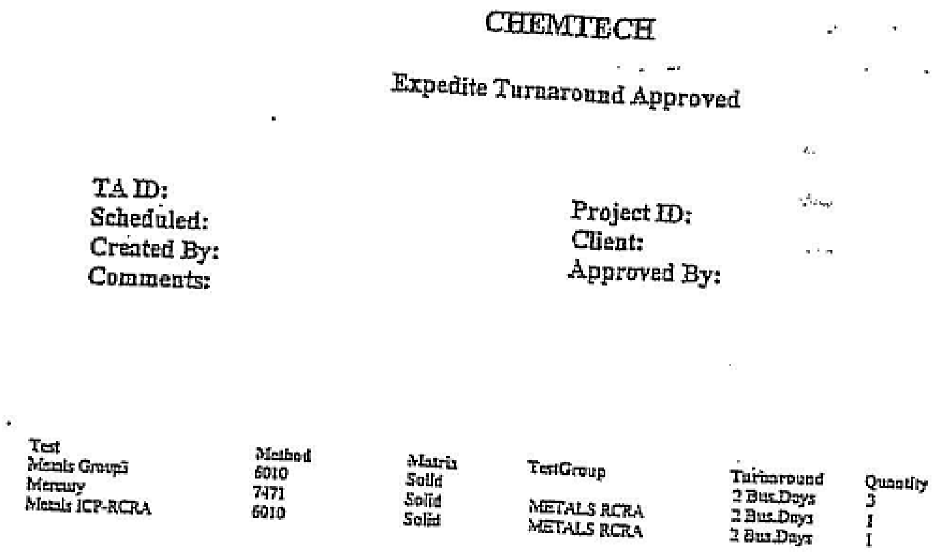
SN	Bottle Type	Preservative	SQ	BQ	ST	Test	Matrix	Method
1	1 Liter Plastic	Cool 4 deg C	1	1	SAM			
						BOD5	Water	SM5210 B
						TSS	Water	SM2540 D
2	500 ml Plastic	Conc H2SO4 to pH < 2	1	1	SAM			
						TKN	Water	SM4500 N Org B or C
3	8 oz Glass	NONE	2	2	SAM			
						Field pH	Water	SM4500-H B

Custody Seal	NO	Extra Lables	NO	Chain Of Custody	NO	No. of Coolers	0

Shipping Comment :	2 day sampling event no later then 2 oclock, set up on 4/7/09. earlier the better then, no later then 2 oclock. pickup on 4/8/09 no later then 2 clock

APPENDIX E

Rush Approval Form



CHEMTECH

Expedite Turnaround Approved

TA ID:
Scheduled:
Created By:
Comments:

Project ID:
Client:
Approved By:

Test	Method	Matrix	TestGroup	Turnaround	Quantity
Metals Group3	6010	Solid		2 Bus.Days	3
Mercury	7471	Solid	METALS RCRA	2 Bus.Days	1
Metals ICP-RCRA	6010	Solid	METALS RCRA	2 Bus.Days	1

APPENDIX F

Internal
Record of Communication
Login Change Form

Order Number: **X**	**Today's Date:**
Client:	**Sample Date:**
Project:	**Form Initiated by:**
Client Contact:	**Project Manager:**
General Comments/Special Instructions:	

Call Initiated by ☐ Client ☐ Chemtech

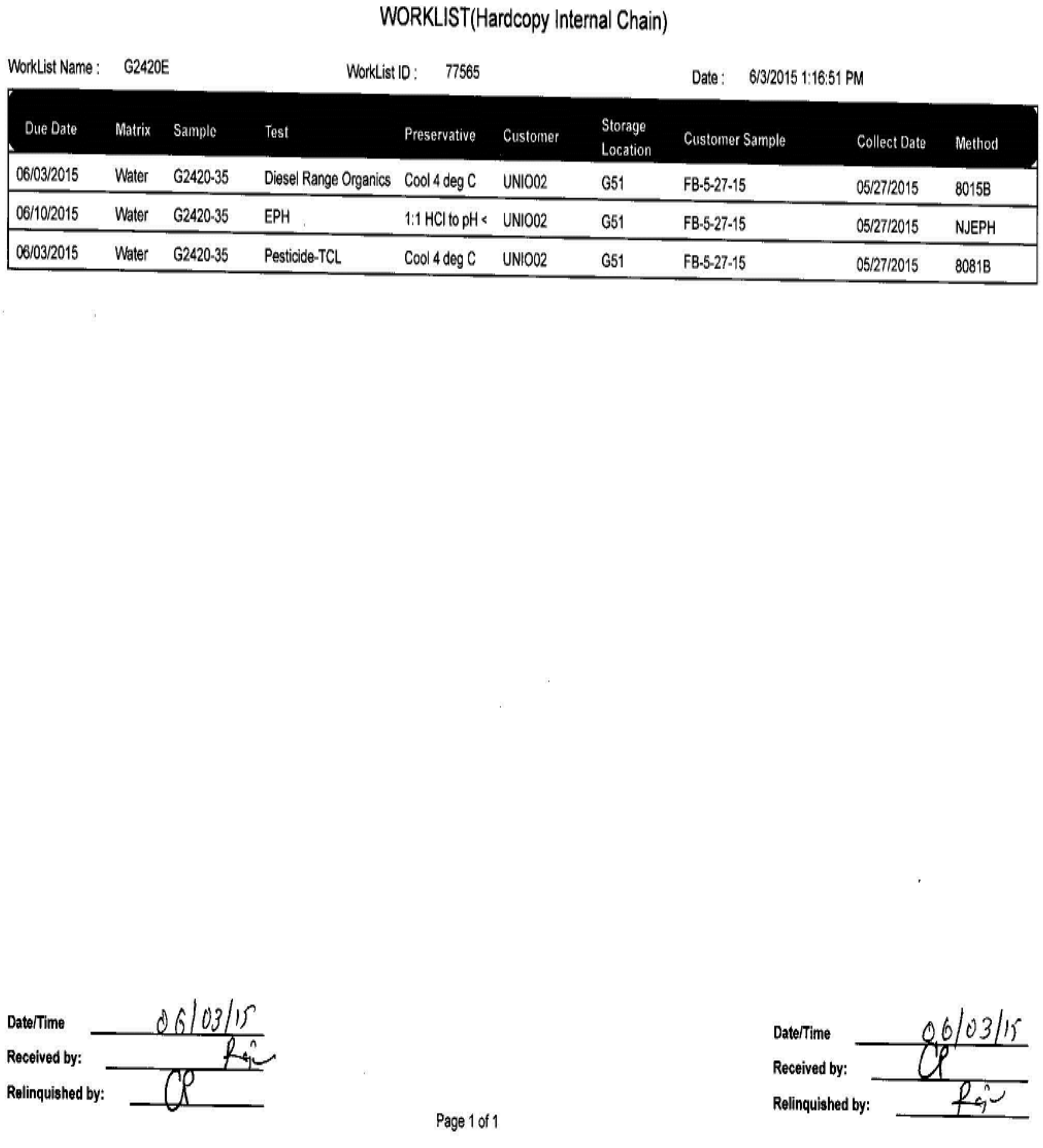
Login Changes

SAMPLE NUMBER	Add Test	Delete Test	Change TAT

Signature ______________________ Date __________

APPENDIX G

Sample Request Form



WORKLIST(Hardcopy Internal Chain)

WorkList Name : G2420E WorkList ID : 77565 Date : 6/3/2015 1:16:51 PM

Due Date	Matrix	Sample	Test	Preservative	Customer	Storage Location	Customer Sample	Collect Date	Method
06/03/2015	Water	G2420-35	Diesel Range Organics	Cool 4 deg C	UNIO02	G51	FB-5-27-15	05/27/2015	8015B
06/10/2015	Water	G2420-35	EPH	1:1 HCl to pH <	UNIO02	G51	FB-5-27-15	05/27/2015	NJEPH
06/03/2015	Water	G2420-35	Pesticide-TCL	Cool 4 deg C	UNIO02	G51	FB-5-27-15	05/27/2015	8081B

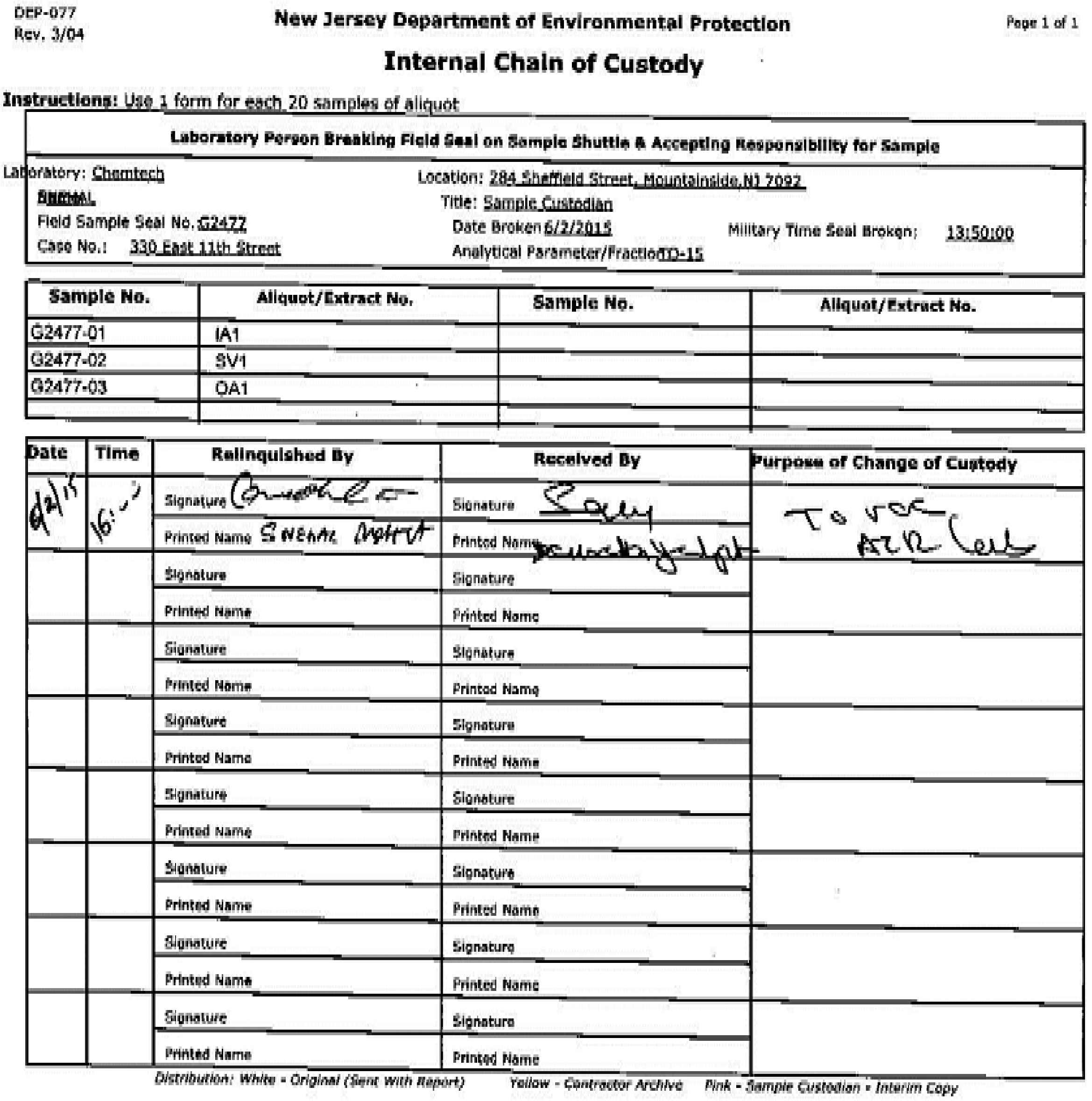
Date/Time 06/03/15
Received by:
Relinquished by:

Date/Time 06/03/15
Received by:
Relinquished by:

Page 1 of 1

APPENDIX H

Sample Retrieval and Return Logbook Page



DEP-077
Rev. 3/04

New Jersey Department of Environmental Protection

Page 1 of 1

Internal Chain of Custody

Instructions: Use 1 form for each 20 samples of aliquot

Laboratory Person Breaking Field Seal on Sample Shuttle & Accepting Responsibility for Sample

Laboratory: Chemtech
SNEHAL
Field Sample Seal No. G2477
Case No.: 330 East 11th Street
Location: 284 Sheffield Street, Mountainside,NJ 7092
Title: Sample Custodian
Date Broken 6/2/2015
Analytical Parameter/Fraction TO-15
Military Time Seal Broken: 13:50:00

Sample No.	Aliquot/Extract No.	Sample No.	Aliquot/Extract No.
G2477-01	IA1		
G2477-02	SV1		
G2477-03	OA1		

Date	Time	Relinquished By	Received By	Purpose of Change of Custody
6/2/15	16:[illegible]	Signature	Signature	To VOC AIR Lab
		Printed Name SNEHAL MEHTA	Printed Name [illegible]	
		Signature	Signature	
		Printed Name	Printed Name	
		Signature	Signature	
		Printed Name	Printed Name	
		Signature	Signature	
		Printed Name	Printed Name	
		Signature	Signature	
		Printed Name	Printed Name	
		Signature	Signature	
		Printed Name	Printed Name	
		Signature	Signature	
		Printed Name	Printed Name	
		Signature	Signature	
		Printed Name	Printed Name	

Distribution: White = Original (Sent With Report) Yellow - Contractor Archive Pink - Sample Custodian = Interim Copy

APPENDIX I

Authorized Sample Custodians

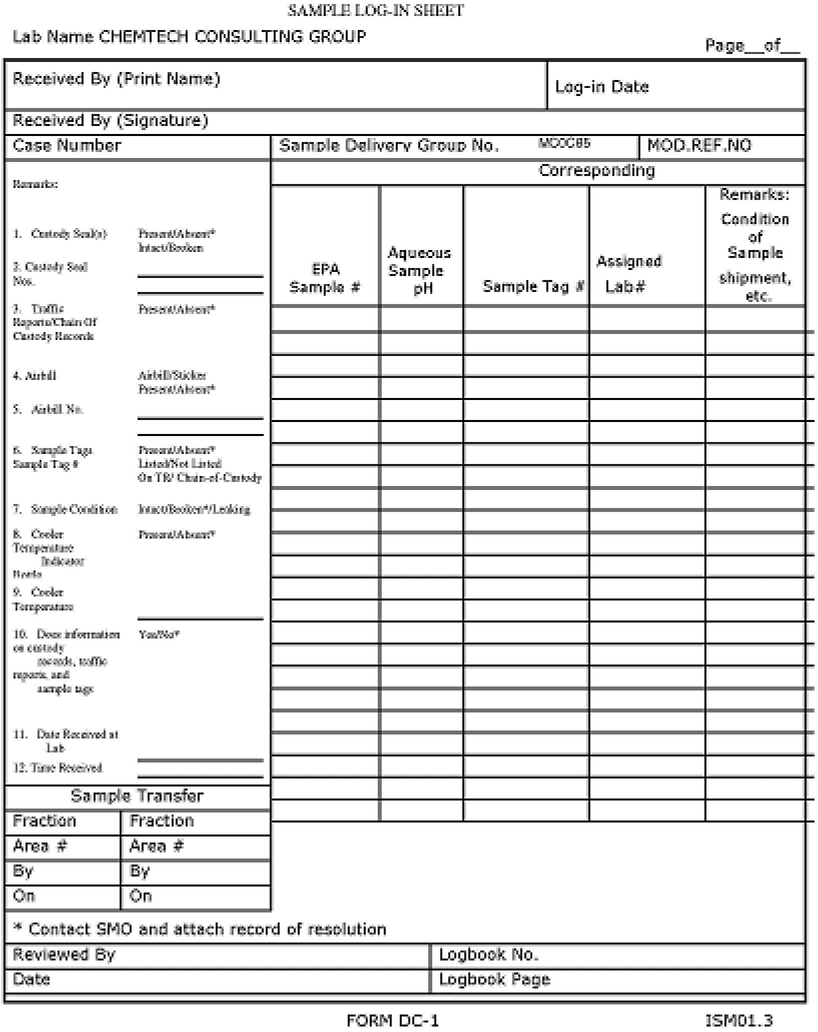
PERSONS AUTHORIZED AS SAMPLE CUSTODIAN

NJ: SNEHAL MEHTA

DESIGNATED SAMPLE CUSTODIAN

APPENDIX J

DC-1 form



SAMPLE LOG-IN SHEET

Lab Name CHEMTECH CONSULTING GROUP

Page__of__

Received By (Print Name)

Log-in Date

Received By (Signature)

Case Number

Sample Delivery Group No. MOOC85

MOD.REF.NO

Remarks:

1. Custody Seal(s) Present/Absent* Intact/Broken
2. Custody Seal Nos.
3. Traffic Reports/Chain Of Custody Records Present/Absent*
4. Airbill Airbill/Sticker Present/Absent*
5. Airbill No.
6. Sample Tags Sample Tag # Present/Absent* Listed/Not Listed On TR/ Chain-of-Custody
7. Sample Condition Intact/Broken*/Leaking
8. Cooler Temperature Indicator Bottle Present/Absent*
9. Cooler Temperature
10. Does information on custody records, traffic reports, and sample tags Yes/No*
11. Date Received at Lab
12. Time Received

		Corresponding		
EPA Sample #	Aqueous Sample pH	Sample Tag #	Assigned Lab#	Remarks: Condition of Sample shipment, etc.

Sample Transfer	
Fraction	Fraction
Area #	Area #
By	By
On	On

* Contact SMO and attach record of resolution

Reviewed By

Logbook No.

Date

Logbook Page

FORM DC-1 ISM01.3

APPENDIX K

Login Guidance

CHEMTECH

284 Sheffield Street, Mountainside, New Jersey 07092, Phone : 908 789 8900, Fax : 908 789 8922

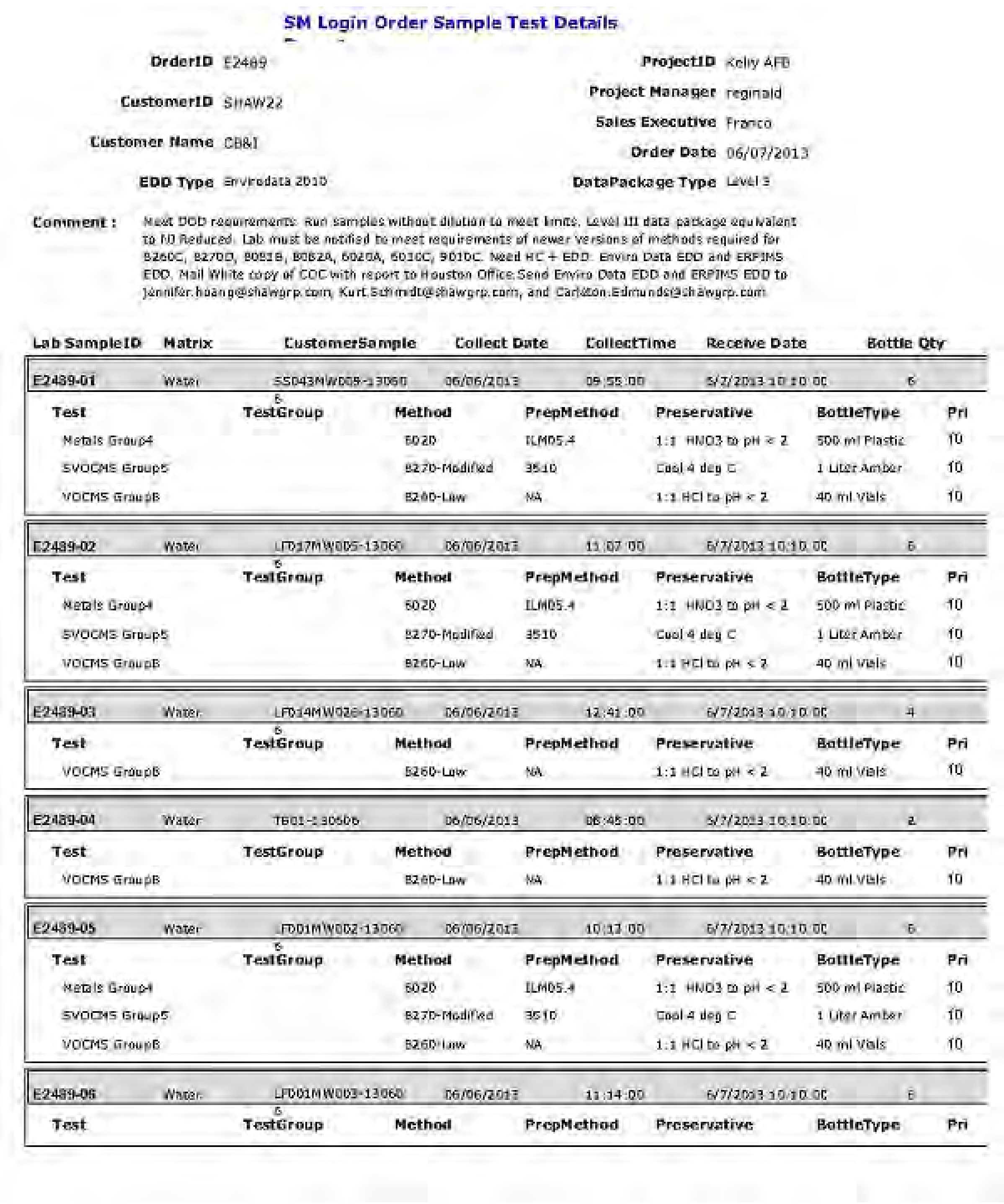
Order Login Guidance

OrderID	G2179	**ProjectID**	National Grid Ravenswood
CustomerID	FOST03	**Customer Contact**	Bob Cantagallo
BillingID	FOST03	**Billing Contact**	Bob Cantagallo
Priority	10 Bus. Days	**Project Manager**	reginald
EDD Type	NYSDEC EDD V-3	**Order Date**	5/8/2015 9:39:00 AM
Data Package Type	NYS ASP B	**PO**	1105733
Criteria Type	Quotation	**Comments**	NY. VOC and SVOC group1s are for Part 375 and CP-51 parameters. Provide Excel EDDs as well for comparison to NY Part 375 lists. Picked up in Morris Plains. Report TIC for VOC and SVOC.

Test	**Matrix**	**Method**	**Criteria**	**Test Group**	**TypeID**	**PrepMethod**
Sample Pickup	AC	SMO	Quotation		Q1403045	NA
SVOCMS Group1	Water	8270D	All Test		All	NA
VOCMS Group1	Water	8260-Low	All Test		All	5030

APPENDIX L

SM Login Sample Test Detail



SM Login Order Sample Test Details

OrderID E2489

CustomerID SHAW22

Customer Name CB&I

EDD Type Envirodata 2010

ProjectID Kelly AFB

Project Manager reginald

Sales Executive Franco

Order Date 06/07/2013

DataPackage Type Level 3

Comment : Meet DOD requirements: Run samples without dilution to meet limits. Level III data package equivalent to NJ Reduced. Lab must be notified to meet requirements of newer versions of methods required for 8260C, 8270D, 8081B, 8082A, 6020A, 6010C, 9010C. Need HC + EDD. Enviro Data EDD and ERPIMS EDD. Mail White copy of COC with report to Houston Office.Send Enviro Data EDD and ERPIMS EDD to jennifer.hoang@shawgrp.com, Kurt.Schmidt@shawgrp.com, and Carlston.Edmunds@shawgrp.com

Lab SampleID	Matrix	CustomerSample	Collect Date	CollectTime	Receive Date	Bottle Qty
E2489-01	Water	SS043MW008-130606	06/06/2013	09:55:00	6/7/2013 10:10:00	6

Test	TestGroup	Method	PrepMethod	Preservative	BottleType	Pri
Metals Group4		6020	ILM05.4	1:1 HNO3 to pH < 2	500 ml Plastic	10
SVOCMS Group5		8270-Modified	3510	Cool 4 deg C	1 Liter Amber	10
VOCMS GroupB		8260-Low	NA	1:1 HCl to pH < 2	40 ml Vials	10

Lab SampleID	Matrix	CustomerSample	Collect Date	CollectTime	Receive Date	Bottle Qty
E2489-02	Water	LFD17MW005-130606	06/06/2013	11:07:00	6/7/2013 10:10:00	6

Test	TestGroup	Method	PrepMethod	Preservative	BottleType	Pri
Metals Group4		6020	ILM05.4	1:1 HNO3 to pH < 2	500 ml Plastic	10
SVOCMS Group5		8270-Modified	3510	Cool 4 deg C	1 Liter Amber	10
VOCMS GroupB		8260-Low	NA	1:1 HCl to pH < 2	40 ml Vials	10

Lab SampleID	Matrix	CustomerSample	Collect Date	CollectTime	Receive Date	Bottle Qty
E2489-03	Water	LFD14MW026-130606	06/06/2013	12:41:00	6/7/2013 10:10:00	4

Test	TestGroup	Method	PrepMethod	Preservative	BottleType	Pri
VOCMS GroupB		8260-Low	NA	1:1 HCl to pH < 2	40 ml Vials	10

Lab SampleID	Matrix	CustomerSample	Collect Date	CollectTime	Receive Date	Bottle Qty
E2489-04	Water	TB01-130606	06/06/2013	08:45:00	6/7/2013 10:10:00	2

Test	TestGroup	Method	PrepMethod	Preservative	BottleType	Pri
VOCMS GroupB		8260-Low	NA	1:1 HCl to pH < 2	40 ml Vials	10

Lab SampleID	Matrix	CustomerSample	Collect Date	CollectTime	Receive Date	Bottle Qty
E2489-05	Water	LFD01MW002-130606	06/06/2013	10:12:00	6/7/2013 10:10:00	6

Test	TestGroup	Method	PrepMethod	Preservative	BottleType	Pri
Metals Group4		6020	ILM05.4	1:1 HNO3 to pH < 2	500 ml Plastic	10
SVOCMS Group5		8270-Modified	3510	Cool 4 deg C	1 Liter Amber	10
VOCMS GroupB		8260-Low	NA	1:1 HCl to pH < 2	40 ml Vials	10

Lab SampleID	Matrix	CustomerSample	Collect Date	CollectTime	Receive Date	Bottle Qty
E2489-06	Water	LFD01MW003-130606	06/06/2013	11:14:00	6/7/2013 10:10:00	6

Test	TestGroup	Method	PrepMethod	Preservative	BottleType	Pri

APPENDIX M

SM Login Question Report

Shipment Verification Detail

OrderID E2489
ProjectID Kelly AFB
CustomerID SHAW22
Project Manager reginald
Customer Name CB&I
Sales Executive Franco
Customer Contact Jennifer Hoang
Order Date 06/07/2013

Are samples submitted with a chain of custody?	Yes ________	No ________	NA _____
Are the number of samples the same as stated on the chain of custody?	Yes ________	No ________	NA _____
Are bottle caps tight and securely in place?	Yes ________	No ________	NA _____
Were all containers intact when received?	Yes ________	No ________	NA _____
Were samples submitted in an ice chest?	Yes ________	No ________	NA _____
Were samples received cold?	Yes ________	No ________	NA _____
Were samples within the holding time for the requested test(s)?	Yes ________	No ________	NA _____
Is the volume of sample submitted sufficient for the requested test(s)?	Yes ________	No ________	NA _____
Are all samples for volatile organic analyses free of headspace?	Yes ________	No ________	NA _____

CHEMTECH 284 Sheffield Street, Mountainside, NJ 07092 (908) 789-8900

READ RECEIPT

Employee Name: ______________________________

Department: ______________________________

________________________ **P250-Log-in Procedure** ________________________

Method or Document Read (Include Title, Number, Revision, as applicable)

Employee Statement: I have read and understood the information in the above mentioned method or document.

____________________________________ ____________________

Employee Signature Date

Supervisory Statement: I have reviewed this document or method with the employee.

____________________________________ ____________________

Supervisor Signature Date

Note: This receipt is to be returned to the Quality Assurance/Quality Control Department for incorporation into employee training record files. If you have questions or would like to review your train record files, see QA/QC Director.

Appendix C
Responses to USEPA Comments, USEPA and TDEC Approval Letters

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Remediation
Memphis Environmental Field Office
8383 Wolf Lake Drive
Bartlett, TN 38133-4119

June 28, 2019

James C. Foster
BRAC Program Manager
Headquarters Department of the Army,
Assistant Chief of Staff for
Installation Management (DAIM-ODB)
Army Pentagon,
2530 Crystal Drive,
Arlington, VA 22202-3934

Subject: **Supplemental Remedial Investigation Phase 4 QAPP Approval**
Defense Depot Memphis, Tennessee
TDoR ID # 79-736
TN4210020570

Mr. Foster,

TDEC-DoR has reviewed the **Supplemental Remedial Investigation Phase 4 QAPP**, as submitted by HDR Inc., and approves of the investigation recommendations outlined in the document. If there are additional issues of concern, please contact me at (901) 371-3041 or at jamie.woods@tn.gov .

Regards,

JA Wood

Jamie A. Woods, P.G.
Project Manager
Division of Remediation
Memphis Environmental Field Office

cc: Joan Hutton (CALIBRE)
T. Holmes (HDR Inc)
D. Lloyd (EPA-PM)
TDoR NCO: file 79-736
TDoR MEFO: file 79-736

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

August 22, 2019

Mr. James Foster
Base Realignment and Closure Division (ACSIM-ODB)
2530 Crystal Drive (Taylor Building), Room 5000
Arlington, VA 22202-3940

Dear Mr. Foster:

The U.S. Environmental Protection Agency (EPA) has received and reviewed the Department of Army, Defense Depot of Memphis, Tennessee, Supplemental Remedial Investigation, Phase 4 Quality Assurance Project Plan (QAPP) Response to EPA Comments.

EPA approves the above mentioned document inclusive of the US Army's response to EPA comments. EPA appreciates the efforts by the Army to address EPA concerns. Should you have any questions or concerns, please feel free to call me at on my cell number 404-229-9500.

Sincerely,

Diedre Lloyd

Diedre Lloyd
Remedial Project Manager
Restoration & Sustainability Branch
Superfund Division

cc: Mr. James Foster, (Signed Original), United Parcel Service, Return Receipt
Mr. Jamie A. Woods, PG, Tennessee, Department of Environment and Conservation, Memphis Environmental Field Office, 8383 Wolf Lake Drive, Bartlett, TN 38133-4119
Ms. Joan Hutton, CALIBRE, 3898 Mountain View Road, Kennesaw, GA 30152
Mr. Thomas Holmes, HDR Environmental, P.O. Box 728, Highlands, NC 28741

Above Letter was also emailed to list below and can be found at the e-file location noted below.

ec: james.c.foster10.civ@mail.mil; jamie.woods@tn.gov; joan.hutton@calibresys.com;
thomas.holmes@hdrinc.com;

e-bbc: Terrell.tina@epa.gov

C:\DDMT\DDMT_SRI_Phase4\...

Responses to Comments from
U.S. Environmental Protection Agency (EPA) Region 4 on:
Supplemental Remedial Investigation Phase 4 QAPP, April 2019
Defense Depot Memphis, Tennessee
Comments Received: 1 July 2019

EPA Comments:

1) Page 6, QAPP Worksheet #6: Communication Pathways: Please include the U.S. Army BRAC/Federal Facility Agreement (FFA) Representative, James Foster, in this worksheet.

Response: Will add Project Oversight with Mr. Foster as responsible party.

2) Page 8, QAPP Worksheet #9: Project Planning Session Summary
    a. Mentions the QAPPs associated with Phase 3 but does not include this information for Phases 1 or 2. Please include this information.

Response: Worksheet #9 references the SRI Phases 1&2 report which was reviewed and approved by EPA and TDEC, the SRI Phase 3 QAPP which was approved by EPA and TDEC, and the SRI Phase 3 report which was submitted for review by EPA and TDEC. References to the Phase 1 and 2 QAPP will be added.

    b. Mentions the SOW for Contract for SRI Phases 3 and 4 but does not include this information for Phases 1 or 2. Please include this information

Response: A paragraph for information on the SRI Phase 1 and 2 SOW will be added.

3) Page 9, QAPP Worksheet #10: Conceptual Site Model
    a. Please include a figure that represents the CSM (older figure) or reference that a new updated CSM will be forthcoming in future reports based on newly gathered information.

Response: A single figure representing the former CSM was not prepared, nor is a new figure specifically included in the current SOW. Worksheet #10 provides a comprehensive summary of the CSM using text, tables and figures in accordance with UFP-QAPP guidance. The following sentence will be added at the end of Worksheet #10 to address this comment: “SRI Phase 4 and related SRI activities (vertical profiling, site stratigraphy review and SVE pilot test) will provide additional information for an updated CSM in the final SRI report to be prepared after completion of SRI Phase 4.”

    b. Page 10, Geology and Hydrology: Please include additional information that clarifies the relationship of nearly level topography and groundwater flow direction in the Fluvial Aquifer onto the Main Installation from all sides.

Response: The text in referenced section (third paragraph) will be revised to “The saturated thickness ranges from 0 ft (dry) to approximately 70 ft. The groundwater level and saturated thickness of the Fluvial Aquifer are mainly controlled by the surface of the uppermost clay in the Upper Claiborne and the areas of downward leakage where the clay layer is thin or absent, as noted below. The groundwater level does not reflect the nearly level ground surface at the MI.”

The final paragraph in this section on flow direction will be deleted since it is discussed in ‘Groundwater Flow’ starting on page 14 with links to groundwater elevation maps.

    c. Page 11, Site Contaminants: Please state if any PFAS chemicals were or were not used on the DDMT site.

Response: There is no indication that PFAS chemicals were used at DDMT.

Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances (September 2018) includes the following: “At Army installations, the primary mechanism for releases of PFAS is through the historic use (post-1972) of Aqueous Film Forming Foam (AFFF), a product applied during firefighting and firefighting-related training. AFFF for firefighting was, and is, generally used in areas where fuel- or petroleum-based fires may have occurred; such as in the vicinity of aviation assets, fuel farms, or aircraft crash sites.” These activities and facilities were not present at DDMT.

Neither the *DDMT RCRA Facility Assessment* (A.T. Kearney, 1990) nor the *MI Remedial Investigation* (RI) (CH2MHILL, 2000) reference the presence or use of AFFF, firefighting or firefighting-related training at DDMT. Those documents state that Lake Danielson on the golf course was used as a source of fire-fighting water. Also the list of environmental sites at DDMT, Table 2 in *2019 Site Management Plan* (HDR, 2019) does not reference AFFF or firefighting activities.

d. Page 12, Risk Assessment: Please delineate the limited surface soil area that had lead levels above the industrial use values.

Response: The area of lead contamination was removed under CERCLA Section 104 prior to completion of MI ROD and was noted as a significant change in the MI ROD. The text will be revised to state that the contaminated area was remediated.

e. Page 17, Plume Delineation:
    i. The QAPP addresses 5 remaining data gaps with respect to plume extent however, only one off-site data gap is included. EPA noted offsite data gaps associated with the DDMT VOC plume in EPA comment # 6 for the 2019 Site Management Plan, Rev 0. Please ensure that this comment is addressed in the final and last phase of the SRI for DDMT.

Response: EPA comment #6 for the 2019 SMP was related to the access agreement for the offsite IAQ well northwest of the MI, which was located to investigate potential offsite migration of the VOC plume; this well is designated as I-1 on Table 4 in Worksheet 17. The Plume Delineation section includes remaining data gaps based on the Phase 3 results. Step 1 on Worksheet #11 lists the data gaps from Worksheet #10 and the remaining data gaps for Phase 3 off-site wells and includes "Offsite extent of CVOCs and groundwater flow direction in IAQ northwest of the MI"; well I-1 addresses that data gap. The access agreement for well I-1 has been executed and the well will be installed during Phase 4 of the SRI.

4) Site History: **<u>QAPP Worksheet #9: Project Planning Session Summary, Page 8</u>:** The text indicates the delineation in each area will consist of drilling, soil sampling, and field monitoring for volatile organic compounds (VOCs) in the soil samples; and installation of a multi-port well or a well cluster for groundwater sampling. However, the criteria that will determine whether a multi-port well or well cluster will be utilized for groundwater sampling has not been presented or referenced.
    a. Please revise the QAPP to address this issue to ensure the decision on whether to install a multi-port well or well cluster is clearly understood.

Response: Two nested wells will be installed for vertical delineation as described in Worksheet #s 11, 14/16 and 17. Worksheet #9 will be revised to "…installation of a nested well for groundwater sampling."

5) **<u>QAPP Worksheet #10: Conceptual Site Model, Vapor Intrusion, Page 13</u>:** The last bullet indicates geotechnical analysis of soil samples identified the shallow soil (loess) as practically impermeable, lean clayey silt. However, the assertion that the geotechnical analysis identified the shallow soil as "practically impermeable, lean clayey silt" was not supported by site specific results (i.e., permeability, porosity). This comment has also been noted in previous EPA comment letter for the Soil Vapor Sampling Main Installation Vapor Intrusion Study, dated January 19, 2019. For clarity and completeness, revise the QAPP to address this issue.

Response: The MI Soil Vapor Sampling memorandum includes the statement "Soil permeability test results ranged $4.6\text{x}10^{-8}$ to $9\text{x}10^{-8}$ centimeters per second, which is classified as practically impermeable (Whitman, 1969)." Several EPA comments on the memo state "practically impermeable" is a misleading term and the sample vapor results indicate a complete pathway exist for soil gas vapor from groundwater. Another comment states that samples from three borings are not sufficient to characterize the surface soil across a large site (567 acres).

As stated in the QAPP, the surficial "loess deposits are about 20 to 30 ft thick and are continuous throughout the DDMT". The three samples, which are "site specific results", had similar permeability test results and are consistent with soil descriptions describing the loess as clayey silt. VOC concentrations in the soil vapor samples indicate a potential VI risk and further sampling is recommended. However, the soil vapor concentrations may be due to residual contamination from surface spills rather than migration from groundwater.

The referenced bullet in Worksheet #10 will be revised to delete "practically impermeable"; the sentence will state "Geotechnical analysis of soil samples identified the shallow soil (loess) as lean clayey silt with permeability test results of $4.6\mathrm{x}10^{-8}$ to $9\mathrm{x}10^{-8}$ centimeters per second."

6) **QAPP Worksheet #10: Conceptual Site Model, Groundwater Flow, Page 15, and Figure 5, Fluvial Aquifer Flow Direction**: The text on page 15 describes the addition of a red line drawn on Figure 5 to approximate area of capture by the window based on flow vectors. The red line drawn in the figure marks the divide for fluvial aquifer flow into the window (north of line) or into the sink (south of line). As seen in the figure, the western end of the redline divide is drawn just to the south of MW-285 indicating the flow direction is north into the window. However, based on the position of the groundwater elevation iso-contour, the flow direction from MW-285 is southerly into the sink. Therefore, the redline divide should be drawn just to the north of MW-285. Revise the figure to address this issue.

Response: The contours and flow direction arrows are based on wells separated by a few hundred feet or more. The red line was drawn to show a larger area of groundwater captured by flow into the window to be conservative, as the window is considered to allow vertical migration of VOCs to the IAQ and potentially the MAQ. The line will be redrawn to pass just south of MW-285 so it does not conflict with any of the flow direction arrows on the map.

7) **QAPP Worksheet #10: Conceptual Site Model, Plume Delineation, Page 17**: Text at the end of the plume delineation section states "[R]emaining data gaps for plume extent are contaminant extent near Building 720, contaminant migration into the window from the West-Central and North-Central plumes, upgradient extent of the TTA-2 plume, upgradient and down-gradient (off-site) extent of the Southeast (MW-270) plume, and contaminant extent in the IAQ beneath the sink." It is unclear what the intended purpose of this statement is, and whether this statement is included to indicate that additional data gaps exist, or whether the installation of the new wells described in the QAPP will address these identified data gaps. Revise Worksheet #10 to address this issue.

Response: The final paragraph in Worksheet 10 will be revised to "Based on the Phase 3 well samples collected in August 2018 and October 2018, additional data gaps for plume extent were identified: contaminant extent near Building 720, contaminant migration into the window from the West-Central and North-Central plumes, upgradient extent of the TTA-2 plume, upgradient and down-gradient (off-site) extent of the Southeast (MW-270) plume, and contaminant extent in the IAQ beneath the sink. These additional data gaps and the remaining data gaps for the Phase 3 offsite wells are listed in Step 1 on Worksheet #11.

8) **QAPP Worksheet #14/16: Project Tasks & Schedule, Well Access, Page 24**: Text on page 24 states that agreements are currently in place with the property owners to obtain access to four of six off-site wells. However, the text in Worksheet #9 states fourteen wells are to be installed during Phase 4, including the five off-site wells that could not be installed in Phase 3. Revise the text to ensure the number of off-site wells installed during Phase 4 is clearly understood.

Response: There are six off-site wells; the five wells remaining from Phase 3 and one additional off-site well selected based on review of results for the Phase 3 and recent LTM samples. The figures showing the well locations are referenced in the sentence preceding 'Well Access', and the off-site locations are clearly shown. The sentence will be revised to clearly state the current status of access agreements: "Agreements are currently in place for four of the six off-site well locations; access for the two remaining off-site wells have been agreed to by the owners and the final agreements are in preparation."

Responses to Comments from
U.S. Environmental Protection Agency (EPA) Region 4 on:
Supplemental Remedial Investigation Phase 4 QAPP, April 2019
Defense Depot Memphis, Tennessee
Comments Received: 1 July 2019

9) **QAPP Worksheet #14/16: Project Tasks & Schedule, Sampling, Page 25:** The text indicates passive diffusion bags (PDBs) will be installed after the initial sample of saturated thickness is sufficient. However, the text does not discuss what a sufficient saturated thickness would be. Revise the QAPP to address this issue to ensure the PDB sampling protocols are clearly understood.

Response: The sentence will be revised to "PDBs will be installed after the initial sample if the saturated screened interval is 5 ft or greater."

10) **QAPP Worksheet #14/16: Project Tasks & Schedule, Sampling, Investigation Derived Waste, Page 29:** The text states "Soil cuttings from the well borings will be transported to Dunn Field and placed on plastic sheeting; the cuttings will be covered by plastic sheeting held in place by perimeter weights. Upon completion of drilling, one soil sample will be collected for approximately each 5 cubic yards of soil cuttings. At each sample location, approximately 6 inches of surface soil will be removed and samples will be collected for VOC analysis by standard extraction and by TCLP extraction." As such, the results of the soil samples collected and submitted for laboratory analysis could be biased low. For example, volatilization of contaminants could occur during the process of transporting the soil cuttings from the Main Installation (MI) to Dunn Field, placing the cuttings on, and covering them with plastic sheeting, then, collecting and submitting the sample for standard (8260) analysis. It is recommended the soil cuttings generated from the Phase 4 sampling investigation be containerized prior to transportation and a Terracore™ soil sample be collected from a portion of the IDW directly from the container to ensure representative and quality results are obtained for decision making. Please provide a response and/or revisions to the QAPP to address this concern.

Response: The stated procedure for storage, sampling and disposal of soil cuttings from well borings at DDMT is the same as in the SRI Phase 3 QAPP and previous work plans. The cuttings will be significantly impacted by the core barrel heating during rotasonic drilling, and determination of the in situ VOC concentration is not the purpose. The objective is to determine if the VOC concentrations in the soil prior to disposal are consistent with disposal requirements, which are below remediation goals in the Dunn Field ROD for disposal on-site or below hazardous waste characteristic concentrations, based on TCLP analysis, for disposal at an off-site CERCLA-approved landfill. Since samples will be collected for each 5 cubic yards of soil cuttings, sampling from the soil pile is considered more appropriate than sampling from randomly selected borings.

11) **QAPP Worksheet #12: Measurement Performance Criteria, Page 22:** Worksheet #12 for the soil/Investigative Derived Waste (IDW) matrix does not list field duplicates or matrix spikes and the associated quality control criteria for acceptance of these results, however QAPP Worksheet #20, Field QC Summary indicates field duplicate and matrix spike samples will be collected for the soil cuttings. Please revise Worksheet #12 to include the measurement performance criteria for field duplicates and matrix spikes for the soil samples.

Response: The soil samples identified for VOC analysis on Worksheet #20 refer to samples collected from soil as described in Worksheet #14/16 under 'Vertical Delineation and Nested Wells'. Five soil samples will be collected from each vertical delineation location; three samples from a DPT boring and two samples from the well boring collected from 'undisturbed' soil below the core barrel.

The table on Worksheet #20 will be revised to include rows for IDW Soil and IDW Water. As noted in response to comment #10, the objectives for soil IDW samples are different than samples for site investigation; QC samples are not considered necessary. The added rows will show expected number of field samples with no QC samples.