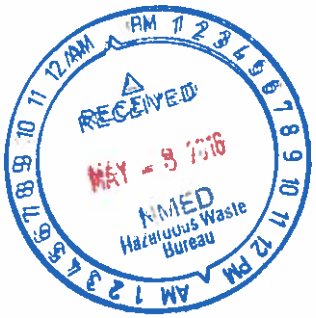
DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)



APR 2 5 2016

Colonel Eric H. Froehlich
377 ABW/CC
2000 Wyoming Blvd SE
Kirtland AFB NM 87117-5600

Mr. John Kieling, Bureau Chief
Hazardous Waste Bureau (HWB)
New Mexico Environment Department (NMED)
2905 Rodeo Park Road
Santa Fe, New Mexico 87505

SUBJECT: Work Plan for Soil Vapor Monitoring and Drinking Water Monitoring, April 2016, Solid Waste Management Unit ST-106/SS-111, Kirtland Air Force Base, New Mexico

Dear Mr. Kieling

Please find attached the *Work Plan for Soil Vapor Monitoring and Drinking Water Monitoring, Solid Waste Management Unit ST-106/SS-111,* Kirtland Air Force Base (AFB), New Mexico. This plan describes tasks related to the periodic sampling of soil vapor monitoring locations and drinking water supply wells as part of the ongoing investigation of the Bulk Fuels Facility release at Kirtland AFB.

If you have any questions or concerns, please contact Mr. L. Wayne Bitner at (505) 853-3484 or at ludie.bitner@us.af.mil, or Ms. Victoria Branson at (505) 846-6362 or at victoria.branson@us.af.mil.

ERIC H. FROEHLICH, Colonel, USAF
Commander

Attachments:
Work Plan for Soil Vapor Monitoring and Drinking Water Monitoring

cc:
NMED-EHD (Roberts, McQuillan)
NMED-HWB (Agnew)
SAF-IEE (Lynnes)
U.S.EPA Region 6 (King, Ellinger)

AFCEC-CZRX (Bodour)
USACE-ABQ District Office (Sanchez, Simpler, Phaneuf)
Public Info Repository, AR/IR and File

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

WORK PLAN FOR

SOIL VAPOR MONITORING AND DRINKING WATER MONITORING

SOLID WASTE MANAGEMENT UNIT ST-106/SS-111

April 2016

377 MSG/CEANR
2050 Wyoming Blvd. SE
KIRTLAND AFB, NEW MEXICO 87117-5270

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

Work Plan for
Soil Vapor Monitoring and
Drinking Water Monitoring
Solid Waste Management Unit ST-106/SS-111

April 2016

Prepared for

U.S. Army Corps of Engineers
Albuquerque District
Albuquerque, New Mexico 87109

USACE Contract No. W912PP-16-C-0002

Prepared by

Sundance Consulting, Inc.
8210 Louisiana Blvd, Suite C
Albuquerque, NM 87113

NOTICE

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REPORT DOCUMENTATION PAGE

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6. AUTHOR

R. Hobbs, P.G.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

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8. PERFORMING ORGANIZATION REPORT NUMBER

KAFB-16-002

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

USACE Albuquerque District

4101 Jefferson Plaza NE Albuquerque, NM 87109

Project Manager: Trent Simpler, P.E.

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

12b. DISTRIBUTION CODE

13. This Soil Vapor Monitoring and Drinking Water Monitoring Work Plan (WP) has been prepared by Sundance Consulting, Inc. as part of the ongoing monitoring effort at Solid Waste Management Unit (SWMU) ST-106/SS-111 at the Kirtland Air Force Base (KAFB) Bulk Fuels Facility. The WP demonstrates the U.S. Air Force's commitment to continuing with the treatment of the fuel contamination resulting from past practices and events at SWMU ST-106/SS-111. This WP outlines activities to be performed in support of continued monitoring of drinking water and the nature and extent of soil vapor contamination at SWMU ST-106/SS-111, and in conjunction with the Quality Assurance Project Plan, will become the procedural guidance document for these activities. This document meets the most recent requirements of the Department of Defense (DoD) regarding planning documents for DoD facilities. The WP was written in accordance with KAFB's Resource Conservation and Recovery Act Permit Number NM9570024423.

14. SUBJECT TERMS

Bulk Fuels Facility (BFF), Soil Vapor Monitoring and Drinking Water Monitoring Work Plan

15. NUMBER OF PAGES

126

16. PRICE CODE

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40 CFR 270.11
DOCUMENT CERTIFICATION
APRIL 2016

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

ERIC H. FROEHLICH, Colonel, USAF
Commander, 377th Air Base Wing

This document has been approved for public release.

KIRTLAND AIR FORCE BASE
377th Air Base Wing Public Affairs

PREFACE

This Soil Vapor Monitoring and Drinking Water Monitoring Work Plan (WP) was prepared by Sundance, Consulting, Inc. (Sundance) for the U.S. Army Corps of Engineers (USACE) under contract W912PP-16-C-0002. It pertains to the Kirtland Air Force Base (KAFB) Bulk Fuels Facility site at Solid Waste Management Unit ST-106/SS-111, located in Albuquerque, New Mexico. This WP was prepared in accordance with the permit issued to KAFB under the Resource Conservation and Recovery Act and applicable federal, state, and local laws and regulations.

This WP presents and describes all activities associated with the quarterly sampling of 284 soil vapor monitoring points and the monthly sampling of four drinking water production wells.

This WP is prepared for work to be performed between 20 January 2016 and 20 January 2018. Ms. Amy Sanchez is the Contracting Officer's Representative for the USACE Albuquerque District, and Mr. Trent Simpler, Professional Engineer, is the Project Manager. Mr. Wayne Bitner, Jr. is the KAFB Restoration Section Chief, and Patrick Scher, Professional Geologist (P.G.), is the Sundance Project Manager. This plan was prepared by Senior Project Geologist Rachel Hobbs, P.G.

Patrick L. Scher, P.G.

Sundance Consulting, Inc.

Senior Project Manager

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TABLES

ACRONYMS AND ABBREVIATIONS

%	percent
^{o}C	degrees Celsius
AFB	Air Force Base
AFCEC	Air Force Civil Engineering Center
Air Force	U.S. Air Force
ALS	ALS Environmental Laboratories
APH	air-phase petroleum hydrocarbons
APP	Accident Prevention Plan
BFF	Bulk Fuels Facility
BTEX	benzene, toluene, ethylbenzene, and xylenes
CO_2	carbon dioxide
COA	City of Albuquerque
CY	calendar year
DO	dissolved oxygen
DoD	U.S. Department of Defense
DTIC	Defense Technical Information Center
EDB	ethylene dibromide
e.g.	example given
EPA	U.S. Environmental Protection Agency
ERP	Environmental Restoration Program
ERPIMS	Environmental Resource Program Information Management System
HC	hydrocarbons
Horiba	Horiba MEXA 584L auto emissions analyzer
IDW	investigation-derived waste
in Hg	inches of mercury
in WC	inches of water column
KAFB	Kirtland Air Force Base
LDC	Laboratory Data Consultants, Inc.
NMED	New Mexico Environment Department
O_2	oxygen
ORP	oxidation reduction potential
P.E.	Professional Engineer
P.G.	Professional Geologist
PID	photoionization detector
PPE	personal protective equipment
ppmv	parts per million by volume

QAPjP	Quality Assurance Project Plan
QC	quality control
QMR	Quarterly Monitoring and Site Investigation Report
RCRA	Resource Conservation and Recovery Act
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
Sundance	Sundance Consulting, Inc.
SVE	soil vapor extraction
SVEW	soil vapor extraction well
SVM	soil vapor monitoring
SVMP	soil vapor monitoring point
SWMU	Solid Waste Management Unit
SWMW	soil vapor monitoring well
U.S.	United States
USACE	U.S. Army Corps of Engineers
VA	Veteran's Administration
VOC	volatile organic compound
WP	Work Plan
YSI	Yellow Springs Instruments

APPENDICES

A Field Forms

-Field Activity Log

-Well Integrity Checklist

-Horiba Calibration Form

-Leak Test Log

-Example Soil Vapor Purge Log

-Example Soil Vapor Sample Collection Log

-Example Soil Vapor Chain of Custody Form

-Example Water Sample Collection Log

-Example Water Chain of Custody Form

B Project Schedule

C Quality Assurance Project Plan

EXECUTIVE SUMMARY

This Soil Vapor Monitoring and Drinking Water Monitoring Work Plan (WP) has been prepared by Sundance Consulting, Inc. as part of the ongoing monitoring effort at Solid Waste Management Unit (SWMU) ST-106/SS-111 at the Kirtland Air Force Base (KAFB) Bulk Fuels Facility. The WP demonstrates the U.S. Air Force's commitment to continuing with the treatment of the fuel contamination resulting from past practices and events at SWMU ST-106/SS-111. This WP outlines activities to be performed in support of continued monitoring of drinking water and the nature and extent of soil vapor contamination at SWMU ST-106/SS-111, and in conjunction with the Quality Assurance Project Plan, will become the procedural guidance document for these activities. These documents meet the most recent requirements of the Department of Defense (DoD) regarding planning documents for DoD facilities. The WP was written in accordance with KAFB's Resource Conservation and Recovery Act Permit Number NM9570024423.

The objective of the WP is to detail the quarterly sampling and analysis of the existing soil vapor monitoring network, and monthly drinking water well sampling and analysis activities to be implemented. The work to be completed is presented under each of the tasks listed below:

- Perform quarterly sampling and reporting at 284 soil vapor monitoring points for 8 quarters beginning in first quarter calendar year (CY) 2016.
- Perform yearly maintenance of the soil vapor monitoring network.
- Abandon and install soil vapor monitoring locations.
- Perform monthly sampling and reporting of four drinking water production wells beginning in February 2016 through the end of CY 2017.

1 INTRODUCTION

This Soil Vapor Monitoring and Drinking Water Monitoring Work Plan (WP) was prepared by Sundance, Consulting, Inc. (Sundance) for the U.S. Army Corps of Engineers (USACE) under contract W912PP-16-C-0002. The WP pertains to sampling activities at the Kirtland Air Force Base (KAFB) Bulk Fuels Facility (BFF), Solid Waste Management Unit (SWMU) ST-106/SS-111 (example given [e.g.] BFF site). Environmental restoration efforts at the BFF site are being conducted under requirements set forth in the Resource Conservation and Recovery Act (RCRA) Permit No. NM9570024423 with the New Mexico Environment Department (NMED) serving as the lead regulatory agency (NMED, 2010).

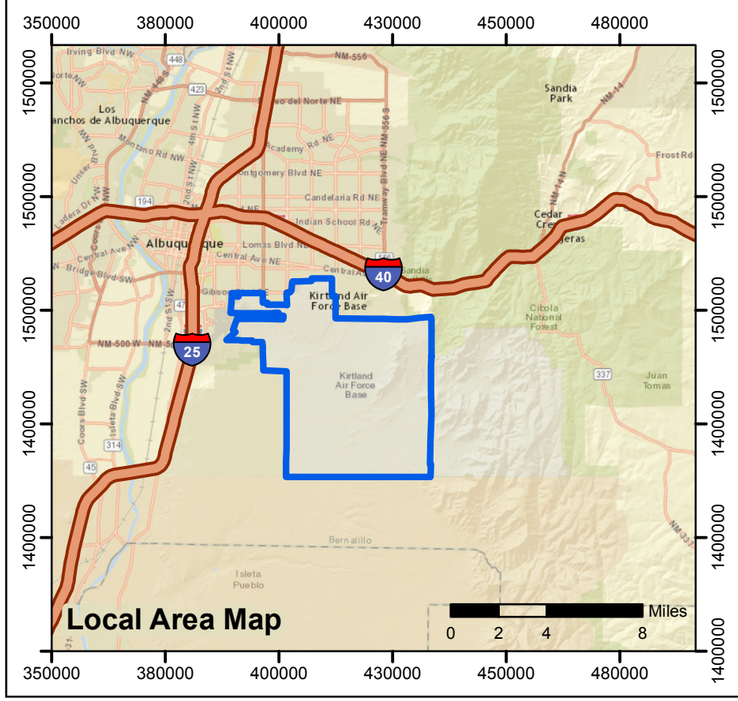
This WP addresses activities that are continuing the implementation of the RCRA process for this site, including the continued monitoring of the soil vapor plume, and monitoring of drinking water production wells. This WP will become the procedural guidance document for these activities to be performed as part of the ongoing investigation and will meet the most recent requirements of the Department of Defense (DoD) regarding planning documents for DoD facilities.

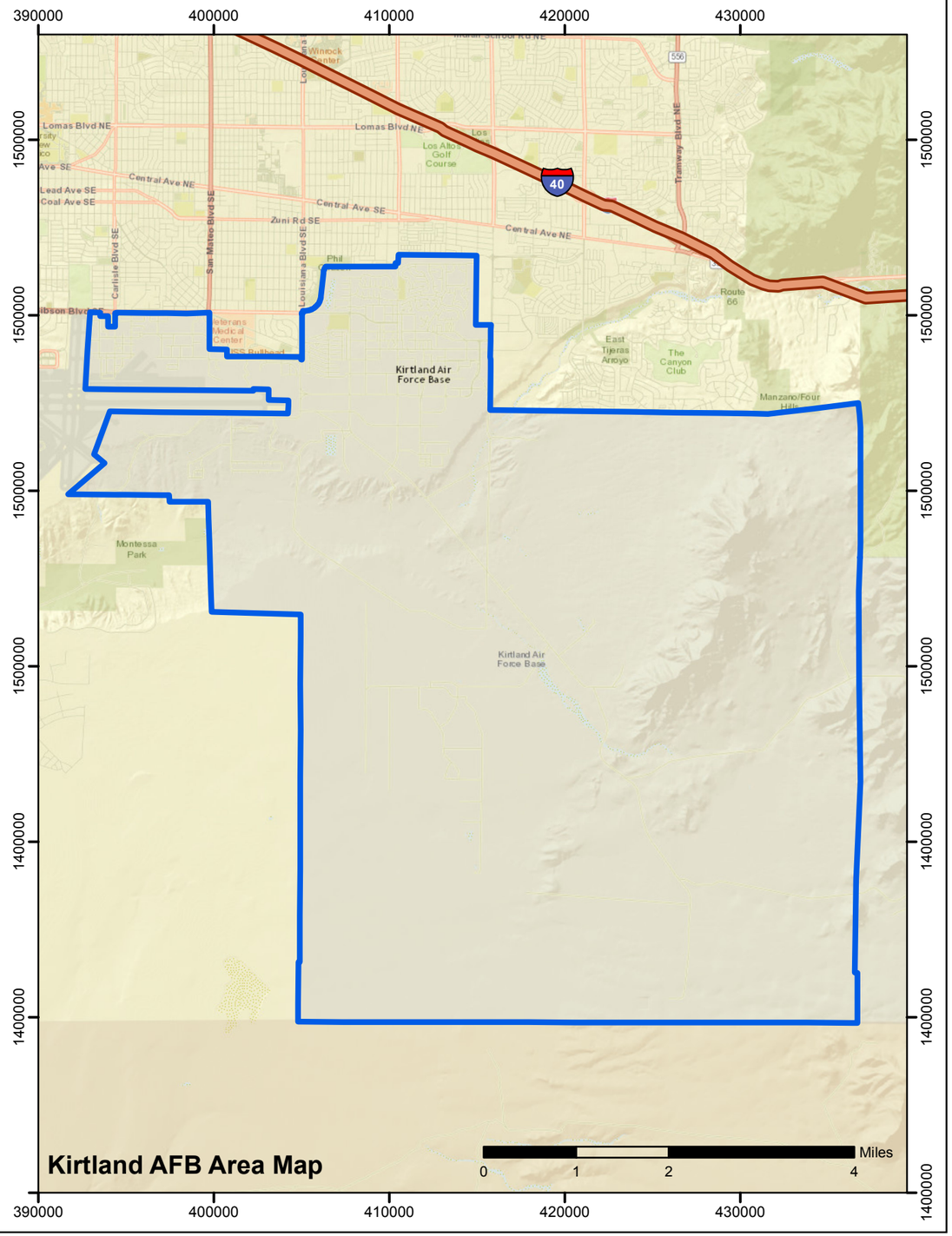
Requirements for the protection of health and safety on the job sites are addressed in the companion *Quarterly Soil Vapor Sampling and Monthly Drinking Water Sampling Accident Prevention Plan* (APP) (Sundance 2016a). The APP also incorporates the Site Safety and Health Plan (SSHP).

1.1 Overview and Scope of Activities

The BFF site is located in Albuquerque, New Mexico (Figure 1-1). Field activities presented in this WP include quarterly soil vapor sampling and analysis of 284 monitoring points installed as part of the investigation at SWMU ST-106/SS-111. In addition, monthly sampling and analysis of four drinking water production wells will be performed. Analytical results from soil vapor and drinking water samples will be reported in the Quarterly Monitoring and Site Investigation Reports (QMRs). Analytical results from the drinking water production well samples will be reported in the QMRs. This WP for quarterly soil vapor sampling and monthly drinking water sampling includes all of the elements of a Sampling and Analysis Plan/Field Sampling Plan and covers all the project tasks associated with:

- Sample soil vapor monitoring network quarterly, beginning in first quarter calendar year (CY) 2016 for eight (8) quarters.
- Sample drinking water production wells monthly, beginning in February 2016 through the end of CY 2017.
- Perform annual maintenance of the soil vapor monitoring network.
- Abandon and install soil vapor monitoring locations.
- Analyze soil vapor and drinking water production well samples, and report results quarterly.





Legend

- Interstate
- US Highway
- State/County Highway
- States
- Kirtland Air Force Base Installation Area

N

Credits: Esri, HERE, DeLorme, USGS, Intermap

Coordinate System:
NAD 1927 StatePlane New Mexico Central FIPS 3002 Feet

Figure 1-1

Site Location Map
Work Plan

Soil Vapor Monitoring
and Drinking Water Monitoring

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

Last Revised: 4/19/2016

1.2 Report Organization

The BFF Soil Vapor Monitoring and Drinking Water Monitoring WP is divided into the following sections:

- Section 1—Presents an introduction to the plan, an overview of the project, and the scope of activities and organization of the WP.
- Section 2—Presents the BFF site description and operational history.
- Section 3—Project tasks are summarized with sufficient detail on how they will be accomplished.
- Section 4—Presents the project schedule.
- Section 5—Provides information on the organizational plan for the execution of work.
- Section 6—Refers to the data management requirements.
- Section 7—Presents information on the management and disposal of the waste generated during this project.
- Section 8—Presents references cited for this WP.

Associated appendices are provided at the end of this WP as follows:

- Appendix A: Field Forms

  -Field Activity Log

  -Well Integrity Checklist

  -Horiba Calibration Form

  -Leak Test Log

  -Example Soil Vapor Purge Log

  -Example Soil Vapor Sample Collection Log

  -Example Soil Vapor Chain of Custody

  -Example Water Sample Collection Log

  -Example Water Chain of Custody
- Appendix B: Project Schedule
- Appendix C: Quality Assurance Project Plan (QAPjP)

2 BACKGROUND INFORMATION

2.1 Site Description

KAFB is located in Bernalillo County, in central New Mexico, southeast of and adjacent to the City of Albuquerque (COA) and the Albuquerque International Sunport (Figure 1-1). The approximate area of the base is 52,287 acres. The BFF site is located in the northwestern portion of KAFB.

2.2 Site History

The BFF and associated infrastructure operated from 1953 through 1999. During this time, the fueling area was separated into a tank holding area where bulk shipments of fuel were received and a fuel off-loading area where individual fuel railcars or trucks were emptied. KAFB stopped using the underground piping at the facility in 1999 due to discovery of leaks in buried fuel transfer piping.

Even though a fuel leak was identified by KAFB in 1999, the exact history of the leaks or releases is unknown. Releases most likely occurred when fuel was transferred from railcars and trucks to the pump house. Initially, it was thought that the leak only affected surface soil around the identified source area; however, during site characterization activities KAFB learned the leaked fuel had reached the groundwater table and that dissolved-phase fuel contamination migrated northeast and north of KAFB.

2.3 Ongoing Monitoring

2.3.1 Ongoing Soil Vapor Monitoring

Quarterly soil vapor monitoring has been ongoing under the *Vadose Zone Investigation Work Plan* (USACE, 2011) as part of the ST-106/SS-111 investigation to monitor the nature and extent of soil vapor contamination in the vadose zone. A total of 56 soil vapor monitoring locations have been installed during the investigation (Figure 2-1). Each location is comprised of one or more soil vapor monitoring points (SVMPs), for a total of 284 monitoring points. Table 2-1 lists each soil vapor monitoring location, its associated SVMPs, and their associated easting and northing coordinates. The 56 soil vapor monitoring locations include:

- One soil vapor monitoring location contains four SVMPs co-located in the same vault as a groundwater monitoring well in Bullhead Park (KAFB-106028-510; See location number one in Table 2-1 below).

- Thirty-five locations installed in 2010 and 2011, each with six SVMPs, are located throughout the BFF, on base property north of the BFF, on COA property in Bullhead Park and its open space area, and on Veteran's Administration (VA) property. These locations are named using the convention KAFB-106XXX, to signify that they were installed as part of the investigation at SWMU ST-106/SS-111. Numbering at these 35 soil vapor monitoring locations range from KAFB-106108 through KAFB-106142 (See locations two through 36 in Table 2-1 below). Individual SVMPs at each location are further identified using the bottom of the screen depth of each point (e.g. KAFB-106108-050).

- Twenty locations installed inside the BFF referred to with the prefix "soil vapor extraction well (SVEW)-XX" or "soil vapor monitoring well (SVMW)-XX (See locations 37 through 56 in table 2-1 below)."

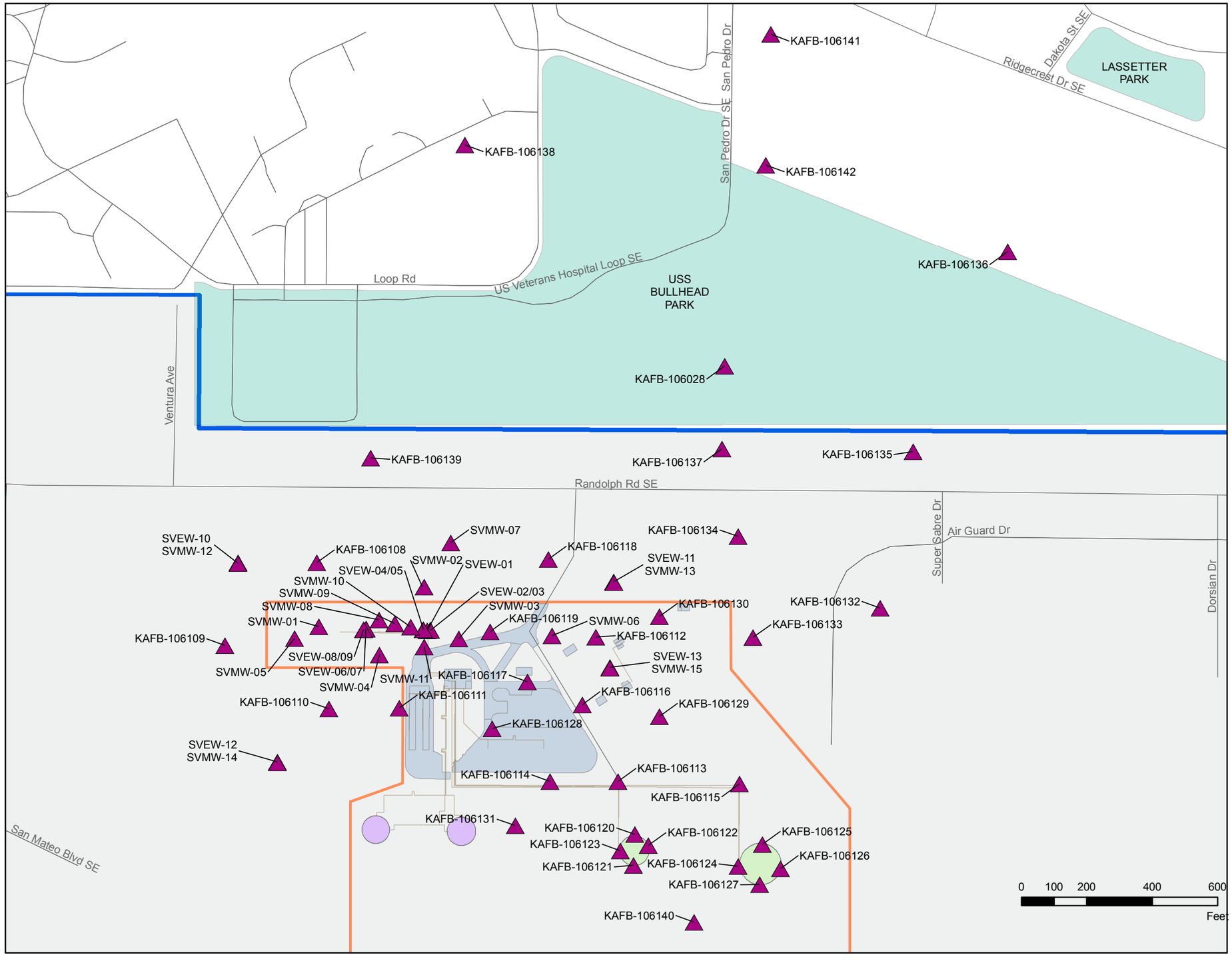
- Four of these 20 locations have both SVMW and SVEW type SVMPs at a single location. [For example, SVMW-13 (comprised of four SVMPs screened between 150 and 450-feet deep) and SVEW-11 (with one SVMP) are located together in a single well vault.

Table 2-1 lists each soil vapor monitoring well location and its associated SVMPs and coordinates.

In first quarter CY 2015, all SVMPs were capped and sealed to minimize barometric-pumping interferences on soil vapor sampling and analyses. Sealing the SVMPs was performed by securing an air-tight cap onto each point/well head and adding a pneumatic quick connect fitting to each monitoring point that serves as a sampling port connection for ease of access and to ensure that an air-tight seal is maintained.

2.3.2 Ongoing Drinking Water Production Well Monitoring

Four drinking water production wells have been sampled monthly as part of the ST-106/SS-111 investigation to confirm that they have not been impacted by groundwater contaminants. These wells include ST106-VA2 on VA hospital property, and KAFB-3, KAFB-15 and KAFB-16 on KAFB property (Figure 2-2). Table 2-2 lists the coordinates of each drinking water well.



Legend

- Kirtland Air Force Base Installation Area
- City of Albuquerque Parks
- Roads
- Bulk Fuels Facility Area
- Soil Vapor Monitoring Location
- Bulk Fuels Facility Infrastructure
- Current Fuel Storage Tanks
- Former Fuel Storage Tanks
- Fuel Transfer Lines

N

Credits: City of Albuquerque

Coordinate System:
NAD 1927 StatePlane New Mexico Central FIPS 3002 Feet

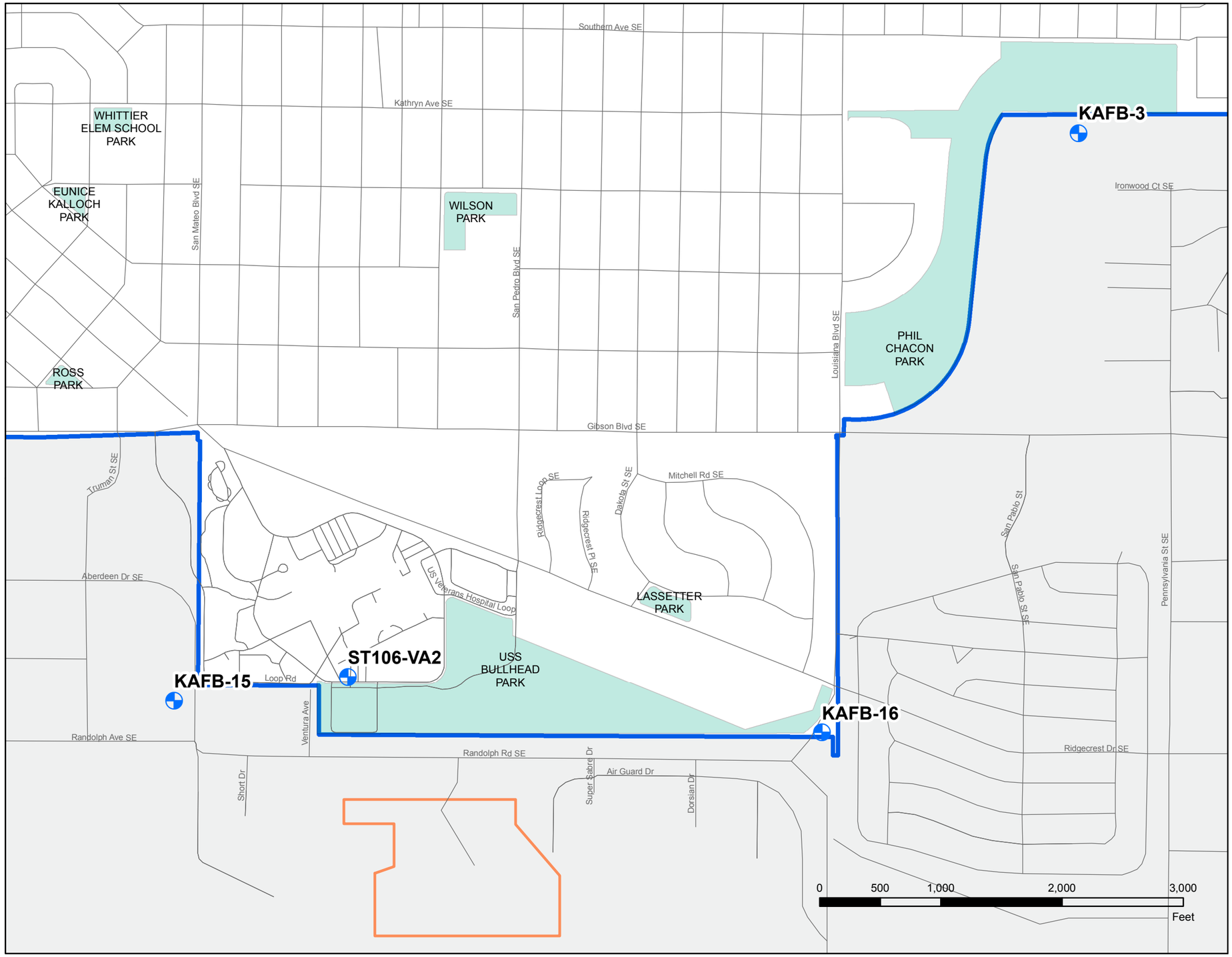
Figure 2-1

Soil Vapor Monitoring Locations
Work Plan

Soil Vapor Monitoring
and Drinking Water Monitoring

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

Last Revised: 4/19/2016



Legend

- Kirtland Air Force Base Installation Area
- City of Albuquerque Parks
- Roads
- Bulk Fuels Facility Area
- Drinking Water Supply Well

N

Credits: City of Albuquerque

Coordinate System:
NAD 1927 StatePlane New Mexico Central FIPS 3002 Feet

Figure 2-2

Drinking Water Supply Wells
Work Plan

Soil Vapor Monitoring
and Drinking Water Monitoring

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

Last Revised: 4/19/2016

Table 2-1. Soil Vapor Monitoring Point Locations and Coordinates
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Location Number	SVM Location ID	SVMP ID	Easting[1]	Northing
1	KAFB-106028	KAFB-106028-150	401910.441776	1474285.009804
		KAFB-106028-250	401910.491777	1474285.239798
		KAFB-106028-350	401910.751783	1474285.259797
		KAFB-106028-450	401910.851786	1474285.409793
2	KAFB-106108	KAFB-106108-025	400664.903033	1473684.446268
		KAFB-106108-050	400664.773030	1473684.206274
		KAFB-106108-150	400664.993035	1473684.016279
		KAFB-106108-250	400665.243040	1473684.156276
		KAFB-106108-350	400665.173039	1473684.456267
		KAFB-106108-450	400665.023035	1473684.846257
3	KAFB-106109	KAFB-106109-025	400384.736587	1473432.363139
		KAFB-106109-050	400384.916591	1473432.573133
		KAFB-106109-150	400384.736587	1473432.853126
		KAFB-106109-250	400384.456580	1473432.763128
		KAFB-106109-350	400384.446580	1473432.443137
		KAFB-106109-450	400384.676586	1473432.693130
4	KAFB-106110	KAFB-106110-025	400702.613980	1473238.228342
		KAFB-106110-050	400702.373975	1473238.008348
		KAFB-106110-150	400702.523978	1473237.768354
		KAFB-106110-250	400702.783984	1473237.818353
		KAFB-106110-350	400702.833985	1473238.098345
		KAFB-106110-450	400702.033967	1473237.748355
5	KAFB-106111	KAFB-106111-025	400916.998944	1473240.918233
		KAFB-106111-050	400917.178948	1473240.698239
		KAFB-106111-150	400917.438954	1473240.808236
		KAFB-106111-250	400917.418954	1473241.068229
		KAFB-106111-350	400917.118947	1473241.148227
		KAFB-106111-450	400917.038945	1473240.748238
6	KAFB-106112	KAFB-106112-025	401517.592816	1473457.832261
		KAFB-106112-050	401517.752819	1473457.592267
		KAFB-106112-150	401518.032826	1473457.692264
		KAFB-106112-250	401518.062827	1473457.962257
		KAFB-106112-350	401517.772820	1473458.082254
		KAFB-106112-450	401517.052803	1473457.742263
7	KAFB-106113	KAFB-106113-020	401585.424459	1473016.904187
		KAFB-106113-050	401585.284456	1473016.594195
		KAFB-106113-150	401585.534462	1473016.404200
		KAFB-106113-250	401585.844469	1473016.554196
		KAFB-106113-350	401585.754467	1473016.824189
		KAFB-106113-450	401585.554462	1473016.764191

Table 2-1. Soil Vapor Monitoring Point Locations and Coordinates
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Easting[1]	Northing
8	KAFB-106114	KAFB-106114-025	401377.539646	1473017.104216
		KAFB-106114-050	401377.289640	1473016.884222
		KAFB-106114-150	401377.419643	1473016.594230
		KAFB-106114-250	401377.729650	1473016.614229
		KAFB-106114-350	401377.759651	1473016.924221
		KAFB-106114-450	401377.589647	1473017.374209
9	KAFB-106115	KAFB-106115-025	401956.373050	1473009.614323
		KAFB-106115-050	401956.193046	1473009.374329
		KAFB-106115-150	401955.923040	1473009.414328
		KAFB-106115-250	401955.893039	1473009.694321
		KAFB-106115-350	401956.163045	1473009.754319
		KAFB-106115-450	401956.063043	1473009.754319
10	KAFB-106116	KAFB-106116-025	401475.631878	1473251.167863
		KAFB-106116-050	401475.951886	1473251.187862
		KAFB-106116-150	401475.521876	1473251.417856
		KAFB-106116-250	401475.741881	1473251.627850
		KAFB-106116-350	401476.021887	1473251.467854
		KAFB-106116-450	401475.051865	1473250.747874
11	KAFB-106117	KAFB-106117-025	401308.888006	1473321.085997
		KAFB-106117-050	401309.028009	1473321.305991
		KAFB-106117-150	401308.838004	1473321.555985
		KAFB-106117-250	401308.567998	1473321.445988
		KAFB-106117-350	401308.577998	1473321.165995
		KAFB-106117-450	401308.047986	1473320.746007
12	KAFB-106118	KAFB-106118-025	401372.389414	1473695.475851
		KAFB-106118-050	401372.479416	1473695.765843
		KAFB-106118-160	401372.589419	1473695.285856
		KAFB-106118-265	401372.809424	1473695.735844
		KAFB-106118-350	401372.879425	1473695.385854
		KAFB-106118-450	401372.049406	1473695.735844
13	KAFB-106119	KAFB-106119-025	401194.105322	1473474.311868
		KAFB-106119-050	401194.275326	1473474.061875
		KAFB-106119-150	401194.545332	1473474.151873
		KAFB-106119-250	401194.585333	1473474.421865
		KAFB-106119-350	401194.315327	1473474.531862
		KAFB-106119-450	401194.045321	1473474.741857
14	KAFB-106120	KAFB-106120-025	401636.035658	1472855.058560
		KAFB-106120-050	401636.135660	1472855.248555
		KAFB-106120-150	401636.015658	1472855.498549
		KAFB-106120-250	401635.685650	1472855.268555
		KAFB-106120-350	401635.855654	1472855.038561
		KAFB-106120-450	401635.915655	1472855.388552

Table 2-1. Soil Vapor Monitoring Point Locations and Coordinates
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Easting[1]	Northing
15	KAFB-106121	KAFB-106121-025	401632.585594	1472760.611118
		KAFB-106121-050	401632.835600	1472760.431123
		KAFB-106121-145	401632.305587	1472760.381125
		KAFB-106121-250	401632.425590	1472760.121132
		KAFB-106121-350	401632.805599	1472760.141131
		KAFB-106121-450	401632.535593	1472760.431123
16	KAFB-106122	KAFB-106122-025	401677.386621	1472821.089473
		KAFB-106122-050	401677.326620	1472821.389465
		KAFB-106122-150	401677.046613	1472821.449464
		KAFB-106122-250	401676.936611	1472821.159472
		KAFB-106122-350	401677.156616	1472820.949477
		KAFB-106122-450	401677.146616	1472821.289468
17	KAFB-106123	KAFB-106123-025	401591.874644	1472805.169919
		KAFB-106123-050	401591.754641	1472805.439911
		KAFB-106123-150	401591.394633	1472805.419912
		KAFB-106123-250	401591.334631	1472805.109920
		KAFB-106123-350	401591.614638	1472804.929925
		KAFB-106123-450	401591.564637	1472805.319915
18	KAFB-106124	KAFB-106124-025	401951.482979	1472757.341154
		KAFB-106124-050	401951.172971	1472757.361154
		KAFB-106124-150	401951.042968	1472757.101161
		KAFB-106124-250	401951.282974	1472756.901166
		KAFB-106124-350	401951.522980	1472757.031163
		KAFB-106124-450	401951.302974	1472757.261156
19	KAFB-106125	KAFB-106125-025	402026.084695	1472824.439325
		KAFB-106125-050	402025.794688	1472824.509323
		KAFB-106125-150	402025.624684	1472824.279330
		KAFB-106125-250	402025.824689	1472824.009337
		KAFB-106125-350	402026.094695	1472824.099334
		KAFB-106125-450	402025.864690	1472824.369327
20	KAFB-106126	KAFB-106126-025	402081.045980	1472750.941306
		KAFB-106126-050	402081.015979	1472751.231298
		KAFB-106126-150	402080.725972	1472751.321296
		KAFB-106126-250	402080.555968	1472751.081302
		KAFB-106126-350	402080.735973	1472750.781310
		KAFB-106126-450	402080.795974	1472751.161300
21	KAFB-106127	KAFB-106127-025	402018.094530	1472701.832646
		KAFB-106127-050	402017.834524	1472701.972642
		KAFB-106127-150	402017.604519	1472701.792647
		KAFB-106127-250	402017.754522	1472701.472656
		KAFB-106127-350	402018.054529	1472701.512655
		KAFB-106127-450	402017.914526	1472701.832646

Table 2-1. Soil Vapor Monitoring Point Locations and Coordinates
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Easting[1]	Northing
22	KAFB-106128	KAFB-106128-025	401200.655523	1473177.999889
		KAFB-106128-050	401200.545521	1473177.729897
		KAFB-106128-150	401200.765526	1473177.529902
		KAFB-106128-250	401201.025532	1473177.669898
		KAFB-106128-350	401200.965530	1473177.999889
		KAFB-106128-450	401200.045509	1473177.749896
23	KAFB-106129	KAFB-106129-025	401711.597348	1473215.518789
		KAFB-106129-050	401711.877355	1473215.378792
		KAFB-106129-150	401712.097360	1473215.618786
		KAFB-106129-250	401711.977357	1473215.878779
		KAFB-106129-350	401711.687350	1473215.848780
		KAFB-106129-450	401711.817353	1473216.128772
24	KAFB-106130	KAFB-106130-025	401711.947306	1473520.410534
		KAFB-106130-050	401712.157311	1473520.280538
		KAFB-106130-150	401712.427317	1473520.380535
		KAFB-106130-250	401712.377316	1473520.660528
		KAFB-106130-350	401712.107310	1473520.740525
		KAFB-106130-450	401712.057308	1473520.740525
25	KAFB-106131	KAFB-106131-025	401271.447212	1472881.677900
		KAFB-106131-055	401271.667217	1472881.497905
		KAFB-106131-150	401271.567214	1472881.987892
		KAFB-106131-245	401271.937223	1472881.657901
		KAFB-106131-350	401271.837220	1472881.947893
		KAFB-106131-450	401271.047202	1472881.757898
26	KAFB-106132	KAFB-106132-025	402385.372896	1473546.049729
		KAFB-106132-050	402384.882885	1473546.139727
		KAFB-106132-175	402385.202892	1473545.799736
		KAFB-106132-250	402384.892885	1473545.829735
		KAFB-106132-350	402385.152891	1473546.259724
		KAFB-106132-450	402385.072889	1473545.739738
27	KAFB-106133	KAFB-106133-025	401997.193922	1473456.332222
		KAFB-106133-050	401997.113920	1473456.612214
		KAFB-106133-170	401997.353925	1473456.832208
		KAFB-106133-250	401997.593931	1473456.672213
		KAFB-106133-350	401997.543930	1473456.362221
		KAFB-106133-450	401997.063919	1473456.742211
28	KAFB-106134	KAFB-106134-025	401952.322832	1473764.643883
		KAFB-106134-050	401952.042825	1473764.673882
		KAFB-106134-170	401952.432834	1473764.923875
		KAFB-106134-250	401952.232830	1473765.113870
		KAFB-106134-350	401951.932823	1473764.953875
		KAFB-106134-450	401952.282831	1473765.433862

Table 2-1. Soil Vapor Monitoring Point Locations and Coordinates
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Easting[1]	Northing
29	KAFB-106135	KAFB-106135-025	402486.125151	1474023.666783
		KAFB-106135-050	402486.335156	1474023.456789
		KAFB-106135-150	402486.195152	1474023.146797
		KAFB-106135-250	402485.865145	1474023.256795
		KAFB-106135-350	402485.875145	1474023.556786
		KAFB-106135-450	402486.055149	1474023.526787
30	KAFB-106136	KAFB-106136-025	402775.081742	1474634.810194
		KAFB-106136-050	402775.081742	1474634.910191
		KAFB-106136-150	402775.081742	1474635.010188
		KAFB-106136-250	402775.081742	1474635.110186
		KAFB-106136-350	402775.081742	1474635.210183
		KAFB-106136-450	402775.081742	1474635.310180
31	KAFB-106137	KAFB-106137-025	401902.701639	1474032.086651
		KAFB-106137-050	401902.451633	1474032.276646
		KAFB-106137-150	401902.181627	1474032.086652
		KAFB-106137-250	401902.311630	1474031.816659
		KAFB-106137-350	401902.661638	1474031.816659
		KAFB-106137-450	401902.521634	1474034.116597
32	KAFB-106138	KAFB-106138-025	401117.783308	1474960.381655
		KAFB-106138-050	401117.443300	1474960.271658
		KAFB-106138-150	401117.413299	1474959.981666
		KAFB-106138-250	401117.693306	1474959.871669
		KAFB-106138-350	401117.913311	1474960.121662
		KAFB-106138-450	401117.613304	1474960.211660
33	KAFB-106139	KAFB-106139-025	400829.366788	1474004.577574
		KAFB-106139-050	400829.566792	1474004.137586
		KAFB-106139-150	400829.296786	1474004.027589
		KAFB-106139-250	400829.156783	1474004.327581
		KAFB-106139-350	400829.636794	1474004.477577
		KAFB-106139-450	400829.556792	1474004.807568
34	KAFB-106140	KAFB-106140-025	401817.689909	1472587.305780
		KAFB-106140-050	401818.019916	1472587.175784
		KAFB-106140-150	401817.719909	1472587.635771
		KAFB-106140-250	401818.019916	1472587.695770
		KAFB-106140-350	401818.249922	1472587.445776
		KAFB-106140-450	401817.949915	1472587.515774
35	KAFB-106141	KAFB-106141-025	402051.934886	1475298.122360
		KAFB-106141-050	402052.064889	1475298.382353
		KAFB-106141-170	402051.904885	1475298.602347
		KAFB-106141-250	402051.614878	1475298.502350
		KAFB-106141-350	402051.644879	1475298.222357
		KAFB-106141-450	402051.844884	1475298.452351

Table 2-1. Soil Vapor Monitoring Point Locations and Coordinates
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Easting[1]	Northing
36	KAFB-106142	KAFB-106142-030	402036.744600	1474898.733172
		KAFB-106142-050	402036.494594	1474898.863168
		KAFB-106142-170	402036.284589	1474898.643174
		KAFB-106142-250	402036.434593	1474898.363182
		KAFB-106142-350	402036.734600	1474898.453179
		KAFB-106142-450	402036.554596	1474898.703173
37	SVEW-01	SVEW-01	401002.570886	1473477.521813
38	SVEW-02/03	SVEW-02/03-060	401012.021105	1473479.611755
		SVEW-02/03-160	401012.091107	1473478.491785
39	SVEW-04/05	SVEW-04/05-313	400990.430605	1473479.771754
		SVEW-04/05-460	400991.320625	1473479.841752
40	SVEW-06/07	SVEW-06/07-060	400815.436552	1473481.961724
		SVEW-06/07-160	400816.096568	1473481.921725
41	SVEW-08/09	SVEW-08/09-260	400807.566370	1473480.611762
		KAFB-106140-050	401818.019916	1472587.175784
42	SVMW-01	SVMW-01-050	400671.123209	1473489.171553
		SVMW-01-100	400671.443217	1473489.531543
		SVMW-01-250	400671.423216	1473489.171553
		SVMW-01-300	400671.163210	1473489.621541
43	SVMW-02	SVMW-02-050	400993.070644	1473610.618212
		SVMW-02-100	400993.170647	1473610.478215
		SVMW-02-150	400993.220648	1473610.748208
44	SVMW-03	SVMW-03-050	401099.413133	1473452.122485
		SVMW-03-100	401099.553136	1473452.472475
		SVMW-03-250	401099.743141	1473452.272481
		SVMW-03-300	401099.633138	1473451.992488
45	SVMW-04	SVMW-04-050	400855.887502	1473403.243849
		SVMW-04-100	400855.527494	1473403.383845
		SVMW-04-250	400855.527494	1473403.113852
		SVMW-04-300	400855.697498	1473402.813860
46	SVMW-05	SVMW-05-050	400597.061500	1473453.092542
		SVMW-05-100	400596.771493	1473453.362535
		SVMW-05-230	400597.201503	1473453.422533
		SVMW-05-290	400596.971498	1473453.502531
47	SVMW-06	SVMW-06-050	401383.549711	1473462.182165
		SVMW-06-100	401384.009722	1473462.052169
		SVMW-06-252	401383.769716	1473462.402159
		SVMW-06-302	401383.689714	1473461.872174
48	SVMW-07	SVMW-07-050	401074.372504	1473745.824538
		SVMW-07-100	401074.072497	1473745.944535
		SVMW-07-150	401074.272502	1473746.164529

Table 2-1. Soil Vapor Monitoring Point Locations and Coordinates
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Concluded)

Location Number	SVM Location ID	SVMP ID	Easting[1]	Northing
49	SVMW-08	SVMW-08-050	400855.727481	1473509.800964
		SVMW-08-100	400855.777482	1473510.000958
		SVMW-08-250	400855.807482	1473509.770965
50	SVMW-09	SVMW-09-050	400903.768595	1473499.001248
		SVMW-09-100	400903.668593	1473498.981249
		SVMW-09-250	400903.458588	1473499.251241
		SVMW-09-266	400903.188581	1473499.171244
51	SVMW-10	SVMW-10-050	400952.179718	1473488.861515
		SVMW-10-100	400952.159717	1473489.341502
		SVMW-10-150	400952.479724	1473489.071509
		SVMW-10-250	400952.069715	1473488.961512
52	SVMW-11	SVMW-11-050	400992.780668	1473428.233149
		SVMW-11-100	400992.940671	1473428.593139
		SVMW-11-250	400992.410659	1473428.593140
		SVMW-11-260	400992.560663	1473428.813134
53	SVMW-12/ SVEW-10	SVMW-12-150	400424.977477	1473683.186342
		SVMW-12-250	400425.217482	1473683.336338
		SVMW-12-350	400424.887475	1473683.766326
		SVMW-12-450	400424.627469	1473683.536333
		SVEW-10	400424.857474	1473685.086291
54	SVMW-13/ SVEW-11	SVMW-13-150	401572.894069	1473624.437741
		SVMW-13-250	401572.554061	1473624.437741
		SVMW-13-350	401572.634063	1473624.217747
		SVMW-13-450	401572.754066	1473623.977754
		SVEW-11	401572.134051	1473626.047698
55	SVMW-14/ SVEW-12	SVMW-14-150	400544.990358	1473074.172810
		SVMW-14-250	400544.730352	1473074.292806
		SVMW-14-350	400544.780353	1473073.942816
		SVMW-14-450	400545.220363	1473073.932816
		SVEW-12	400545.010358	1473076.332751
56	SVMW-15/ SVEW-13	SVMW-15-150	401560.833833	1473362.634831
		SVMW-15-250	401561.343845	1473362.704829
		SVMW-15-350	401561.013837	1473362.434836
		SVMW-15-450	401561.013837	1473362.994821
		SVEW-13	401560.863833	1473364.984767

[1] Well coordinates are provided in New Mexico State Plane (NAD27).

Table 2-2. Drinking Water Supply Well Names and Coordinates
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Well Location Name	Easting	Northing
ST106-VA2	400544.79	1474576.3
KAFB-3	406572.7	1479061.58
KAFB-15	399113.43	1474381.13
KAFB-16	404456.63	1474118.74

3 TASKS AND ACTIVITIES

This section presents the activities that will be performed under this project. Major divisions include mobilization/demobilization, quarterly soil vapor sampling and analysis, and monthly production well sampling and analysis. This section also describes soil vapor monitoring well installation and abandonment, equipment decontamination, use of personal protective equipment (PPE) and photoionization detector (PID), field quality control and sample packaging and shipping.

3.1 Mobilization/Demobilization

A secure, fenced equipment yard has been established for both equipment and materials for sampling activities both on and off KAFB for this project. A portable office trailer with electrical power has been established inside the secured equipment yard proximal to the BFF at KAFB.

3.2 Soil Vapor Sampling

Sundance will perform quarterly sampling of the existing 284 SVMP network described in section 2.3. All field personnel collecting soil vapor samples are required to be trained and fully understand the sampling procedure outlined in this document. Any and all questions will be addressed prior to the start of sampling via a field sampling orientation led by the Sundance Technical Lead. During the first quarter CY 2016 sampling performed by Sundance, the condition of each well port will be examined by the field personnel to confirm the integrity of each fitting and to immediately address and mitigate any problems or replace any defective parts. The well integrity inspection form can be found in Appendix A, Field Forms.

3.2.1 Pre-Sampling Steps

3.2.1.1 Horiba Model MEXA 584L Calibration

During sampling of each soil vapor well, field parameters including total hydrocarbons (HC), oxygen (O_2), and carbon dioxide (CO_2) will be measured using a Horiba Mexa 584L auto emissions analyzer (Horiba). This instrument will be calibrated daily prior to the start of sampling activities.

The Horiba is sold as an engine exhaust monitoring instrument, and the measurement of field parameters during soil vapor monitoring is not the manufacturer's intended purpose. However, while not the intended use of the instrument, the Horiba's sampling ability and the non-dispersive infrared detector and chemical cell detector make it an appropriate instrument for total soil vapor HC, CO_2, and O_2 analyses.

The Horiba manufacturer's calibration procedure, which was developed for engine exhaust monitoring, has been modified to better calibrate the instrument for measuring soil vapor petroleum HC, O_2 and CO_2 concentrations. The modified calibration method includes a more representative calibration gas, more frequent calibration than specified by the manufacturer, frequent calibration checks (HC, O_2 and CO_2) during daily Horiba usage, and real-time data analysis to look for indicators of potential calibration deviations.

At the beginning of every work day (and if deemed necessary during the day), the Horiba will be calibrated for air-phase petroleum HC and CO_2 against a calibration standard of known concentrations in a premixed gas cylinder. The Horiba will also be calibrated for O_2 against atmospheric concentrations. The same calibration gas cylinder will be used to calibrate every Horiba instrument and the same person will complete calibration each day to ensure consistent calibrations. The calibration gas consists of 1,600 parts per million by volume (ppmv) propane, 13.0% (percent) CO_2, and the remaining volume will consist of nitrogen. This calibration gas mixture was selected to accurately calibrate the Horiba for the gases that

are present in the vadose zone during soil vapor sampling and respiration/rebound testing, specifically, CO_2 and HC (calibrated as propane).

The instrument will be calibrated by applying the pre-mixed gas into the calibration port located on top of the instrument. The calibration steps listed in the Horiba manual for applying the calibration gas and the sequence of key strokes listed will be followed to complete calibration. After calibration, HC and CO_2 concentrations should be within 5% of the known calibration gas values.

The Horiba Instruction Manual goes through the calibration of each compound. During the calibration of HC, the Horiba will display three numbers as shown in the Horiba Instruction Manual. The top number is the known value of the calibration gas (propane at 1,600 ppmv). The middle number will be constant for a particular instrument, but will vary from instrument to instrument; this number is the factory calibration setting for that instrument that corresponds to the input value of the calibration gas. The bottom number will change as the calibration gas is applied and read by the instrument. Both the middle and bottom numbers are reporting the gas as hexane rather than propane; hexane is the standard for HC for the Horiba instrument. The conversion between hexane and propane for the Horiba is approximately one half the concentration. Thus, a reading of 800 ppmv reported as hexane by the detector is the equivalent of 1,600 ppmv as propane. Once the gas is applied, the bottom HC number on the display should read within 5% of the middle number. A value of approximately 800 ppmv HC is expected after the Horiba instrument is calibrated.

After calibration is confirmed, the same calibration gas will be used to fill a 3 liter Tedlar® gas sampling bag. The customized sampling system (Figure 3-1) will be used to complete the calibration as follows:

Step 1. Disconnect all quick connect pneumatic fittings from sampling system with the exception of the hose. This ensures the system is sealed from all points except through the hose.

Step 2. Visually check that the red drain separator O-ring (approximately 2-inches in diameter) is visible at the opening of the sample inlet port, which is located on the front of the Horiba and to the right of the screen display. Insert the male pneumatic fitting on the end of the Horiba sampling tube to the female quick connect on the sampling system and ensure a secure fit.

Step 3. Ensure that the sampling system is purged according to the steps listed below under Section 3.2.1.2 - Cross Contamination Purging for Sampling System.

Step 4. Once within the given values, attach the Tedlar® bag to the male pneumatic fitting at the end of the braided stainless steel tubing.

Step 5. Open the Tedlar® bag valve to allow the calibration gas to be pulled through the sampling system.

Step 6. Record the instrument read-outs when the instrument has stabilized and compare the results to the calibration gas concentrations.

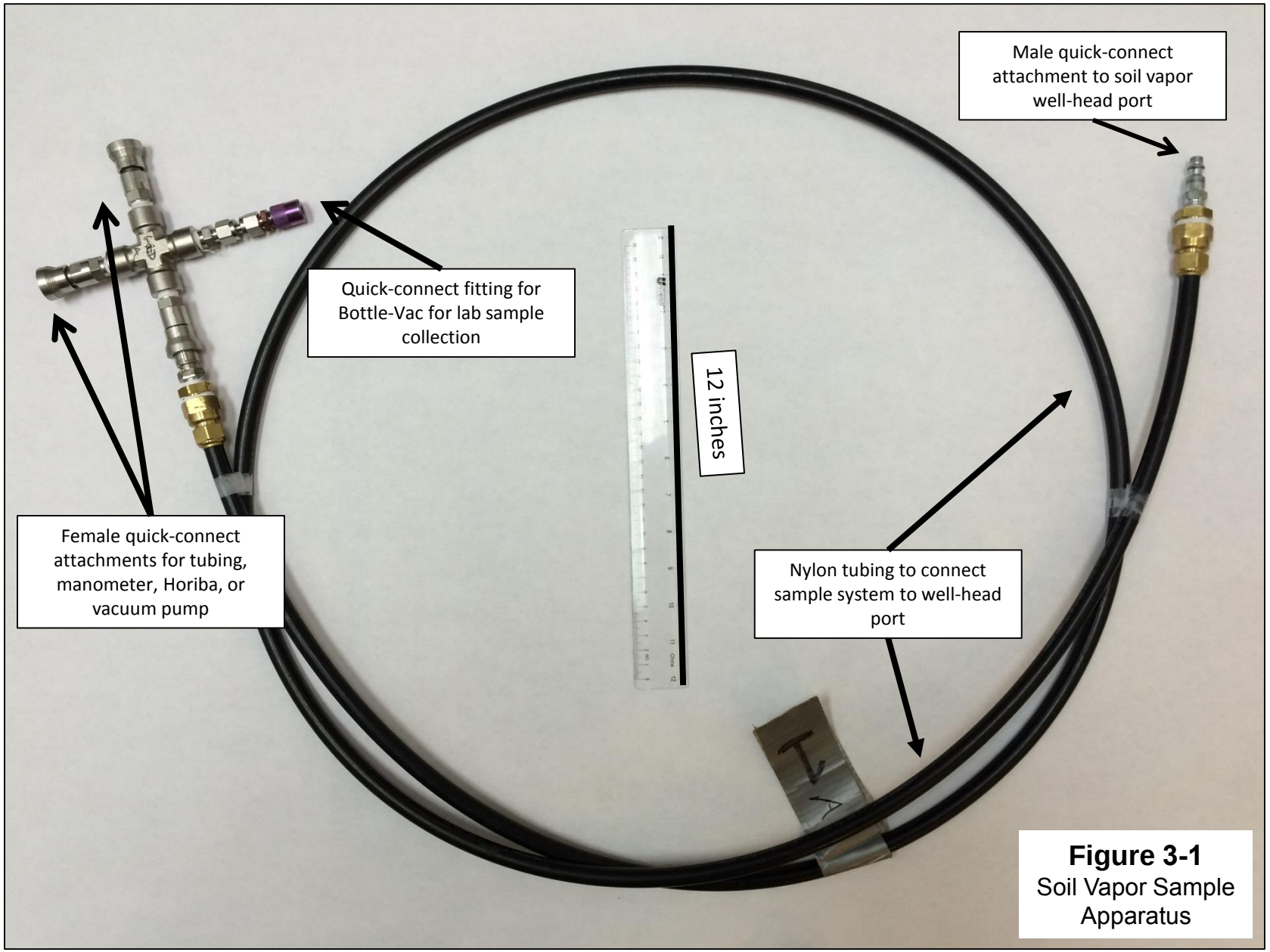


Figure 3-1
Soil Vapor Sample Apparatus

If the values for HC, O_2 and CO_2 are within 5% of the calibration values made using the calibration port, the calibration process is complete. As stated previously, the Horiba read-outs for HC are reported as hexane. A value of approximately 800 ppmv HC is expected. All other gas composition values should match the calibration gas values. If values are outside of this range, perform a leak check as described in Section 3.2.1.3 and follow the calibration process again.

If at any point during sampling, a reading for HC, O_2 or CO_2 reaches an unreasonable value (e.g., an O_2 concentration greater than 22%) or if a data value falls outside the trend indicated by previous readings at a given SVMP, a calibration check will be triggered. The expected range of values are: for HC - from 0 to 40,000 ppmv, for percent O_2 from 0 % to 22%, and for percent CO_2 from 0% to 15%. If any readings are outside of these ranges, a calibration check must be made and if necessary, the instrument will be recalibrated.

3.2.1.2 Cross Contamination Purging for Sampling System

The sampling system must be purged with ambient air before being attached to a SVMP sample port to minimize the potential for cross contamination between sample collections. To ensure the entire sample train is thoroughly purged, attach the pump to the setup and flush atmospheric air through the quick connect port and the nylon tubing. All quick connect pneumatic fittings are to be opened during this process by placing a male fitting into the female fitting to allow for flow. Monitor the purging effectiveness using the Horiba to ensure no contaminants are still present and only ambient air is being read. Correct values for ambient air must be less than 5 ppmv HC, between 20% to 22% for percent O_2, and 0% for percent CO_2. Complete instrument purging must be performed after sampling each SVMP.

3.2.1.3 Leak Check of Sample System

At the beginning of each day, the sampling system will be leak checked by using the pump to apply vacuum to the sampling system as follows:

Step 1. Cap the male pneumatic fitting on the end of the nylon tubing with a spare female quick disconnect fitted to a vacuum/pressure gauge.

Step 2. Connect the SVMP purging/sampling pump to one of the quick disconnect fittings on the sample system and evacuate the air from the sample system to establish a vacuum.

Step 3. Disconnect the pump and immediately record the vacuum reading from the pressure/vacuum gauge.

Step 4. After 10 minutes have elapsed, check and record the vacuum reading on the gauge.

Step 5. Verify that the starting and ending vacuum readings are within 10% to ensure that the sampling system is not leaking.

Step 6. If the two vacuum readings are not within 10% of each other, check the conditions of the seals and repeat the leak test until the sampling system is confirmed to be air tight.

3.2.2 Soil Vapor Sampling Procedures

3.2.2.1 Sample Train Setup

The Horiba analyzer must be turned on, warmed up, and calibrated according to the steps stated above and then attached to the sampling system. The Horiba analyzer is turned on for the first time at the

beginning of the day and remains in the on position throughout the day. The Horiba analyzer is plugged into the 12V DC outlet in the project vehicle using an AC inverter. All other equipment is gas powered or will be powered by generator, and can be powered off between sampling at each well. The pump is attached and sealed to the setup by a quick connect fitting. It is important that no pneumatic fittings besides the tubing to the soil vapor well port are attached prior to turning on the pump.

3.2.2.2 Static Pressure Measurement

Before taking the static pressure reading, the manometer instrument must be zeroed to atmospheric pressure. The screen should read 0.00 inches of water column (in WC). After confirming that the manometer is zeroed, the following procedure is used to connect the sampling system to the SVMPs and measure the static (also called baseline) pressure, to assure readiness for purging and sampling:

Step 1. Connect the manometer to the quick connect on the side of the sampling system opposite of the Bottle-Vac™ sample collection port (see Figure 3-1).

Step 2. Verify that the manometer reads 0.00 in WC.

Step 3. Insert the male quick connect fitting on the end of the nylon tubing to the female quick disconnect fitting on the top of the SVMP and ensure a secure connection.

Step 4. Monitor the change in manometer readings over time and record the pressure/vacuum reading when the meter stabilizes.

Note: Static pressure readings have typically ranged from +2.00 in (pressure) to -12.00 in WC (vacuum) at each soil vapor well port.

3.2.2.3 Well Purging

Stagnant soil vapor is purged from the SVMP as follows:

Step 1. Tum on the SVMP sampling pump, verify the operation of the flow rotameter, and check for potential leaks as necessary.

Step 2. Consult the Purge Table (Table 3-1) for the initial purge volume.

Step 3. Connect the female quick disconnect on the terminal end of the sampling system to the male quick connect on the vacuum side of the soil vapor monitoring sampling pump and start timing the purge cycle. (Note: Use the flow rate on the rotameter and the pre-calculated purge volume to quickly calculate the purge time. The purge time is determined by the well port diameter, well depth, and rate of the pump; all of which are known before sampling with the exception of the flowrate. The amount of vapor needed to be removed is based on one well casing volume.)

Step 4. After adequately purging for the appropriate time, quickly disconnect the sampling system from the vacuum pump. (Note: The sampling system is to remain connected to the SVMP for the duration of sampling.)

Step 5. Allow the manometer reading to return to within 0.10 in. WC of the static pressure reading before moving to the next step in the sampling procedure.

3.2.2.4 Horiba Readings

Once the SVMP has been purged, the following procedure is used to take and record HC, O_2 and CO_2 measurements using the calibrated Horiba:

Step l. Ensure that the Horiba is turned on and functioning properly.

Step 2. Record the manometer reading.

Step 3. Insert the male quick connect fitting into the female quick connect fitting on the terminal side of the sampling system and ensure a tight connection.

Step 4. Observe the Horiba O_2 reading for stability or for a maximum of one minute, whichever comes first.

Step 5. Record the O_2, CO_2, and HC readings and quickly disconnect the Horiba. Photograph the Horiba reading for quality control (QC) reference. Include the well number in the picture.

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
1	KAFB-106028	KAFB-106028-150	148.75	151.25	0.50	0.00136	0.409	0.615
		KAFB-106028-250	248.75	251.25	0.50	0.00136	0.409	0.752
		KAFB-106028-350	348.75	351.25	0.50	0.00136	0.409	0.888
		KAFB-106028-450	448.75	451.25	0.50	0.00136	0.409	1.024
2	KAFB-106108	KAFB-106108-025	15.30	25.30	0.75	0.00307	1.636	1.714
		KAFB-106108-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106108-150	140.20	150.20	0.75	0.00307	1.636	2.097
		KAFB-106108-250	240.30	250.30	0.75	0.00307	1.636	2.404
		KAFB-106108-350	340.30	350.30	0.75	0.00307	1.636	2.711
		KAFB-106108-450	440.00	450.00	3.00	0.04909	1.636	23.725
3	KAFB-106109	KAFB-106109-025	15.20	25.20	0.75	0.00307	1.636	1.713
		KAFB-106109-050	40.10	50.10	0.75	0.00307	1.636	1.790
		KAFB-106109-150	140.00	150.00	0.75	0.00307	1.636	2.096

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
		KAFB-106109-250	240.20	250.20	0.75	0.00307	1.636	2.404
		KAFB-106109-350	340.60	350.60	0.75	0.00307	1.636	2.712
		KAFB-106109-450	440.00	450.00	3.00	0.04909	1.636	23.725
4	KAFB-106110	KAFB-106110-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106110-050	40.10	50.10	0.75	0.00307	1.636	1.790
		KAFB-106110-150	140.30	150.30	0.75	0.00307	1.636	2.097
		KAFB-106110-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106110-350	340.20	350.20	0.75	0.00307	1.636	2.710
		KAFB-106110-450	440.00	450.00	3.00	0.04909	1.636	23.725
5	KAFB-106111	KAFB-106111-025	15.20	25.20	0.75	0.00307	1.636	1.713
		KAFB-106111-050	40.10	50.10	0.75	0.00307	1.636	1.790
		KAFB-106111-150	140.30	150.30	0.75	0.00307	1.636	2.097
		KAFB-106111-250	240.30	250.30	0.75	0.00307	1.636	2.404
		KAFB-106111-350	340.40	350.40	0.75	0.00307	1.636	2.711
		KAFB-106111-450	440.30	450.30	3.00	0.04909	1.636	23.740

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
6	KAFB-106112	KAFB-106112-025	15.00	25.00	0.75	0.00307	1.636	1.713
		4KAFB-1506112-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106112-150	140.00	150.00	0.75	0.00307	1.636	2.096
		KAFB-106112-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106112-350	339.00	349.00	0.75	0.00307	1.636	2.707
		KAFB-106112-450	439.00	449.00	3.00	0.04909	1.636	23.676
7	KAFB-106113	KAFB-106113-020	10.00	20.00	0.75	0.00307	1.636	1.697
		KAFB-106113-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106113-150	140.00	150.00	0.75	0.00307	1.636	2.096
		KAFB-106113-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106113-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106113-450	440.00	450.00	3.00	0.04909	1.636	23.725
8	KAFB-106114	KAFB-106114-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106114-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106114-150	140.00	150.00	0.75	0.00307	1.636	2.096

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
		KAFB-106114-250	235.00	245.00	0.75	0.00307	1.636	2.388
		KAFB-106114-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106114-450	439.60	449.60	3.00	0.04909	1.636	23.706
9	KAFB-106115	KAFB-106115-025	14.60	24.60	0.75	0.00307	1.636	1.711
		KAFB-106115-050	39.60	49.60	0.75	0.00307	1.636	1.788
		KAFB-106115-150	144.60	154.60	0.75	0.00307	1.636	2.110
		KAFB-106115-250	239.60	249.60	0.75	0.00307	1.636	2.402
		KAFB-106115-350	339.60	349.60	0.75	0.00307	1.636	2.709
		KAFB-106115-450	439.60	449.60	3.00	0.04909	1.636	23.706
10	KAFB-106116	KAFB-106116-025	10.00	19.45	0.75	0.00307	1.546	1.606
		KAFB-106116-050	40.00	49.45	0.75	0.00307	1.546	1.698
		KAFB-106116-150	140.00	149.45	0.75	0.00307	1.546	2.005
		KAFB-106116-250	240.00	249.45	0.75	0.00307	1.546	2.311
		KAFB-106116-350	340.00	349.45	0.75	0.00307	1.546	2.618
		KAFB-106116-450	440.00	448.95	3.00	0.04909	1.464	23.502

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
11	KAFB-106117	KAFB-106117-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106117-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106117-150	140.00	150.00	0.75	0.00307	1.636	2.096
		KAFB-106117-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106117-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106117-450	440.00	450.00	3.00	0.04909	1.636	23.725
12	KAFB-106118	KAFB-106118-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106118-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106118-160	150.00	160.00	0.75	0.00307	1.636	2.127
		KAFB-106118-265	255.00	265.00	0.75	0.00307	1.636	2.449
		KAFB-106118-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106118-450	440.00	450.00	3.00	0.04909	1.636	23.725
13	KAFB-106119	KAFB-106119-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106119-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106119-150	140.00	150.00	0.75	0.00307	1.636	2.096

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
		KAFB-106119-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106119-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106119-450	440.00	450.00	3.00	0.04909	1.636	23.725
14	KAFB-106120	KAFB-106120-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106120-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106120-150	140.00	150.00	0.75	0.00307	1.636	2.096
		KAFB-106120-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106120-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106120-450	434.00	444.00	3.00	0.04909	1.636	23.431
15	KAFB-106121	KAFB-106121-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106121-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106121-145	135.00	145.00	0.75	0.00307	1.636	2.081
		KAFB-106121-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106121-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106121-440	434.00	444.00	3.00	0.04909	1.636	23.431

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
16	KAFB-106122	KAFB-106122-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106122-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106122-150	140.00	150.00	0.75	0.00307	1.636	2.096
		KAFB-106122-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106122-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106122-450	434.00	444.00	3.00	0.04909	1.636	23.431
17	KAFB-106123	KAFB-106123-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106123-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106123-150	140.00	150.00	0.75	0.00307	1.636	2.096
		KAFB-106123-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106123-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106123-450	432.00	442.00	3.00	0.04909	1.636	23.333
18	KAFB-106124	KAFB-106124-025	15.10	25.00	0.75	0.00307	1.620	1.696
		KAFB-106124-050	40.10	50.00	0.75	0.00307	1.620	1.773
		KAFB-106124-150	140.10	150.00	0.75	0.00307	1.620	2.080

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
		KAFB-106124-250	240.10	250.00	0.75	0.00307	1.620	2.387
		KAFB-106124-350	340.10	350.00	0.75	0.00307	1.620	2.693
		KAFB-106124-450	440.10	450.00	3.00	0.04909	1.620	23.709
19	KAFB-106125	KAFB-106125-025	15.20	25.00	0.75	0.00307	1.603	1.680
		KAFB-106125-050	40.20	50.00	0.75	0.00307	1.603	1.757
		KAFB-106125-150	140.20	150.00	0.75	0.00307	1.603	2.063
		KAFB-106125-250	240.20	250.00	0.75	0.00307	1.603	2.370
		KAFB-106125-350	340.20	350.00	0.75	0.00307	1.603	2.677
		KAFB-106125-450	440.20	450.00	3.00	0.04909	1.603	23.693
20	KAFB-106126	KAFB-106126-025	15.10	25.00	0.75	0.00307	1.620	1.696
		KAFB-106126-050	40.10	50.00	0.75	0.00307	1.620	1.773
		KAFB-106126-150	140.10	150.00	0.75	0.00307	1.620	2.080
		KAFB-106126-250	240.10	250.00	0.75	0.00307	1.620	2.387
		KAFB-106126-350	340.10	350.00	0.75	0.00307	1.620	2.693
		KAFB-106126-450	440.20	450.00	3.00	0.04909	1.603	23.693

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
21	KAFB-106127	KAFB-106127-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106127-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106127-150	140.00	150.00	0.75	0.00307	1.636	2.096
		KAFB-106127-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106127-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106127-450	440.00	450.00	3.00	0.04909	1.636	23.725
22	KAFB-106128	KAFB-106128-025	15.04	25.04	0.75	0.00307	1.636	1.713
		KAFB-106128-050	40.07	50.07	0.75	0.00307	1.636	1.790
		KAFB-106128-150	140.19	150.19	0.75	0.00307	1.636	2.097
		KAFB-106128-250	240.29	250.29	0.75	0.00307	1.636	2.404
		KAFB-106128-350	340.39	350.39	0.75	0.00307	1.636	2.711
		KAFB-106128-450	440.06	450.06	3.00	0.04909	1.636	23.728
23	KAFB-106129	KAFB-106129-025	15.10	25.10	0.75	0.00307	1.636	1.713
		KAFB-106129-050	39.70	49.70	0.75	0.00307	1.636	1.788
		KAFB-106129-150	140.20	150.20	0.75	0.00307	1.636	2.097

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
		KAFB-106129-250	240.10	250.10	0.75	0.00307	1.636	2.403
		KAFB-106129-350	337.40	347.40	0.75	0.00307	1.636	2.702
		KAFB-106129-450	440.70	450.70	3.00	0.04909	1.636	23.760
24	KAFB-106130	KAFB-106130-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106130-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106130-150	150.00	160.00	0.75	0.00307	1.636	2.127
		KAFB-106130-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106130-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106130-450	440.00	450.00	3.00	0.04909	1.636	23.725
25	KAFB-106131	KAFB-106131-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106131-055	45.00	55.00	0.75	0.00307	1.636	1.805
		KAFB-106131-150	140.00	150.00	0.75	0.00307	1.636	2.096
		KAFB-106131-245	235.00	245.00	0.75	0.00307	1.636	2.388
		KAFB-106131-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106131-450	430.00	440.00	3.00	0.04909	1.636	23.234

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
26	KAFB-106132	KAFB-106132-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106132-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106132-175	164.00	174.00	0.75	0.00307	1.636	2.170
		KAFB-106132-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106132-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106132-450	440.00	450.00	3.00	0.04909	1.636	23.725
27	KAFB-106133	KAFB-106133-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106133-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106133-170	160.00	170.00	0.75	0.00307	1.636	2.158
		KAFB-106133-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106133-350	339.00	349.00	0.75	0.00307	1.636	2.707
		KAFB-106133-450	439.00	449.00	3.00	0.04909	1.636	23.676
28	KAFB-106134	KAFB-106134-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106134-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106134-170	160.00	170.00	0.75	0.00307	1.636	2.158

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
		KAFB-106134-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106134-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106134-450	440.00	450.00	3.00	0.04909	1.636	23.725
29	KAFB-106135	KAFB-106135-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106135-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106135-150	140.00	150.00	0.75	0.00307	1.636	2.096
		KAFB-106135-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106135-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106135-450	440.00	450.00	3.00	0.04909	1.636	23.725
30	KAFB-106136	KAFB-106136-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106136-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106136-150	140.00	150.00	0.75	0.00307	1.636	2.096
		KAFB-106136-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106136-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106136-450	440.00	450.00	3.00	0.04909	1.636	23.725

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
31	KAFB-106137	KAFB-106137-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106137-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106137-150	140.00	150.00	0.75	0.00307	1.636	2.096
		KAFB-106137-250	240.10	250.10	0.75	0.00307	1.636	2.403
		KAFB-106137-350	340.50	350.50	0.75	0.00307	1.636	2.711
		KAFB-106137-450	440.00	450.00	3.00	0.04909	1.636	23.725
32	KAFB-106138	KAFB-106138-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106138-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106138-150	140.00	150.00	0.75	0.00307	1.636	2.096
		KAFB-106138-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106138-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106138-450	440.00	450.00	3.00	0.04909	1.636	23.725
33	KAFB-106139	KAFB-106139-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106139-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106139-150	140.00	150.00	0.75	0.00307	1.636	2.096

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
		KAFB-106139-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106139-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106139-450	440.00	450.00	3.00	0.04909	1.636	23.725
34	KAFB-106140	KAFB-106140-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106140-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106140-150	141.80	151.80	0.75	0.00307	1.636	2.102
		KAFB-106140-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106140-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106140-450	440.00	450.00	3.00	0.04909	1.636	23.725
35	KAFB-106141	KAFB-106141-025	15.00	25.00	0.75	0.00307	1.636	1.713
		KAFB-106141-050	50.00	60.00	0.75	0.00307	1.636	1.820
		KAFB-106141-170	160.00	170.00	0.75	0.00307	1.636	2.158
		KAFB-106141-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106141-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106141-450	440.00	450.00	3.00	0.04909	1.636	23.725

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
36	KAFB-106142	KAFB-106142-030	20.00	30.00	0.75	0.00307	1.636	1.728
		KAFB-106142-050	40.00	50.00	0.75	0.00307	1.636	1.789
		KAFB-106142-170	160.00	170.00	0.75	0.00307	1.636	2.158
		KAFB-106142-250	240.00	250.00	0.75	0.00307	1.636	2.403
		KAFB-106142-350	340.00	350.00	0.75	0.00307	1.636	2.710
		KAFB-106142-450	440.00	450.00	3.00	0.04909	1.636	23.725
37	SVEW-01	SVEW-01-260	245.00	260.00	2.00	0.02182	2.454	8.126
38	SVEW-02/03	SVEW-02-060	45.00	60.00	2.00	0.02182	2.454	3.763
		SVEW-03-160	145.00	160.00	2.00	0.02182	2.454	5.945
39	SVEW-04/05	SVEW-04-313	298.00	313.00	2.00	0.02182	2.454	9.283
		SVEW-05-460	445.00	460.00	2.00	0.02182	2.454	12.490
40	SVEW-06/07	SVEW-06-060	45.00	60.00	2.00	0.02182	2.454	3.763
		SVEW-07-160	145.00	160.00	2.00	0.02182	2.454	5.945
41	SVEW-08/09	SVEW-08-260	245.00	260.00	2.00	0.02182	2.454	8.126
		SVEW-09-460	443.00	457.00	2.00	0.02182	2.290	12.261
42	SVMW-01	SVMW-01-050	50.00	52.50	0.50	0.00136	0.409	0.481
		SVMW-01-100	100.00	102.50	0.50	0.00136	0.409	0.549
		SVMW-01-250	250.70	253.20	0.50	0.00136	0.409	0.754
		SVMW-01-300	308.50	310.00	0.50	0.00136	0.245	0.668
43	SVMW-02	SVMW-02-050	50.00	52.50	0.50	0.00136	0.409	0.481
		SVMW-02-100	97.00	99.50	0.50	0.00136	0.409	0.545
		SVMW-02-150	150.00	152.50	0.50	0.00136	0.409	0.617
44	SVMW-03	SVMW-03-050	50.00	52.50	0.50	0.00136	0.409	0.481
		SVMW-03-100	100.00	102.50	0.50	0.00136	0.409	0.549
		SVMW-03-250	250.00	252.50	0.50	0.00136	0.409	0.753

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
		SVMW-03-300	300.00	302.50	0.50	0.00136	0.409	0.821
45	SVMW-04	SVMW-04-050	50.00	52.50	0.50	0.00136	0.409	0.481
		SVMW-04-100	98.00	100.50	0.50	0.00136	0.409	0.546
		SVMW-04-250	250.00	252.50	0.50	0.00136	0.409	0.753
		SVMW-04-300	297.50	300.00	0.50	0.00136	0.409	0.818
46	SVMW-05	SVMW-05-050	50.00	52.50	0.50	0.00136	0.409	0.481
		SVMW-05-100	100.00	102.50	0.50	0.00136	0.409	0.549
		SVMW-05-230	229.50	231.00	0.50	0.00136	0.245	0.560
		SVMW-05-290	287.50	290.00	0.50	0.00136	0.409	0.804
47	SVMW-06	SVMW-06-050	50.00	52.50	0.50	0.00136	0.409	0.481
		SVMW-06-100	99.50	102.00	0.50	0.00136	0.409	0.548
		SVMW-06-252	252.00	254.50	0.50	0.00136	0.409	0.756
		SVMW-06-302	302.50	305.00	0.50	0.00136	0.409	0.825
48	SVMW-07	SVMW-07-050	49.50	52.00	0.50	0.00136	0.409	0.480
		SVMW-07-100	95.50	98.00	0.50	0.00136	0.409	0.543
		SVMW-07-150	147.50	150.00	0.50	0.00136	0.409	0.614
49	SVMW-08[2]	SVMW-08-050	50.00	52.50	0.50	0.00136	0.409	0.481
		SVMW-08-100	100.00	102.50	0.50	0.00136	0.409	0.549
		SVMW-08-250	250.00	252.50	0.50	0.00136	0.409	0.753
50	SVMW-09	SVMW-09-050	50.00	52.50	0.50	0.00136	0.409	0.481
		SVMW-09-100	100.00	102.50	0.50	0.00136	0.409	0.549
		SVMW-09-250	250.00	252.50	0.50	0.00136	0.409	0.753
		SVMW-09-266	266.00	268.50	0.50	0.00136	0.409	0.775
51	SVMW-10	SVMW-10-050	50.00	52.50	0.50	0.00136	0.409	0.481
		SVMW-10-100	100.00	102.50	0.50	0.00136	0.409	0.549
		SVMW-10-150	150.00	152.50	0.50	0.00136	0.409	0.617
		SVMW-10-250	250.00	252.50	0.50	0.00136	0.409	0.753

Table 3-1. Soil Vapor Monitoring Point Construction Parameters and Pre-Calculated Purge Volumes
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Concluded)

Location Number	SVM Location ID	SVMP ID	Screened Interval (ft)		Well Diameter (in)	Casing Area (sq ft)	Filter Pack Volume (cu ft)[1]	Purge Volume (cu ft)
			Top	Bottom				
52	SVMW-11	SVMW-11-050	50.00	52.50	0.50	0.00136	0.409	0.481
		SVMW-11-100	100.00	102.50	0.50	0.00136	0.409	0.549
		SVMW-11-250	250.00	252.50	0.50	0.00136	0.409	0.753
		SVMW-11-260	260.00	262.50	0.50	0.00136	0.409	0.767
53	SVMW-12/ SVEW-10	SVMW-12-150	150.00	152.50	0.50	0.00136	0.409	0.617
		SVMW-12-250	250.00	252.50	0.50	0.00136	0.409	0.753
		SVMW-12-350	350.00	352.50	0.50	0.00136	0.409	0.890
		SVMW-12-450	450.00	452.50	0.50	0.00136	0.409	1.026
		SVEW-10-410	400.00	410.00	2.00	0.02182	1.636	10.581
54	SVMW-13/ SVEW-11	SVMW-13-150	150.00	152.50	0.50	0.00136	0.409	0.617
		SVMW-13-250	250.00	252.50	0.50	0.00136	0.409	0.753
		SVMW-13-350	350.00	352.50	0.50	0.00136	0.409	0.890
		SVMW-13-450	450.00	452.50	0.50	0.00136	0.409	1.026
		SVEW-11-410	400.00	410.00	2.00	0.02182	1.636	10.581
55	SVMW-14/ SVEW-12	SVMW-14-150	150.00	152.50	0.50	0.00136	0.409	0.617
		SVMW-14-250	250.00	252.50	0.50	0.00136	0.409	0.753
		SVMW-14-350	350.00	352.50	0.50	0.00136	0.409	0.890
		SVMW-14-450	450.00	452.50	0.50	0.00136	0.409	1.026
		SVEW-12-410	400.00	410.00	2.00	0.02182	1.636	10.581
56	SVMW-15/ SVEW-13	SVMW-15-150	150.00	152.50	0.50	0.00136	0.409	0.617
		SVMW-15-250	250.00	252.50	0.50	0.00136	0.409	0.753
		SVMW-15-350	350.00	352.50	0.50	0.00136	0.409	0.890
		SVMW-15-450	450.00	452.50	0.50	0.00136	0.409	1.026
		SVEW-13-410	400.00	410.00	2.00	0.02182	1.636	10.581

[1]borehole casing factor = (((10 inch diameter/12 inches)^2)(3.14159/4))(0.3 porosity)= 0.1636

[2]SVMW-08-266 is clogged and cannot be sampled

3.2.2.5 Bottle-Vac™ Sampling

The following procedure will be used when collecting Bottle-Vac™ samples for laboratory analyses:

Step 1. Check the vacuum in a Bottle-Vac™ prior to sampling by taking a vacuum reading using a lab-supplied vacuum gauge. The gauge is connected to the bottle through a quick connect set in the same way that the bottle is connected to the sampling system. (Note: Bottles are required to be within 10% of -26 inches of mercury (in Hg) of vacuum. If a lower vacuum is measured, do not use the Bottle-Vac™ for sample collection.)

Step 2. With the nylon tubing still connected to the well port, record the static pressure indicated on the manometer read-out.

Step 3. Connect the Bottle-Vac™ to the specialized female pneumatic connection on the sample system (see Figure 3-1).

Step 4. Disconnect the Bottle-Vac™ after two minutes or once the manometer reading returns to static pressure, whichever comes first.

Step 5. Check the vacuum in the Bottle-Vac™ after removing from the sampling system. (Note: The vacuum should read no higher than 0.10 in Hg of vacuum. If there is still a positive vacuum reading, re-attach the Bottle- Vac™ to the sampling system for two additional minutes before checking the pressure once more; repeat as necessary.)

Bottle-Vacs will be shipped weekly to ALS Environmental Laboratories (ALS) in Simi Valley California, where they will be analyzed for the following analytical methods:

- Volatile organic compounds (VOC) in air by modified method TO-15
- Ethylene dibromide (EDB) by California Air Resources Board method 422
- Air-Phase Petroleum Hydrocarbons (APH) by MA APH 1.0
- Fixed Gases (H_2, Carbon Monoxide, CO_2, N_2, CH_4 and O_2/Ar) by modified U.S. Environmental Protection Agency (EPA) Method 3C

3.2.2.6 Humidity Measurements

Field measurements of subsurface humidity may be collected during future soil vapor sampling events to evaluate the water activity potential in the vadose zone for the assessment of natural biodegradation conditions.

A humidity probe will be used to collect soil-gas humidity and temperature measurements following SVMP purging and sample collection. The humidity probe will be calibrated each day it is used following the manufacturer instructions. The probe will be kept at a steady temperature while being calibrated.

Once calibrated, the humidity probe will be connected to the SVM point. The probe end of the instrument will be sealed so that only soil-gas humidity is read. Once connected to the SVM point, the vacuum pump will be connected to the top of the flow-through chamber so that soil-gas is pulled past the probe. The instrument will not read as accurately in non-moving air. Both the temperature and relative humidity of the soil-gas will be recorded.

3.2.3 Annual Monitoring Network Maintenance

Operations and maintenance for the soil vapor monitoring network will be performed during the sampling events. Wellheads will be inspected for integrity and necessary repairs will be performed as soon as possible. The findings of the inspections and the repairs will be documented by photographs and on the appropriate field forms (Appendix A).

3.3 Drinking Water Production Well Sampling

Sundance will perform monthly sampling of four drinking water production wells: KAFB-3, KAFB-15, KAFB-16 and VA-2 (Figure 2-2). These existing drinking water production wells at KAFB and the VA Hospital actively provide drinking water to the facilities' employees and inhabitants. Because the wells will be actively producing water during sampling, water levels at these wells will not be measured prior to sampling. In addition, one well volume will not be purged prior to sampling. Sampling at the drinking water production wells will be performed in accordance with the following steps:

Step 1. A Yellow Springs Instruments (YSI) 556 multi-probe system multi-parameter instrument will be used to collect field readings for dissolved oxygen (DO), pH, oxidation reduction potential (ORP), conductivity, and temperature during sampling. Calibrate the YSI according to the manufacturer's instructions for pH, ORP, conductivity and DO. Record the readings in a calibration log. Turbidity will be measured using a portable turbidimeter.

Step 2. Place a bucket underneath the sample port at the wellhead, and open the sample port. Purge any water in the sample port for thirty seconds to ensure that any accumulated sediment is removed.

Step 3. Fill the lower container of the YSI from the sample port and take a baseline reading of DO, pH, ORP, conductivity, and temperature. Fill the sample cell of the portable turbidimeter and collect the turbidity reading. Record these parameters on the sample collection log.

Step 4. Fill the water sample containers in accordance with requirements of the QAPjP (Appendix C). Samples for volatile organic analysis will be collected first. The sample bottles will be carefully filled to avoid overflow and potential loss of preservative, and tapped so entrapment of air is minimized and no head space exists. If bubbles appear, the vial will be refilled or a new vial will be used if a sample preservative (e.g., hydrochloric acid) is used.

Step5. Place analytical samples in a cooler and chill to 4 degrees Celsius (°C). Samples must be shipped to the appropriate laboratory within 24 hours. The sample cooler must be shaded from direct sunlight immediately after collection.

Step 6. The field logbook, sample log sheet, labels, custody seals, and chain-of-custody forms will be filled out during sample collection.

Drinking water production well samples will be shipped to ALS laboratory in Kelso, WA where they will be analyzed for the following analytical parameters:

- EDB by EPA Method 504.1
- Benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Method 524.2

3.4 Soil Vapor Monitoring Well Abandonment

Soil vapor monitoring location and well abandonment techniques and details will be provided in future revisions of this WP. Once the monitoring location(s) to be abandoned has been determined, the specifications will be submitted describing requirements for abandonment.

3.5 Soil Vapor Monitoring Well Installation

Drilling techniques and details on the design and installation of the soil vapor monitoring location(s) will be provided in future revisions of this WP. Once the design of the SVMPs has been completed, then specifications will be submitted describing the installation requirements for these locations.

3.6 Equipment Decontamination

The objective of field decontamination is to remove contaminants of concerns from sampling, and other field equipment to concentrations that will not impact study objectives.

Decontamination procedures specific to soil vapor sampling are outlined in Section 3.2.1.2. It is not anticipated that any additional decontamination procedures will be required for this project.

If reusable sampling materials are used for drinking water production well sampling, then KAFB Base-Wide Standard Operating Procedure B.1-11 (Equipment Decontamination) will be used by field personnel responsible for determination of appropriate decontamination procedures.

3.7 Personal Protective Equipment

Modified Level D PPE will be worn during sampling as described in the project APP, which was submitted under a separate cover. Please reference Section 9.0 of the APP for more detailed information on PPE.

3.8 Photoionization Detector

A PID will be used for breathing zone monitoring during sampling activities. The PID will be calibrated and tested as required in the QAPjP (Appendix C).

3.9 Field Quality Control

Field QC samples will be collected throughout field investigation activities to ensure the integrity and reproducibility of data. Field QC samples include duplicates and trip blanks for VOC analysis.

Field QC samples are discussed in the QAPjP (Appendix C) and are listed below:

- Field duplicate samples (water/vapor) – 10% of total number of environmental samples per event
- Matrix spike/matrix spike duplicate samples (water) – 5% of total number of environmental samples per event
- Trip blank samples (water/vapor) – one per each shipment of groundwater and vapor samples per event for VOCs only
- Temperature blank (water) – 1 per each shipment of environmental samples

3.10 Sample Packaging and Shipping

The primary objective of sample packaging and shipping requirements is to maintain sample integrity from the time a sample is collected until it is received at the analytical laboratory. Chain-of-custody forms, sample labels, custody seals, and other sample documents will be completed as specified in the QAPjP, provided in Appendix C. Specific procedures for packaging and shipping of environmental samples are presented below:

Step 1. A sample label is attached to the sample bottle and completed with indelible ink.

Step 2. For water samples, a cooler (such as a Coleman or other sturdy cooler) will be used as a shipping container. In preparation for shipping samples, the drain plug will be taped shut so that no fluids, such as melted ice, will drain out of the cooler during shipment. A large plastic bag may be used as a liner for the cooler and packing material, such as bubble wrap, or Styrofoam beads, will be placed in the bottom of the liner. All water samples for chemical analysis must be shipped cooled to 4 °C with ice. All samples will require icing prior to shipping.

Step 3. Soil vapor samples will be returned to the lab in the sample container boxes in which they were sent. There are no temperature or preservative requirements for shipping of the soil vapor samples.

Step 4. The liner will be taped closed, if used, and sufficient packing material will be used to prevent sample containers from making contact or rolling around during shipment.

Step 5. A copy of the completed chain-of-custody record will be placed inside the cooler or box.

Step 6. The cooler or box will be closed and taped shut with packing tape.

Step 7. Custody seals will be placed on the cooler or box.

Step 8. The cooler or box will be shipped in accordance with the particular sample media and corresponding hold times.

3.11 Investigation-Derived Waste

It is not anticipated that any soil or water investigation-derived waste (IDW) will be generated during sampling. Soil vapor sampling does not generate any containerized waste. In addition, any excess drinking water will be disposed of via KAFB's waste water treatment system, or will be disposed of to the ground. Non-reusable PPE will be disposed of in accordance with the project APP (Section 9.0). Any additional waste associated with sampling (plastic bags, paper waste, etc.) will be collected and disposed of via the COA waste management system.

IDW management details pertaining to any well installation or abandonment that may be performed will be provided in Section 7 of future revisions of this WP. Once the drilling techniques and waste streams are determined, specifications will be submitted describing the management of that waste.

3.12 Reporting

Analytical data collected during soil vapor and drinking water monitoring activities described in this WP will be included in the Periodic Monitoring Reports delivered to NMED (quarterly, or the most current NMED-approved reporting requirement) as part of the investigation at SWMU ST-106/SS-111.

First, second and third quarter CY reports will document the monitoring activities performed during each quarter and will provide the detailed information listed below. The fourth quarter CY report may have additional requirements or information, and include cumulative information from the entire year.

- Descriptions of field activities performed during the quarter
- Tables of analytical concentrations
- Maps illustrating contaminant concentrations at specific well locations
- Analytical laboratory data
- Data validation summary of laboratory data and discussion of data quality

4 PROJECT SCHEDULE

The project schedule is provided in Appendix B of this WP.

5 ORGANIZATIONAL PLAN

The organizational structure of the Sundance Team is shown on Figure 5-1. Table 5-1 summarizes the responsibilities, qualifications, and authorities of project team members.

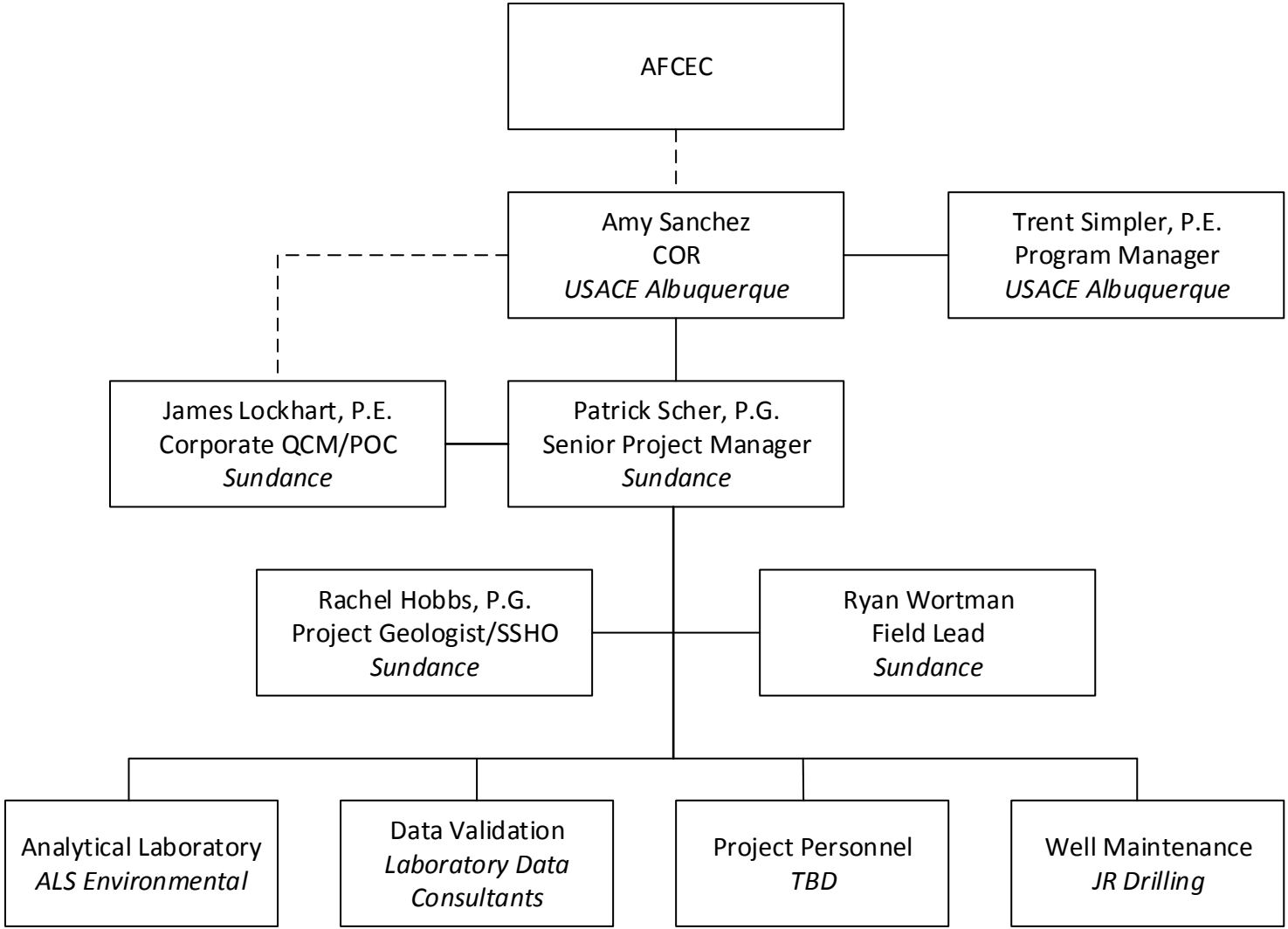

AFCEC
Amy Sanchez
COR
USACE Albuquerque
Trent Simpler, P.E.
Program Manager
USACE Albuquerque
James Lockhart, P.E.
Corporate QCM/POC
Sundance
Patrick Scher, P.G.
Senior Project Manager
Sundance
Rachel Hobbs, P.G.
Project Geologist/SSHO
Sundance
Ryan Wortman
Field Lead
Sundance
Analytical Laboratory
ALS Environmental
Data Validation
Laboratory Data Consultants
Project Personnel
TBD
Well Maintenance
JR Drilling

Table 5-1. Staff Roles, Responsibilities, and Authorities
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Position/Staff	Qualifications	Responsibilities	Authority Level
Vice President of Operations Jim Lockhart, P.E.	• BSME, MBA; • 33 years' experience in environmental remediation and engineering; • 25 years in management of environmental and engineering projects.	• As a Sundance Officer, authorized to negotiate and commit resources; • Primary point-of-contact for USACE on contractual and programmatic items; • Ensures consistency in deliverables and cost/performance reporting and progress reporting/invoicing; • Coordinates issue resolution as needed with Contracting Officer's Representative and/or Contracting Officer.	• Coordinates corrective action at programmatic level.
Project Manager Patrick Scher, P.G.	• M.S in Geology; • Registered Professional Geologist in two states; • 30 years' experience in environmental remediation/compliance; • 25 years' experience in DoD Project and Program Management; • 15 years' experience as technical lead/project manager on complex environmental projects; • 30-year accident free track record.	• Ensures that all work is accomplished with adequate internal controls; • Main point of contact for USACE on project-specific matters; • Reviews/confirms technical approach from kickoff meeting and throughout project execution to ensure project objectives are met; • Assembles and schedules resources; • Ensures on-schedule and high-quality services are delivered within budget; • Manages subcontractors;	• Full responsibility and authority to execute Task Orders; • Approves subcontractors' invoices, project charges, and deliverables; • Implements corrective action; • Stops work for any reason related to the project.

Table 5-1. Staff Roles, Responsibilities, and Authorities
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Position/Staff	Qualifications	Responsibilities	Authority Level
		• Coordinates Sundance's participation in the Identifies and mitigates risks related to execution of the technical aspects of the work and ensures site safety; • Ensures work is performed in accordance with USACE/U.S. Air Force Guidelines, state/federal regulations; • Applies lessons learned from current and past projects; • Responsible for front and back end transition activities to ensure continuity on the project; • Ensures public relations sensitivities are met.	
Project Technical Lead/Site Safety and Health Officer Rachel Hobbs, P.G.	• M.S. in Geology; • Registered Professional Geologist in the state of Tennessee; • 5 years' experience in environmental remediation; • Past experience coordinating Kirtland BFF project tasks.	• Reports to the Project Manager and serves as the Alternative Project Manager; • Overall responsibility for design, implementation, and management of sampling activities; • Reviews all work plan, reporting, and data deliverables; • Coordinates with Field Personnel for oversight and QC; • Responsible for providing input for the design of the corrective actions	• Approves APPs/SSHPs and all modifications before issuance to USACE; • Manages Health and Safety Program and directs training and required attendance; • Investigates safety concerns raised by staff; • Investigates any accidents; • Stops work for any reason including noncompliance/safety violation, or quality violations.

Table 5-1. Staff Roles, Responsibilities, and Authorities
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued)

Position/Staff	Qualifications	Responsibilities	Authority Level
		and reviews corrective elements specific to sampling; • Oversees development of APP in accordance with Engineer Manual 385-1-1 and Occupational Safety and Health Administration regulations; • Assists Project Manager and procurement staff in verification of safety performance of subcontractors Investigates any incidents, accidents, or safety violations Performs safety audits; • Manages monitoring reports.	
Field Team Lead Ryan Wortman	• B.S. in Geology; • Past experience coordinating Kirtland BFF project tasks.	• Reports to Technical Lead and/or Project Manager; • Oversees sampling team and sampling activities; • Coordinates with the Project Manager and Project Technical Lead on any deviations from the QAPjP due to changed field conditions such that data quality objectives are met; • Coordinates with SSHO to ensure that project activities are being performed in accordance with the APP.	• Stop sampling work at any time due to safety or quality violations.

Table 5-1. Staff Roles, Responsibilities, and Authorities
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Concluded)

BFF – Bulk Fuels Facility
B.S. – Bachelor of Science Degree
M.S. – Master of Science Degree
P.E. – Professional Engineer
P.G. – Professional Geologist
QAPjP – Quality Assurance Project Plan
SSHO – Site Safety and Health Officer
SSHP – Site Safety and Health Plan
USACE – US Army Corps of Engineers

6 DATA MANAGEMENT PLAN

Environmental laboratory services will be provided only by laboratories compliant with the *DoD Quality Systems Manual for Environmental Laboratories, Version 5.0* (DoD, 2013) or a most recent version and that hold a current DoD Environmental Laboratory Accreditation Program accreditation for all appropriate analytical methods (DoD, 2013). ALS will provide analytical results in support of this project. ALS will provide electronic data in the Environmental Resource Program Information Management System (ERPIMS) format. The ERPIMS deliverable will be validated for upload to the U.S. Air Force (Air Force) data repository. All analytical data generated in support of this project will be uploaded to the Air Force Data Repository.

Analytical data generated in support of this project will undergo an EPA level III data review by Laboratory Data Consultants, Inc. (LDC). Automated data review software, developed by LDC, will be used to perform 100% EPA Level III data review. The data review will be performed for the monthly drinking water supply well data, as well as soil vapor analytical data obtained from each of the quarterly monitoring events. The data review will be performed using the QC criteria specified in Section 4.0 of the project QAPjP (Appendix C).

ERPIMS Version 5.0 submittals will be reviewed for accuracy and completeness before submittal. ERPIMS submittals will be provided to the Air Force, at a minimum, every six months or as appropriate for data generation for uploading to the Air Force data repository. Submittals will be deemed complete upon receipt of the insertion letter from the Air Force.

All project-related data will be maintained and archived in the electronic project files on the corporate server and will be made available to the government as necessary. All data generated in support of this contract will be maintained in accordance with the contract requirements.

7 INVESTIGATION-DERIVED WASTE MANAGEMENT PLAN

Additional project activities that require an IDW management plan may be required as part of this project. If any such project activities are preformed, an IDW management plan will be included in this section as part of a revision to this WP.

8 REFERENCES

DoD. 2013. *DoD Quality Systems Manual for Environmental Laboratories, Version 5.0.* July.

New Mexico Environment Department (NMED). 2010. Hazardous Waste Treatment Facility Operating Permit, EPA ID No. NM9570024423, issued to U.S. Air Force for the Open Detonation Unit Located at Kirtland Air Force Base, Bernalillo County, New Mexico, by the NMED Hazardous Waste Bureau. July.

Sundance Consulting, 2016. *Quarterly Soil Vapor Sampling and Monthly Drinking Water Sampling Accident Prevention Plan*. Sundance Consulting, Inc., February 2016.

USACE, 2011. *Vadose Zone Investigation Work Plan Bulk Fuels Facility Spill Solid Waste Management Units ST-106 and SS-111.* Prepared by Shaw Environmental and Infrastructure, Kirtland Air Force Base, New Mexico. March.

Appendix A
Field Forms

Field Activity Log

Job Number:	Task Description:	Date:

Weather:	Important Notes:	Sundance Employes Onsite:	Visitors:

Name:	Signature:	Date:

Field Activity Log (Continuation)

Page ____ of _____

Job Number:	Task Description:	Date:

Sundance Consulting Inc.

Well Integrity Checklist

Well ID: _____ **Inspector's Name:** _____
Date: _____
Time: _____ **Inspector's Signature:**_____

Before Opening Well

1. Is well cement pad in good condition? _____
2. Is lid securely tightened to vault?_____
3. Is well clearly labeled? _____
4. Do wells outside of BFF have security bolts? _____
5. Photograph well.

After Removing Lid Before Sampling Well

1. Is gasket worn or damaged? _____
2. Is vault flooded? _____
3. Are ports capped/labeled? _____
4. Are ports angled correctly? _____
5. Are all fittings and quick connects intact and operational?

   _____
6. Can you hear well breathing? _____
7. Photograph well with lid off.

During Sampling

1. Do all quick connects fit securely to sample system? _____
2. Does static pressure after purging return to initial static pressure within one minute?

   _____
3. Is well clogged? _____

Comments:_____

_____

Horiba Calibration Sheet

Horiba ID #: ______________

	Know Gas Mixture			Initial Horiba Reading			Post Cal. Horiba Readings			Flow Through Readings			
Date/Time	C3H8(ppm)	% CO2	% O2*	HC(ppm)	% CO2	% O2*	HC(ppm)	% CO2	% O2*	HC(ppm)	% CO2	% O2*	Initals
	1600	13	20.9										
	1600	13	20.9										
	1600	13	20.9										
	1600	13	20.9										
	1600	13	20.9										
	1600	13	20.9										
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	1600	13	20.9										
	1600	13	20.9										
	1600	13	20.9										
	1600	13	20.9										

* = Atmospheric %O2 Concentrations

Leak Test Log

Date	Intital Vacuum Reading	Time	Vacuum Reading After 10 Min.*	Time	Initials

*Min Minutes

Sundance Consulting Inc.

Purge Log

Project Name: Bulk Fuels Facility

Project Location: Kirtland Air Force Base

Well ID/Port Depth: _____

Samplers: _____

Sampler Signature/Date :_____

Screened Interval: Top:_____(ft. b.g.s)
Bottom:_____(ft. b.g.s)

Is Well damaged/Flooded: Yes - No

If yes, describe: _____

Weather Observations _____

Pump ID:_____ Horiba ID: _____ Sample System ID: _____ Manometer ID: _____

Was the sample system purged of hydrocarbons before connection with well port: Yes - No

Initial Static Pressure (inWC) _____

A. Pre- Calculated purge volume (cu. ft) Located on well data sheet	(Ft^3)
B. Flow Rate (SCFM) On flowmeter for air pump	(SCFM)
C. Purge time (Min. and Sec.) 1. Equals A/B 2. Write down whole number as minute 3. Multiple decimal by 60 for seconds	

Post Purge Static Pressure (inWC) _____

Sample Date/Time	CO2 %	O2%	Actual Purge Time	Hydrocarbons (ppmv)

Comments: _____

Bottle Vac. Number:_____

Initial B.V. Pressure:_____

Sample ID: _____

Final B.V. Pressure: _____

Reviewed by (Name): _____

Reviewer (Signature/Date): _____

Sundance Consulting Inc.

Date: _____

Time: _____

Project No.: __US01-023_____

C0C #: _____

Sample Collection Log

Project Name: ___KAFB_Bulk Fuels Facility_____

Sample No.: _____

Sample Location: ___Kirtland AFB ____

Sample Type: ____GRAB_____

Composite: (Y/N) _____No_____

Sample Team: _____

Trip Blank: _____

Sample:

Analytical Suite	Preservative	Container	TAT	Initials
VOCs by TO-15, EDB by CARB 422, Air-Phase Petroleum Hydrocarbons by MA APH 1.0, and Fixed Gases (H2, CO, CO2, N2, CH4 and O2/Ar) by E3C.	None	One Liter Amber Glass	15 Days	

Comments:

_____

_____

_____

_____

Logged By: _____ **Reviewed By**: _____

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

COC #:

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.

Company Name & Address (Reporting Information)

Sundance Consulting, Inc.
6700 Jefferson St NE, Suite C-3,
Albuquerque, NM 87109

Project Name/ Number: KAFB Bulk Fuels Facility/US01-023

Waynbill Number:

Project Manager: Rachel Hobbs

P.O. # / Billing Information:

Phone: 505-835-7660

Fax: 505-345-0742

Email Address for Result Reporting: rhobbs@sundance@sundance-inc.net

Sampler (Print & Sign):

Analytical Methods:

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Bottle Vac ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Bottle Vac Start Pressure "Hg	Bottle Vac End Pressure "Hg/psig	Sample Volume	TO-15 Project Specific List	MA APH HC Ranges	CARB 422 1,2-Dibromoethane	EPA 3C (O2, N2, CO2, CH4)	Comments e.g. Actual Preservative or specific instructions

Report Tier Levels - please select

Tier I - Results (Default if not specified) _____
Tier II (Results + QC Summaries) _____
Tier III (Results + QC & Calibration 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

Sundance Consulting Inc.

Sample Collection Log

Date: _____

Time: _____

Project No: __US01-023_____

COC #:_____

Task:_____

Project Name ___KAFB Bulk Fuels Facility_____

Sample No. _____

Sample Location ___Kirtland AFB _____

Sample Type ____GRAB_____

Composite: Y/N ____No_____

Sample Team _____

Trip Blank _____

Sample:

Analytical Suite	Preservative	Quantity	Container	Temp.	FLT.	TAT	Initials
EDB by EPA 504.1	None	3	3x40 ml VOA	4°C	N	10 Days	
BTEX by EPA 524.2	HCL	3	3x40 ml VOA	4°C	N	10 Days	

Comments:

_____

_____

_____

_____

Logged by: _____ Reviewed by: _____

Groundwater- Chain of Custody Record & Analytical Service Request

Page _____ of _____

1317 S. 13th Ave
Kelso, WA 98626
Phone (360) 577 7222
Fax (360) 636 1068

Waybill #	COC #:

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.

Company Name & Address (Reporting Information)	PO/Billing Information	Project Name / Project Number
Sundance Consulting, Inc. 6700 Jefferson St NE, Suite C-3, Albuquerque, NM 87109		KAFB Bulk Fuel Facilities US01-23
Project Manager: Rachel Hobbs	Sampler Name/Signature	Analytical Methods:
Phone: 505-835-7660 / Fax: 505-345-0742		
Email Address for Result Reporting: rhobbs@sundance@sundance-inc.net		

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Sample Matrix	No. Of Containers	Preservative					Sample Volume	Comments (e.g. specific instructions)

Report Tier Levels - please select

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

EDD required Yes / No
Type: _____ Units:_____

Chain of Custody Seal: (Circle)
INTACT BROKEN ABSENT

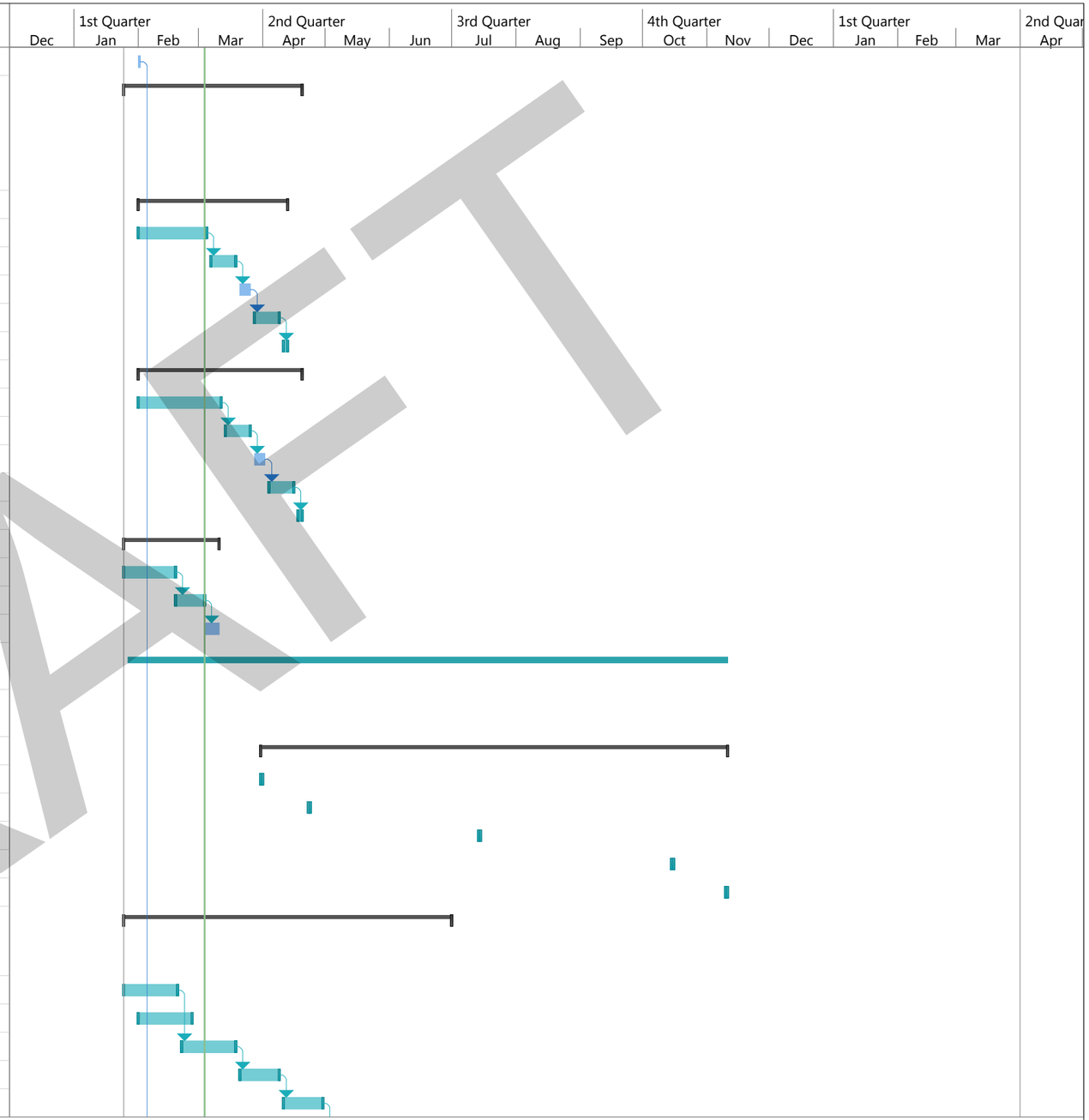
Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:		Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Date:	Time:		Received by: (Signature)	Date:	Time:

Cooler / Blank Temperature ____°C

Appendix B
Project Schedule

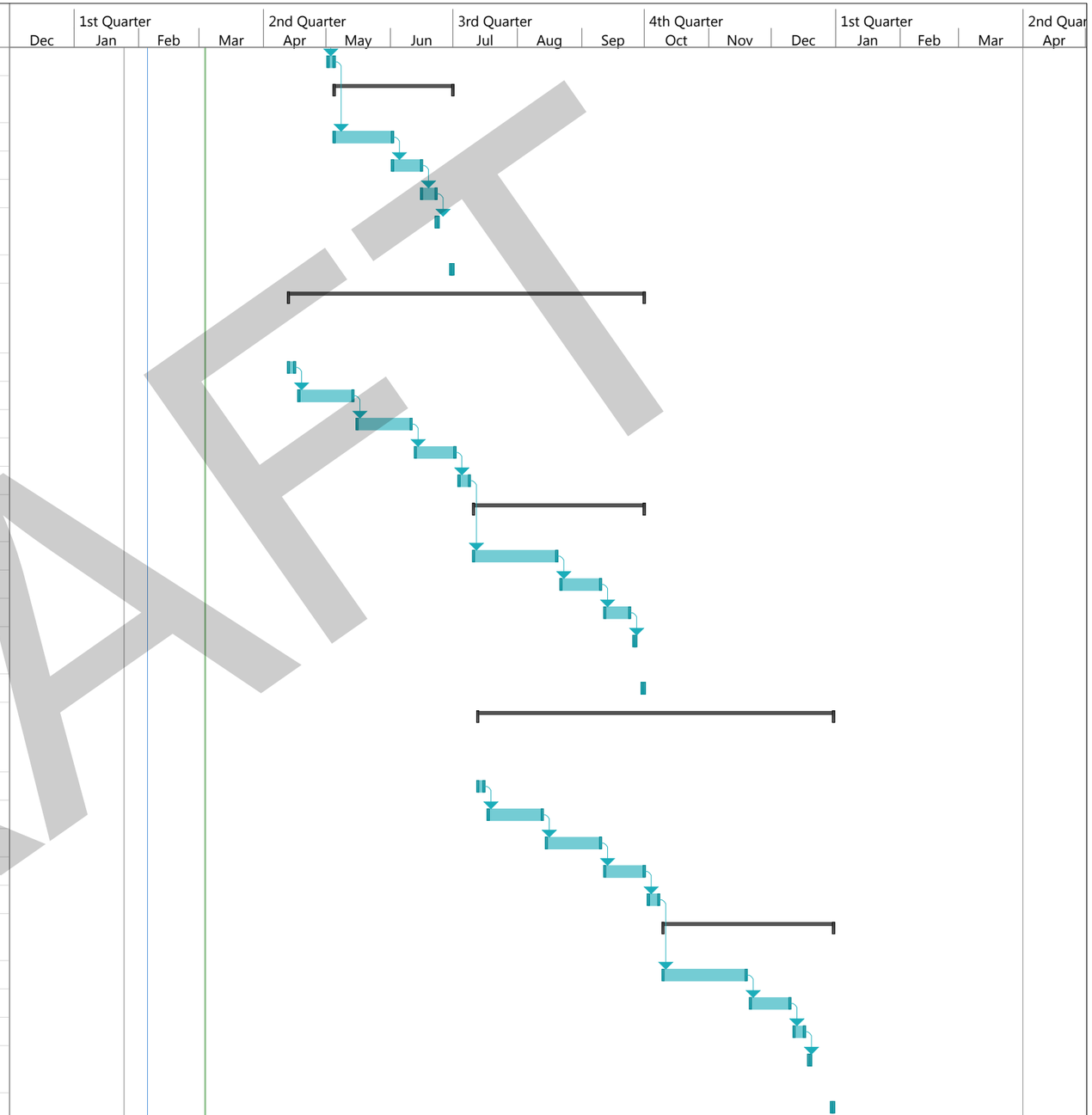
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		Kick Off Meeting	1 day	Mon 2/1/16	Mon 2/1/16	
2		Update Quality Assurance Project Plan (Accident Prevention Plan (APP), Sampling and Analysis Plan (SAP), Field Sampling Plan (FSP)) CY 2016	62 days	Mon 1/25/16	Tue 4/19/16	
3		Work Plan	52 days	Mon 2/1/16	Tue 4/12/16	
4		Draft Work Plan	25 days	Mon 2/1/16	Fri 3/4/16	
5		USACE/AFCEC/KAFB Review	10 days	Mon 3/7/16	Fri 3/18/16	4
6		Incoporate Comments	5 days	Mon 3/21/16	Fri 3/25/16	5
7		Commander Signature	10 days	Mon 3/28/16	Fri 4/8/16	6
8		Delivery to NMED	2 days	Mon 4/11/16	Tue 4/12/16	7
9		QAPjP (Attached to Work Plan)	57 days	Mon 2/1/16	Tue 4/19/16	
10		Draft QAPjP	30 days	Mon 2/1/16	Fri 3/11/16	
11		USACE/AFCEC/KAFB Review	10 days	Mon 3/14/16	Fri 3/25/16	10
12		Incoporate Comments	5 days	Mon 3/28/16	Fri 4/1/16	11
13		Commander Signature	10 days	Mon 4/4/16	Fri 4/15/16	12
14		Delivery to NMED	2 days	Mon 4/18/16	Tue 4/19/16	13
15		APP	34 days	Mon 1/25/16	Thu 3/10/16	
16		Draft APP	19 days	Mon 1/25/16	Thu 2/18/16	
17		USACE/AFCEC/KAFB Review	10 days	Fri 2/19/16	Thu 3/3/16	16
18		Incoporate Comments	5 days	Fri 3/4/16	Thu 3/10/16	17
19		New Recurring Project Meetings CY 2016				
20		Status calls/CSI/other meetings to be held as needed				
21		Public Meetings CY 2016	161 days	Thu 3/31/16	Thu 11/10/16	
22		1st Public Meeting	1 day	Thu 3/31/16	Thu 3/31/16	
23		1st Field Trip	1 day	Sat 4/23/16	Sat 4/23/16	
24		2nd Public Meeting	1 day	Thu 7/14/16	Thu 7/14/16	
25		2nd Field Trip	1 day	Sat 10/15/16	Sat 10/15/16	
26		3rd Public Meeting	1 day	Thu 11/10/16	Thu 11/10/16	
27		Vadose Zone Sampling, Analysis and Reporting First Quarter CY 2016	114 days	Mon 1/25/16	Thu 6/30/16	
28		Project Mobilization	20 days	Mon 1/25/16	Fri 2/19/16	
29		Sample Planning	20 days	Mon 2/1/16	Fri 2/26/16	
30		Soil Vapor Sampling Field Work	20 days	Mon 2/22/16	Fri 3/18/16	28
31		Laboratory Analysis	15 days	Mon 3/21/16	Fri 4/8/16	30
32		Data Validation	15 days	Mon 4/11/16	Fri 4/29/16	31



Project: KAFB_Schedule_022916
Date: Fri 3/4/16

Task	Project Summary	Manual Task	Start-only	Deadline	
Split	Inactive Task	Duration-only	Finish-only	Progress	
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress	
Summary	Inactive Summary	Manual Summary	External Milestone		

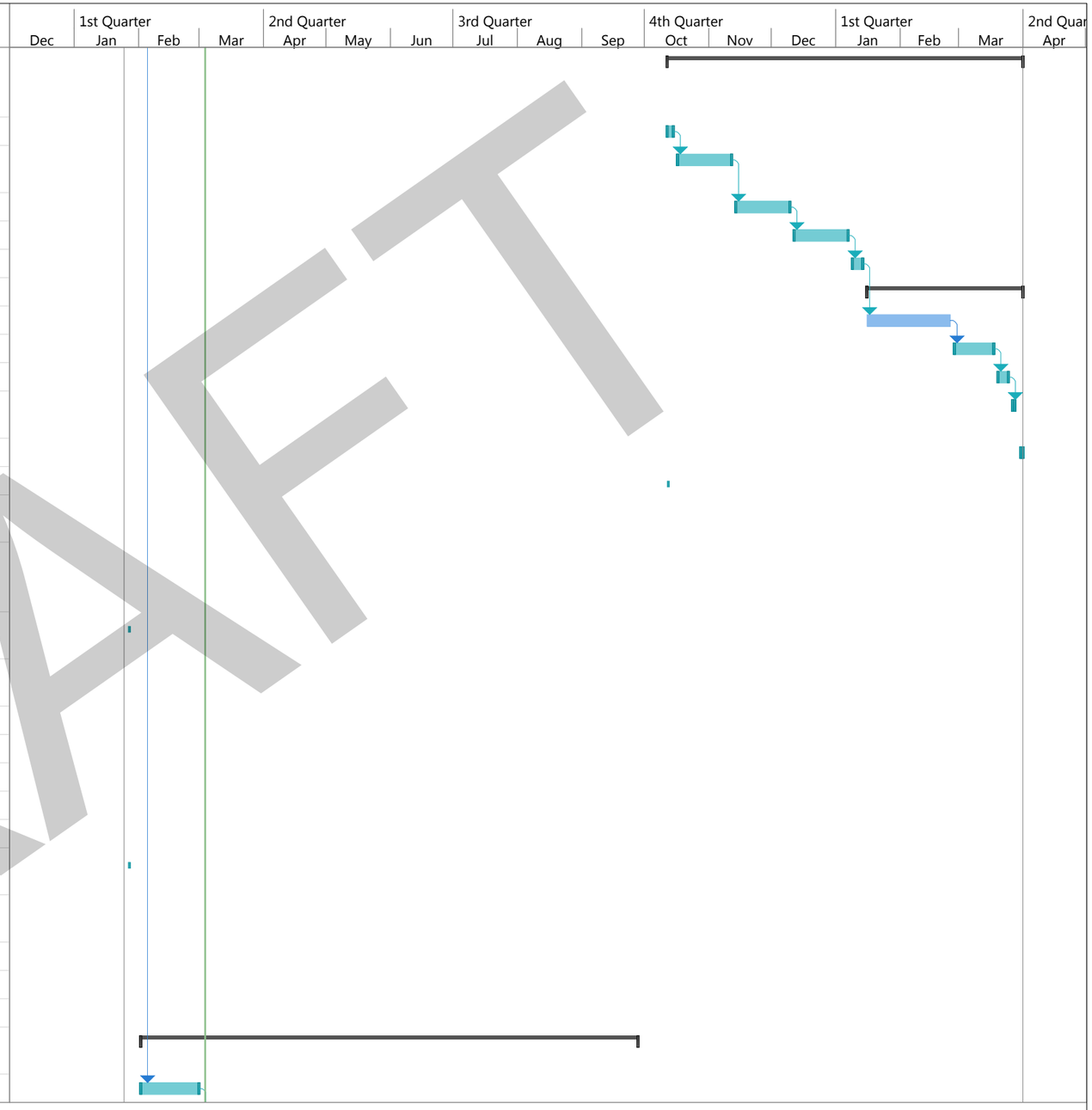
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
33		Database Management	3 days	Mon 5/2/16	Wed 5/4/16	32
34		Data Dump Report First Quarter CY 2016	41 days	Thu 5/5/16	Thu 6/30/16	
35		Draft Data Dump Report	20 days	Thu 5/5/16	Wed 6/1/16	33
36		USACE/AFCEC/KAFB Review	10 days	Thu 6/2/16	Wed 6/15/16	35
37		Incoporporate Comments	5 days	Thu 6/16/16	Wed 6/22/16	36
38		Incorporation into Quarterly Report	1 day	Thu 6/23/16	Thu 6/23/16	37
39		Delivery to NMED	1 day	Thu 6/30/16	Thu 6/30/16	
40		Vadose Zone Sampling, Analysis and Reporting Second Quarter CY 2016	123 days	Wed 4/13/16	Fri 9/30/16	
41		Sample Planning	3 days	Wed 4/13/16	Fri 4/15/16	
42		Soil Vapor Sampling Field Work	20 days	Mon 4/18/16	Fri 5/13/16	41
43		Laboratory Analysis	20 days	Mon 5/16/16	Fri 6/10/16	42
44		Data Validation	15 days	Mon 6/13/16	Fri 7/1/16	43
45		Database Management	5 days	Mon 7/4/16	Fri 7/8/16	44
46		Data Dump Report Second Quarter CY 2016	60 days	Mon 7/11/16	Fri 9/30/16	
47		Draft Data Dump Report	30 days	Mon 7/11/16	Fri 8/19/16	45
48		USACE/AFCEC/KAFB Review	15 days	Mon 8/22/16	Fri 9/9/16	47
49		Incoporporate Comments	10 days	Mon 9/12/16	Fri 9/23/16	48
50		Incorporation into Quarterly Report	1 day	Mon 9/26/16	Mon 9/26/16	49
51		Delivery to NMED	1 day	Fri 9/30/16	Fri 9/30/16	
52		Vadose Zone Sampling, Analysis and Reporting Third Quarter CY 2016	123 days	Wed 7/13/16	Fri 12/30/16	
53		Sample Planning	3 days	Wed 7/13/16	Fri 7/15/16	
54		Soil Vapor Sampling Field Work	20 days	Mon 7/18/16	Fri 8/12/16	53
55		Laboratory Analysis	20 days	Mon 8/15/16	Fri 9/9/16	54
56		Data Validation	15 days	Mon 9/12/16	Fri 9/30/16	55
57		Database Management	5 days	Mon 10/3/16	Fri 10/7/16	56
58		Data Dump Report Third Quarter CY 2016	60 days	Mon 10/10/16	Fri 12/30/16	
59		Draft Data Dump Report	30 days	Mon 10/10/16	Fri 11/18/16	57
60		USACE/AFCEC/KAFB Review	15 days	Mon 11/21/16	Fri 12/9/16	59
61		Incoporporate Comments	5 days	Mon 12/12/16	Fri 12/16/16	60
62		Incorporation into Quarterly Report	1 day	Mon 12/19/16	Mon 12/19/16	61
63		Delivery to NMED	1 day	Fri 12/30/16	Fri 12/30/16	



Project: KAFB_Schedule_022916
Date: Fri 3/4/16

Task	Project Summary	Manual Task	Start-only	Deadline	
Split	Inactive Task	Duration-only	Finish-only	Progress	
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress	
Summary	Inactive Summary	Manual Summary	External Milestone		

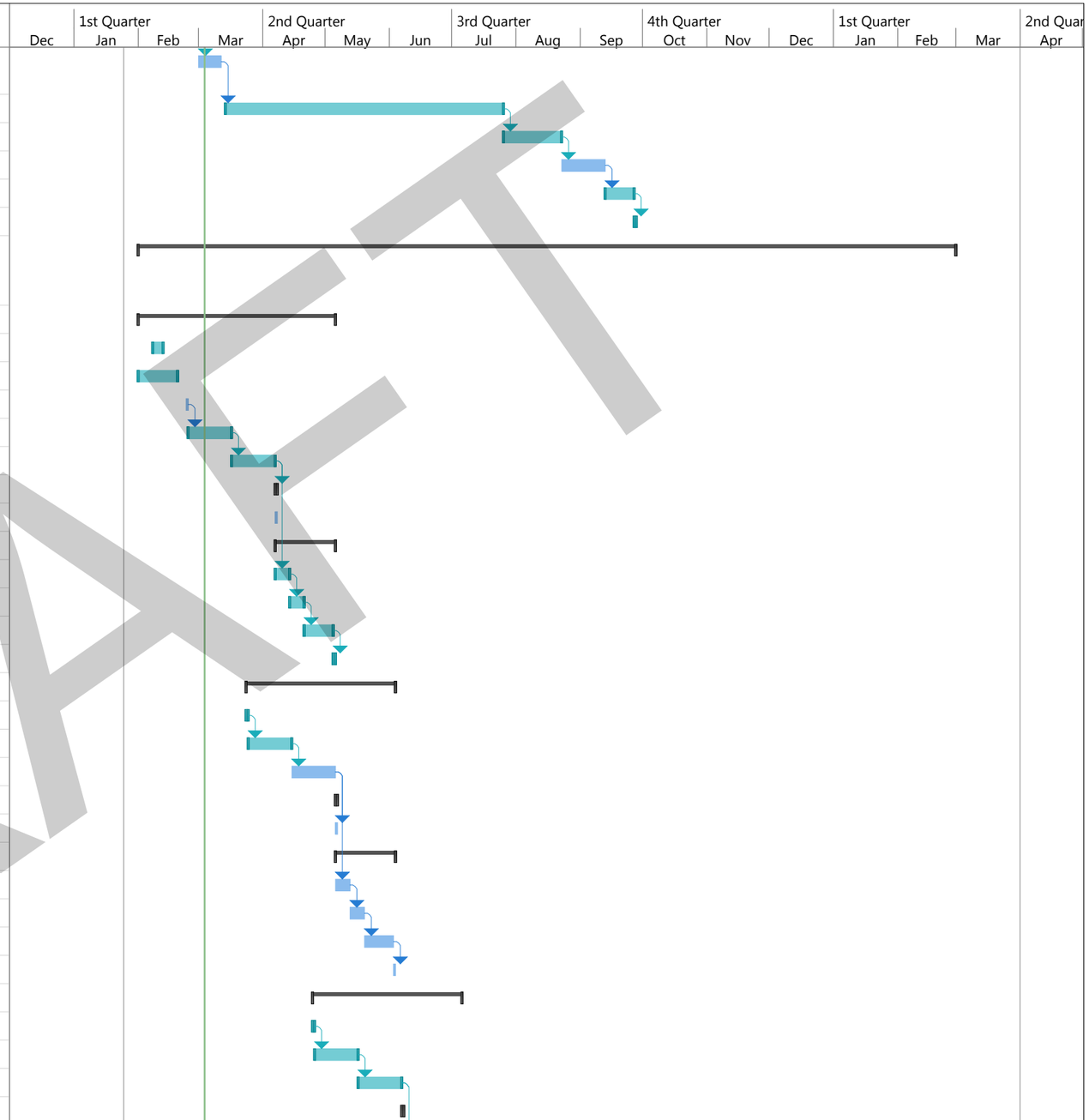
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
64		Vadose Zone Sampling, Analysis and Reporting Fourth Quarter CY 2016	123 days	Wed 10/12/16	Fri 3/31/17	
65		Sample Planning	3 days	Wed 10/12/16	Fri 10/14/16	
66		Soil Vapor Sampling Field Work	20 days	Mon 10/17/16	Fri 11/11/16	65
67		Laboratory Analysis	20 days	Mon 11/14/16	Fri 12/9/16	66
68		Data Validation	20 days	Mon 12/12/16	Fri 1/6/17	67
69		Database Management	5 days	Mon 1/9/17	Fri 1/13/17	68
70		Annual Monitoring Report	55 days	Mon 1/16/17	Fri 3/31/17	
71		Draft Annual Monitoring Report	30 days	Mon 1/16/17	Fri 2/24/17	69
72		USACE/AFCEC/KAFB Review	15 days	Mon 2/27/17	Fri 3/17/17	71
73		Incoporporate Comments	5 days	Mon 3/20/17	Fri 3/24/17	72
74		Incorporation into Quarterly Report	1 day	Mon 3/27/17	Mon 3/27/17	73
75		Delivery to NMED	1 day	Fri 3/31/17	Fri 3/31/17	
76		Maintenance Activities				
77		To be scheduled as determined necessary				
78		Well Installation and Abandonment - To be scheduled as determined necessary				
79		Well Installation				
80		Office of State Engineer Permit Application				
81		Kirtland Dig Permit				
82		Well Installation				
83		IDW Sampling and Letters				
84		OSE Report-Installation				
85		Well Survey				
86		Well Abandonment				
87		Office of State Engineer Permit Application				
88		Well Abandonment				
89		OSE Report-Abandonment				
90		Reporting				
91		RFI Report with Risk Assessment	171 days	Tue 2/2/16	Tue 9/27/16	
92		Planning Meetings	20 days	Tue 2/2/16	Mon 2/29/16	1



Project: KAFB_Schedule_022916
Date: Fri 3/4/16

Task	Project Summary	Manual Task	Start-only	Deadline	
Split	Inactive Task	Duration-only	Finish-only	Progress	
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress	
Summary	Inactive Summary	Manual Summary	External Milestone		

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
93		Draft Outline	9 days	Tue 3/1/16	Fri 3/11/16	92
94		Draft RFI Report	96 days	Mon 3/14/16	Mon 7/25/16	93
95		USACE/AFCEC/KAFB Review	20 days	Tue 7/26/16	Mon 8/22/16	94
96		Incoporate Comments	15 days	Tue 8/23/16	Mon 9/12/16	95
97		Commander Signature	10 days	Tue 9/13/16	Mon 9/26/16	96
98		Delivery to NMED	1 day	Tue 9/27/16	Tue 9/27/16	97
99		Monthly Drinking Water Sampling, Analysis and Reporting CY 2016	282 days	Mon 2/1/16	Tue 2/28/17	
100		Month 1 (Feb 2016)	69 days	Mon 2/1/16	Thu 5/5/16	
101		Mobilization	5 days	Mon 2/8/16	Fri 2/12/16	
102		Sample Planning	15 days	Mon 2/1/16	Fri 2/19/16	
103		Field Work	1 day	Wed 2/24/16	Wed 2/24/16	
104		Laboratory Analysis	15 days	Thu 2/25/16	Wed 3/16/16	103
105		Data Validation	15 days	Thu 3/17/16	Wed 4/6/16	104
106		Database Management	1 day	Thu 4/7/16	Thu 4/7/16	105
107		ERPIMS uploads	1 day	Thu 4/7/16	Thu 4/7/16	
108		Technical Memo	21 days	Thu 4/7/16	Thu 5/5/16	
109		Draft Technical Memo	5 days	Thu 4/7/16	Wed 4/13/16	105
110		USACE/AFCEC/KAFB Review	5 days	Thu 4/14/16	Wed 4/20/16	109
111		Commander Signature	10 days	Thu 4/21/16	Wed 5/4/16	110
112		Delivery to NMED	1 day	Thu 5/5/16	Thu 5/5/16	111
113		Month 2 (March 2016)	52 days	Thu 3/24/16	Fri 6/3/16	
114		Field Work	1 day	Thu 3/24/16	Thu 3/24/16	
115		Laboratory Analysis	15 days	Fri 3/25/16	Thu 4/14/16	114
116		Data Validation	15 days	Fri 4/15/16	Thu 5/5/16	115
117		Database Management	1 day	Fri 5/6/16	Fri 5/6/16	
118		ERPIMS uploads	1 day	Fri 5/6/16	Fri 5/6/16	116
119		Technical Memo	21 days	Fri 5/6/16	Fri 6/3/16	
120		Draft Technical Memo	5 days	Fri 5/6/16	Thu 5/12/16	116
121		USACE/AFCEC/KAFB Review	5 days	Fri 5/13/16	Thu 5/19/16	120
122		Commander Signature	10 days	Fri 5/20/16	Thu 6/2/16	121
123		Delivery to NMED	1 day	Fri 6/3/16	Fri 6/3/16	122
124		Month 3 (April 2016)	52 days	Mon 4/25/16	Tue 7/5/16	
125		Field Work	1 day	Mon 4/25/16	Mon 4/25/16	
126		Laboratory Analysis	15 days	Tue 4/26/16	Mon 5/16/16	125
127		Data Validation	15 days	Tue 5/17/16	Mon 6/6/16	126
128		Database Management	1 day	Tue 6/7/16	Tue 6/7/16	



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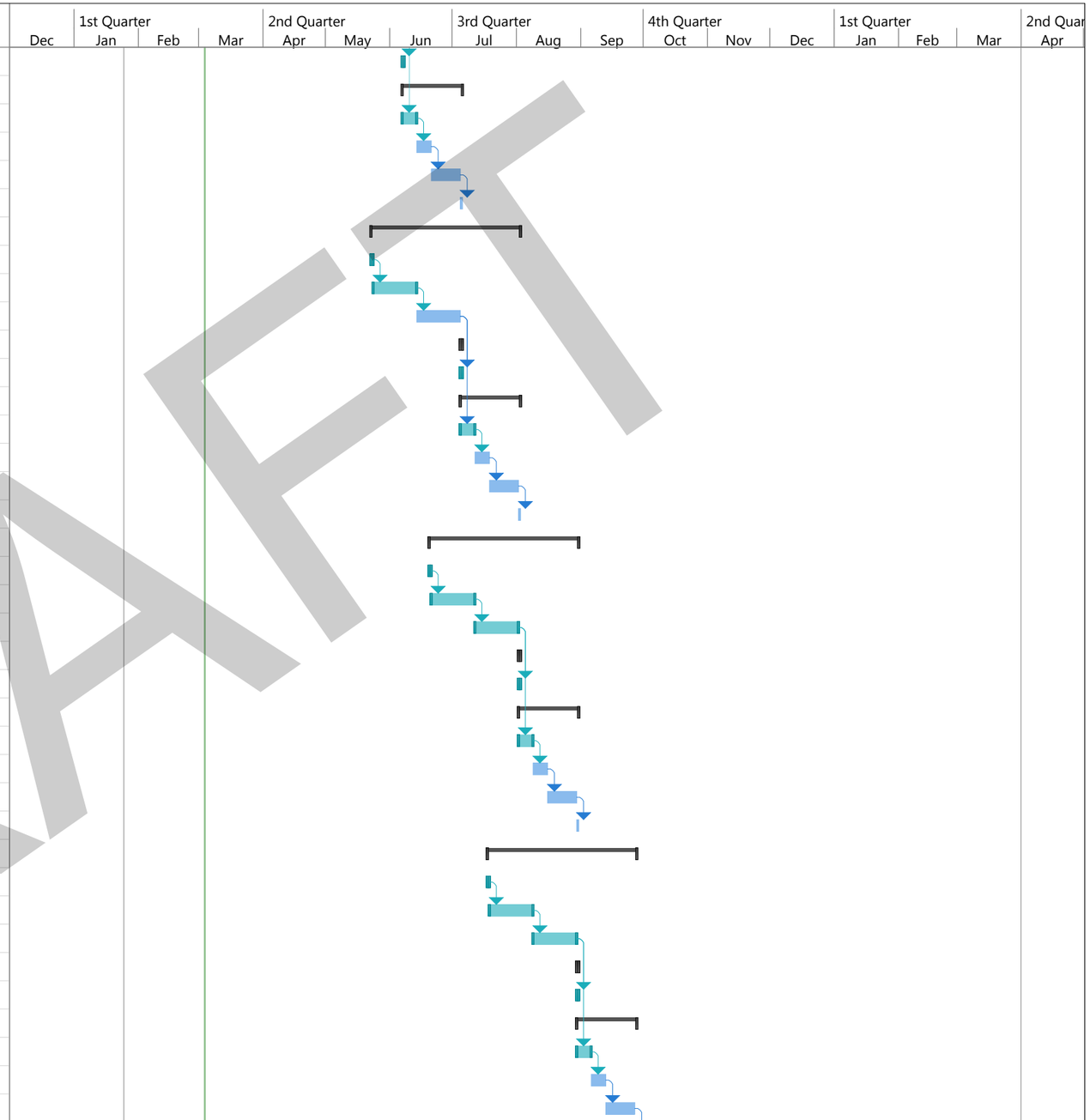
Split	Inactive Task	Duration-only	Finish-only	Progress	
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress	
Summary	Inactive Summary	Manual Summary	External Milestone		

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
129		ERPIMS uploads	1 day	Tue 6/7/16	Tue 6/7/16	127
130		Technical Memo	21 days	Tue 6/7/16	Tue 7/5/16	
131		Draft Technical Memo	5 days	Tue 6/7/16	Mon 6/13/16	127
132		USACE/AFCEC/KAFB Review	5 days	Tue 6/14/16	Mon 6/20/16	131
133		Commander Signature	10 days	Tue 6/21/16	Mon 7/4/16	132
134		Delivery to NMED	1 day	Tue 7/5/16	Tue 7/5/16	133
135		Month 4 (May 2016)	52 days	Mon 5/23/16	Tue 8/2/16	
136		Field Work	1 day	Mon 5/23/16	Mon 5/23/16	
137		Laboratory Analysis	15 days	Tue 5/24/16	Mon 6/13/16	136
138		Data Validation	15 days	Tue 6/14/16	Mon 7/4/16	137
139		Database Management	1 day	Tue 7/5/16	Tue 7/5/16	
140		ERPIMS uploads	1 day	Tue 7/5/16	Tue 7/5/16	138
141		Technical Memo	21 days	Tue 7/5/16	Tue 8/2/16	
142		Draft Technical Memo	5 days	Tue 7/5/16	Mon 7/11/16	138
143		USACE/AFCEC/KAFB Review	5 days	Tue 7/12/16	Mon 7/18/16	142
144		Commander Signature	10 days	Tue 7/19/16	Mon 8/1/16	143
145		Delivery to NMED	1 day	Tue 8/2/16	Tue 8/2/16	144
146		Month 5 (June 2016)	52 days	Mon 6/20/16	Tue 8/30/16	
147		Field Work	1 day	Mon 6/20/16	Mon 6/20/16	
148		Laboratory Analysis	15 days	Tue 6/21/16	Mon 7/11/16	147
149		Data Validation	15 days	Tue 7/12/16	Mon 8/1/16	148
150		Database Management	1 day	Tue 8/2/16	Tue 8/2/16	
151		ERPIMS uploads	1 day	Tue 8/2/16	Tue 8/2/16	149
152		Technical Memo	21 days	Tue 8/2/16	Tue 8/30/16	
153		Draft Technical Memo	5 days	Tue 8/2/16	Mon 8/8/16	149
154		USACE/AFCEC/KAFB Review	5 days	Tue 8/9/16	Mon 8/15/16	153
155		Commander Signature	10 days	Tue 8/16/16	Mon 8/29/16	154
156		Delivery to NMED	1 day	Tue 8/30/16	Tue 8/30/16	155
157		Month 6 (July 2016)	52 days	Mon 7/18/16	Tue 9/27/16	
158		Field Work	1 day	Mon 7/18/16	Mon 7/18/16	
159		Laboratory Analysis	15 days	Tue 7/19/16	Mon 8/8/16	158
160		Data Validation	15 days	Tue 8/9/16	Mon 8/29/16	159
161		Database Management	1 day	Tue 8/30/16	Tue 8/30/16	
162		ERPIMS uploads	1 day	Tue 8/30/16	Tue 8/30/16	160
163		Technical Memo	21 days	Tue 8/30/16	Tue 9/27/16	
164		Draft Technical Memo	5 days	Tue 8/30/16	Mon 9/5/16	160
165		USACE/AFCEC/KAFB Review	5 days	Tue 9/6/16	Mon 9/12/16	164
166		Commander Signature	10 days	Tue 9/13/16	Mon 9/26/16	165



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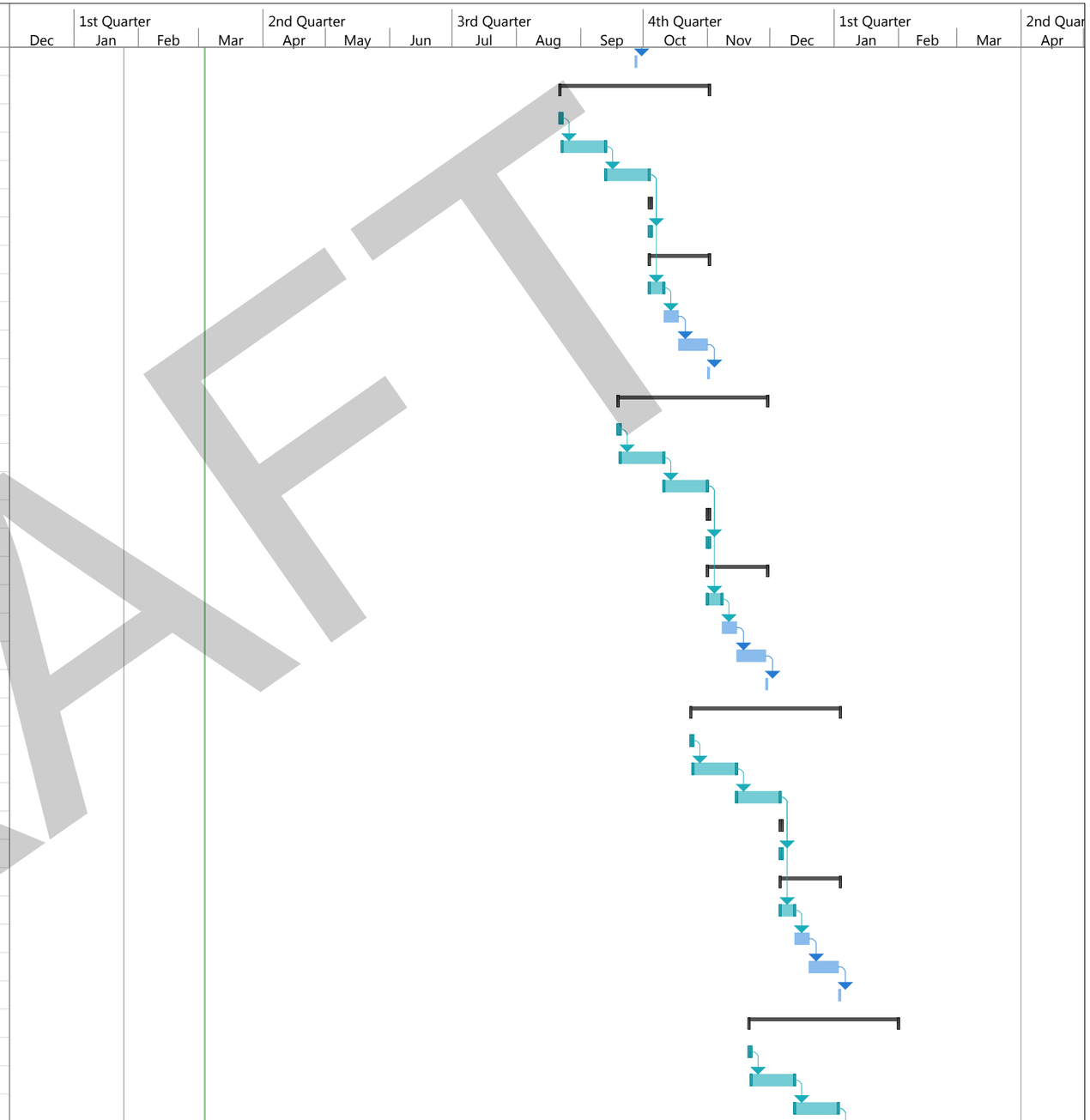
Split	Inactive Task	Duration-only	Finish-only	Progress	
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress	
Summary	Inactive Summary	Manual Summary	External Milestone		

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
167		Delivery to NMED	1 day	Tue 9/27/16	Tue 9/27/16	166
168		Month 7 (August 2016)	52 days	Mon 8/22/16	Tue 11/1/16	
169		Field Work	1 day	Mon 8/22/16	Mon 8/22/16	
170		Laboratory Analysis	15 days	Tue 8/23/16	Mon 9/12/16	169
171		Data Validation	15 days	Tue 9/13/16	Mon 10/3/16	170
172		Database Management	1 day	Tue 10/4/16	Tue 10/4/16	
173		ERPIMS uploads	1 day	Tue 10/4/16	Tue 10/4/16	171
174		Technical Memo	21 days	Tue 10/4/16	Tue 11/1/16	
175		Draft Technical Memo	5 days	Tue 10/4/16	Mon 10/10/16	171
176		USACE/AFCEC/KAFB Review	5 days	Tue 10/11/16	Mon 10/17/16	175
177		Commander Signature	10 days	Tue 10/18/16	Mon 10/31/16	176
178		Delivery to NMED	1 day	Tue 11/1/16	Tue 11/1/16	177
179		Month 8 (September 2016)	52 days	Mon 9/19/16	Tue 11/29/16	
180		Field Work	1 day	Mon 9/19/16	Mon 9/19/16	
181		Laboratory Analysis	15 days	Tue 9/20/16	Mon 10/10/16	180
182		Data Validation	15 days	Tue 10/11/16	Mon 10/31/16	181
183		Database Management	1 day	Tue 11/1/16	Tue 11/1/16	
184		ERPIMS uploads	1 day	Tue 11/1/16	Tue 11/1/16	182
185		Technical Memo	21 days	Tue 11/1/16	Tue 11/29/16	
186		Draft Technical Memo	5 days	Tue 11/1/16	Mon 11/7/16	182
187		USACE/AFCEC/KAFB Review	5 days	Tue 11/8/16	Mon 11/14/16	186
188		Commander Signature	10 days	Tue 11/15/16	Mon 11/28/16	187
189		Delivery to NMED	1 day	Tue 11/29/16	Tue 11/29/16	188
190		Month 9 (October 2016)	52 days	Mon 10/24/16	Tue 1/3/17	
191		Field Work	1 day	Mon 10/24/16	Mon 10/24/16	
192		Laboratory Analysis	15 days	Tue 10/25/16	Mon 11/14/16	191
193		Data Validation	15 days	Tue 11/15/16	Mon 12/5/16	192
194		Database Management	1 day	Tue 12/6/16	Tue 12/6/16	
195		ERPIMS uploads	1 day	Tue 12/6/16	Tue 12/6/16	193
196		Technical Memo	21 days	Tue 12/6/16	Tue 1/3/17	
197		Draft Technical Memo	5 days	Tue 12/6/16	Mon 12/12/16	193
198		USACE/AFCEC/KAFB Review	5 days	Tue 12/13/16	Mon 12/19/16	197
199		Commander Signature	10 days	Tue 12/20/16	Mon 1/2/17	198
200		Delivery to NMED	1 day	Tue 1/3/17	Tue 1/3/17	199
201		Month 10 (November 2016)	52 days	Mon 11/21/16	Tue 1/31/17	
202		Field Work	1 day	Mon 11/21/16	Mon 11/21/16	
203		Laboratory Analysis	15 days	Tue 11/22/16	Mon 12/12/16	202
204		Data Validation	15 days	Tue 12/13/16	Mon 1/2/17	203



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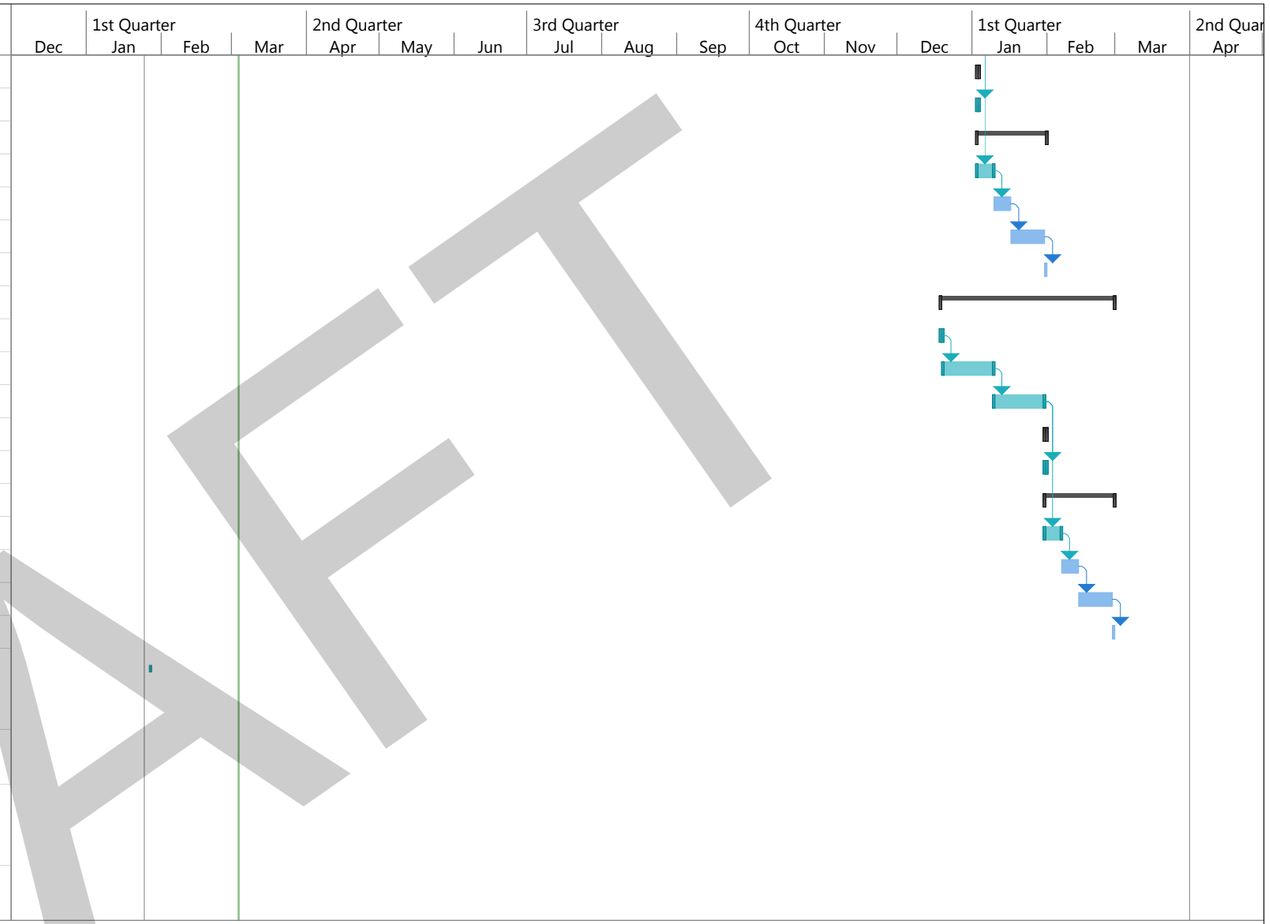
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress	
Summary	Inactive Summary	Manual Summary	External Milestone		

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
205		Database Management	1 day	Tue 1/3/17	Tue 1/3/17	
206		ERPIMS uploads	1 day	Tue 1/3/17	Tue 1/3/17	204
207		Technical Memo	21 days	Tue 1/3/17	Tue 1/31/17	
208		Draft Technical Memo	5 days	Tue 1/3/17	Mon 1/9/17	204
209		USACE/AFCEC/KAFB Review	5 days	Tue 1/10/17	Mon 1/16/17	208
210		Commander Signature	10 days	Tue 1/17/17	Mon 1/30/17	209
211		Delivery to NMED	1 day	Tue 1/31/17	Tue 1/31/17	210
212		Month 11 (December 2016)	52 days	Mon 12/19/16	Tue 2/28/17	
213		Field Work	1 day	Mon 12/19/16	Mon 12/19/16	
214		Laboratory Analysis	15 days	Tue 12/20/16	Mon 1/9/17	213
215		Data Validation	15 days	Tue 1/10/17	Mon 1/30/17	214
216		Database Management	1 day	Tue 1/31/17	Tue 1/31/17	
217		ERPIMS uploads	1 day	Tue 1/31/17	Tue 1/31/17	215
218		Technical Memo	21 days	Tue 1/31/17	Tue 2/28/17	
219		Draft Technical Memo	5 days	Tue 1/31/17	Mon 2/6/17	215
220		USACE/AFCEC/KAFB Review	5 days	Tue 2/7/17	Mon 2/13/17	219
221		Commander Signature	10 days	Tue 2/14/17	Mon 2/27/17	220
222		Delivery to NMED	1 day	Tue 2/28/17	Tue 2/28/17	221
223		Monthly Drinking Water Sampling, Analysis and Reporting CY 2017				
224		Will follow same schedule as 2016 events				
225		Vadose Zone Sampling, Analysis and Reporting First Quarter CY 2017				
226		Will follow similar schedule to 2016 events				



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Summary	Inactive Summary	Manual Summary	External Milestone	

Appendix C
Quality Assurance Project Plan

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

Quality Assurance Project Plan for Soil Vapor Monitoring and Drinking Water Monitoring Bulk Fuels Facility Solid Waste Management Unit ST-106/SS-111 Kirtland Air Force Base, New Mexico

April 2016

Prepared for

U.S. Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza NE
Albuquerque, NM 87109

Contract No. W912PP-16-C-0002

Prepared by

Sundance Consulting, Inc.
8210 Louisiana Blvd. NE Suite C
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Acronyms and Abbreviations:

AFCEC = Air Force Civil Engineer Center
BFF = Bulk Fuels Facility
COR = Contracting Officer's Representative
KAFB = Kirtland Air Force Base
NMED = New Mexico Environment Department
P.E. = Professional Engineer
P.G. = Professional Geologist
PhD = Doctor of Philosophy
PM = Project Manager
POC = point of contact
QAPjP = Quality Assurance Project Plan
SSHO = Site Safety and Health Officer
Sundance = Sundance Consulting, Inc.
USACE = U.S. Army Corps of Engineers

CONTENTS

CONTENTS (CONCLUDED)

ATTACHMENTS

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
%	percent
AFB	Air Force Base
ALS	ALS Environmental Laboratory
APH	air-phase petroleum hydrocarbon
APP	Accident Prevention Plan
ASTM	ASTM International
BFF	Bulk Fuels Facility
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CARB	California Air Resources Board
CO	carbon monoxide
COA	City of Albuquerque
CoC	contaminants of concern
COC	chain-of-custody
COPC	contaminant of potential concern
CY	calendar year
DoD	U.S. Department of Defense
DQA	data quality assessment
DQO	data quality objective
EDB	ethylene dibromide
e.g.	example given
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ft	foot/feet
HC	hydrocarbon
ID	identification
IDW	investigation-derived waste
KAFB	Kirtland Air Force Base
L	liter
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LDC	Laboratory Data Consultants, Inc.
LOQ	limit of quantitation
MA APH	Massachusetts Air-Phase Petroleum Hydrocarbons
MA DEP	Massachusetts Department of Environmental Protection

ACRONYMS AND ABBREVIATIONS (CONTINUED)

MCL	maximum contaminant level
MDL	method detection limit
mL	milliliter
MS	matrix spike
MSD	matrix spike duplicate
NAPL	non-aqueous phase liquid
NCR	Nonconformance Report
NIST	National Institute of Standards and Technology
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
No.	number
NOD	Notice of Deficiency
O_2	oxygen (molecular)
OSRTI	Office of Superfund Remediation and Technology Innovation
OSWER	Office of Solid Waste and Emergency Response
PARCC	precision, accuracy, representiveness, comparability and completeness
P.E.	Professional Engineer
P.G.	Professional Geologist
PM	Project Manager
POC	point of contact
PPE	personal protective equipment
QA	quality assurance
QAPjP	Quality Assurance Project Plan
QC	quality control
QCM	Quality Control Manager
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RPD	relative percent difference
RSL	regional screening level
Sundance	Sundance Consulting, Inc.
SOP	standard operating procedure
SVE	soil vapor extraction
SVM	soil vapor monitoring
SVMP	soil vapor monitoring point
SVOC	semi volatile organic compound
SWMU	solid waste management unit
TPH	total petroleum hydrocarbons
U.S.	United States
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force

ACRONYMS AND ABBREVIATIONS (CONCLUDED)

VA	Veteran's Administration
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon
WP	Work Plan

SIGNATURE SHEET

SOIL VAPOR MONITORING AND DRINKING WATER MONITORING BULK FUELS FACILITY, SOLID WASTE MANAGEMENT UNIT ST-106/SS-111 KIRTLAND AIR FORCE BASE, NEW MEXICO

Rachel Hobbs

April 22, 2016

Rachel Hobbs, P.G.
Site Safety and Health Officer/Project Geologist
Sundance Consulting, Inc.

Date

Patrick L Scher

April 22, 2016

Patrick Scher, P.G.
Project Manager
Sundance Consulting, Inc.

Date

CERTIFICATION

James L. Lockhart

April 22, 2016

James L. Lockhart, P.E.
Vice President of Operations
Sundance Consulting Inc.

Date

EXECUTIVE SUMMARY

This Quality Assurance Project Plan (QAPjP) has been prepared by Sundance Consulting, Inc. (Sundance) under the U.S. Army Corps of Engineers (USACE)–Albuquerque District, Contract Number W912PP-16-C-0002. This QAPjP was developed to support soil vapor monitoring and drinking water monitoring at Kirtland Air Force Base (KAFB). The work to be conducted under this contract will include periodic monitoring of soil vapor and drinking water, as well as the abandonment and installation of soil vapor monitoring points at a location and date to be determined by USACE.

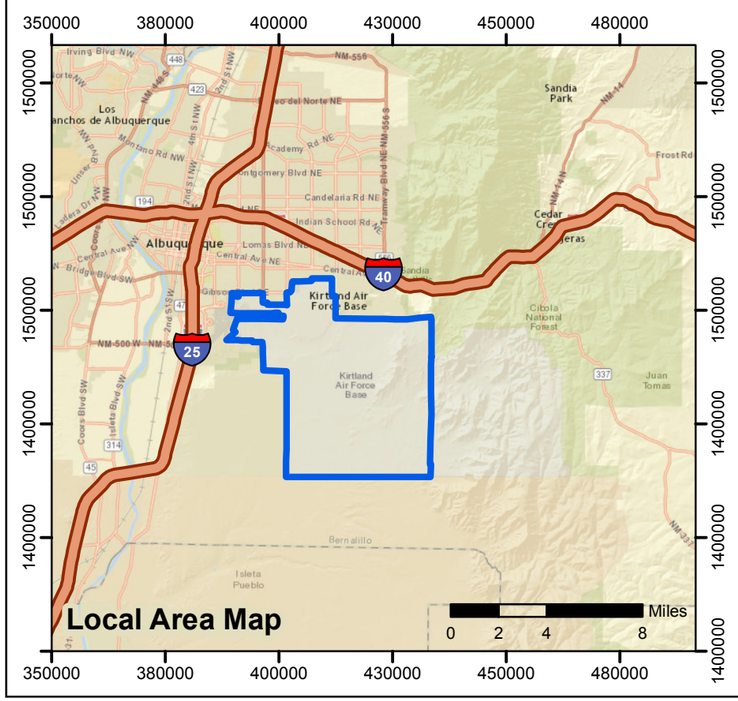
This QAPjP was developed for the periodic monitoring at KAFB Bulk Fuels Facility to meet the quality control requirements defined in the Department of Defense Quality Systems Manual (Version 5.0, July 2013). The QAPjP documents project management procedures and describes data generation and acquisition for field sampling and laboratory analytical processes, laboratory analytical methods, quality assurance/quality control protocols, data validation and usability, assessment and oversight, data management processes, and reporting requirements to be implemented for the project.

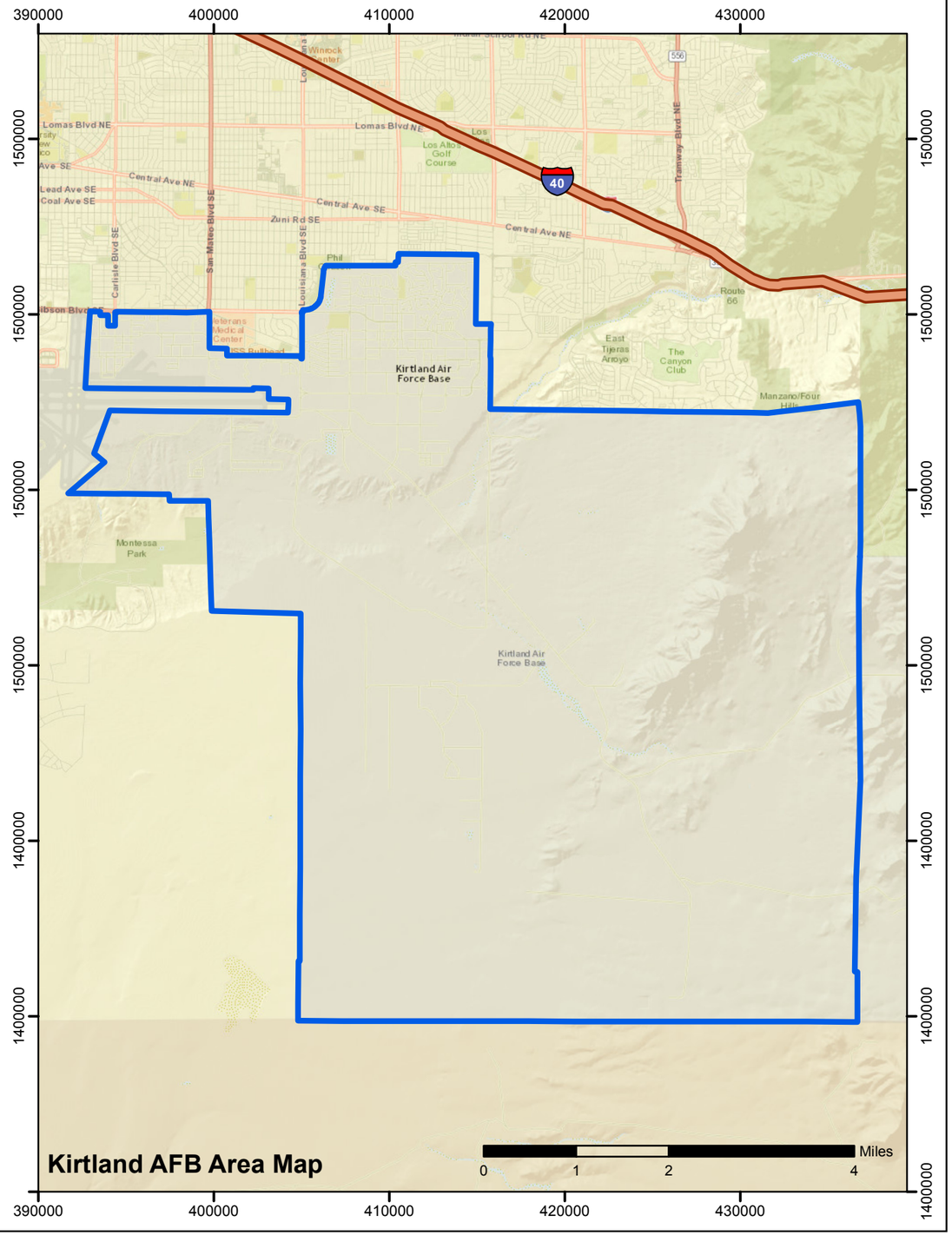
1 INTRODUCTION

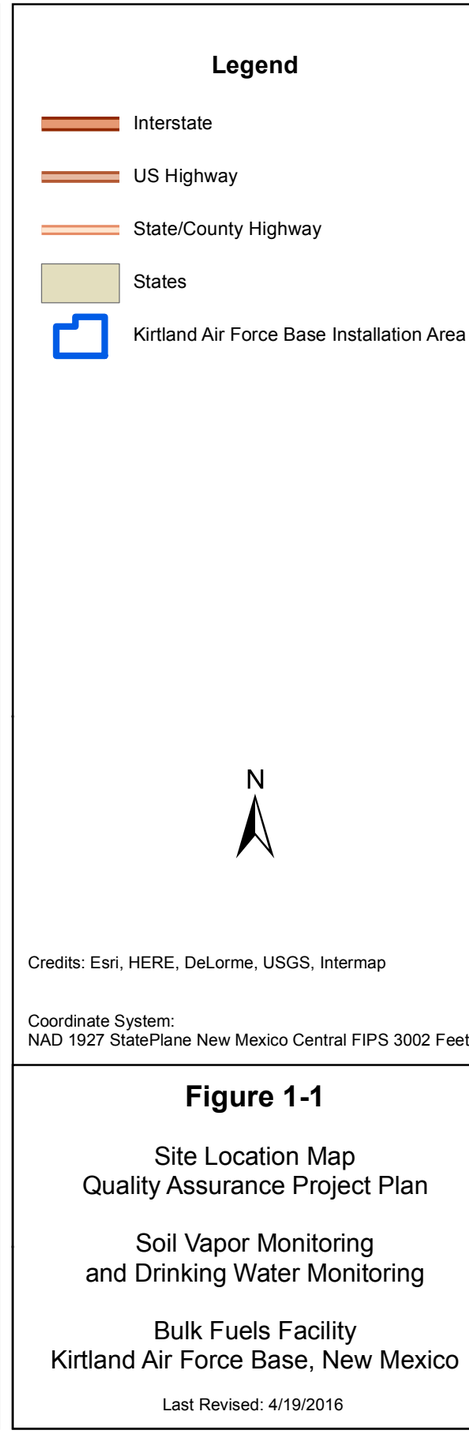
This Soil Vapor Monitoring and Drinking Water Monitoring Quality Assure Project Plan was prepared by Sundance Consulting, Inc. (Sundance) for the United States Army Corps of Engineers (USACE) under contract number W912PP-16-C-0002. Kirtland Air Force Base (KAFB) is located in Bernalillo County, in central New Mexico, southeast of and adjacent to the City of Albuquerque and the Albuquerque International Sunport. The approximate area of the base is 52,287 acres. The Bulk Fuels Facility (BFF) site, comprised of Solid Waste Management Unit (SWMU) ST-106/SS-111, is located in the northwestern part of KAFB (Figure 1-1). Environmental restoration efforts at the BFF site are being conducted under requirements set forth in the Resource Conservation and Recovery Act (RCRA), Permit Number (No.) NM9570024423, with the New Mexico Environment Department (NMED) serving as the lead regulatory agency (NMED 2010). This Quality Assurance Project Plan (QAPjP) addresses activities that are continuing the implementation of the RCRA Interim Measures for the site, including continuation of soil vapor monitoring (SVM) and drinking water supply well monitoring, and the installation and abandonment of one or more soil vapor monitoring points (SVMPs) at locations and dates to be determined by USACE with United States Air Force (USAF) input.

The BFF and associated infrastructure operated from 1953 through 1999. During this time, the fueling area was separated into a tank holding area where bulk shipments of fuel were received, and a fuel loading area where individual fuel railcars or trucks were emptied or disharged. In 1999, KAFB stopped using the underground piping at the facility and removed this piping from service due to discovery of a leak. Although the fuel leak was identified by KAFB, the exact history of the releases is unknown. Releases could have occurred when fuel was transferred from railcars or trucks to the pump house. Initially, it was thought that the leak only affected surface soil around the identified source area; however, KAFB learned through characterization activities that the leaked fuel had migrated to the groundwater table and that dissolved phase fuel contamination had migrated northeast and north of KAFB.

In order to comply with NMED Hazardous Waste Bureau requirements, a RCRA Facility Investigation (RFI) has been ongoing since 2011. As part of this ongoing investigation, 284 SVMPs have been and are sampled to characterize the nature and extent of soil vapor contamination in the vadose zone (approximately 460 feet (ft) from the ground surface to the top of the water table). In addition, drinking water supply wells have been and continue to be monitored to ensure they have not been impacted by contaminants from the BFF site. Under this project, SVM will continue and annual maintenance will be performed at the SVMPs. The drinking water supply well monitoring will continue through sampling and analysis.







Credits: Esri, HERE, DeLorme, USGS, Intermap

Coordinate System:
NAD 1927 StatePlane New Mexico Central FIPS 3002 Feet

Figure 1-1

Site Location Map
Quality Assurance Project Plan

Soil Vapor Monitoring
and Drinking Water Monitoring

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

Last Revised: 4/19/2016

2 PROJECT MANAGEMENT AND ORGANIZATION

Project management for the soil vapor and drinking water monitoring activities will be performed in accordance with the requirements and the authority of the USACE, Contract No. W912PP-16-C-0002, and other applicable federal and state regulations.

The BFF project team consists of representatives from USACE, USAF, Sundance and its subcontractors, and the NMED. The USAF is the lead federal agency for direction of site activities and decision-making. The NMED Hazardous Waste Bureau is the lead regulatory agency.

2.1 Project Quality Assurance Organization

The project quality assurance (QA) organization, presented in Figure 2-1, identifies key Sundance individuals and responsibilities to ensure project QA objectives are achieved for soil vapor and drinking water monitoring.

2.2 Personnel Qualifications

Personnel qualifications for key Sundance individuals supporting the monitoring activities are listed in Table 2-1 in addition to the title, responsibility, education, experience, and authority level.

2.3 Task Description

The tasks to be addressed under this QAPjP include quarterly SVM and monthly drinking water supply well monitoring. This document addresses all of the quality aspects of the following tasks:

- Sample SVM network of 284 SVMPs quarterly for volatile organic compounds (VOCs) by method TO-15, ethylene dibromide (EDB) by method California Air Resources Board (CARB) 422, air-phase petroleum hydrocarbons (APH) by Massachusetts Air-Phase Petroleum Hydrocarbon (MA APH) method 1.0, and fixed gases by U.S. Environmental Protection Agency (EPA) method 3C (Figure 2-2).

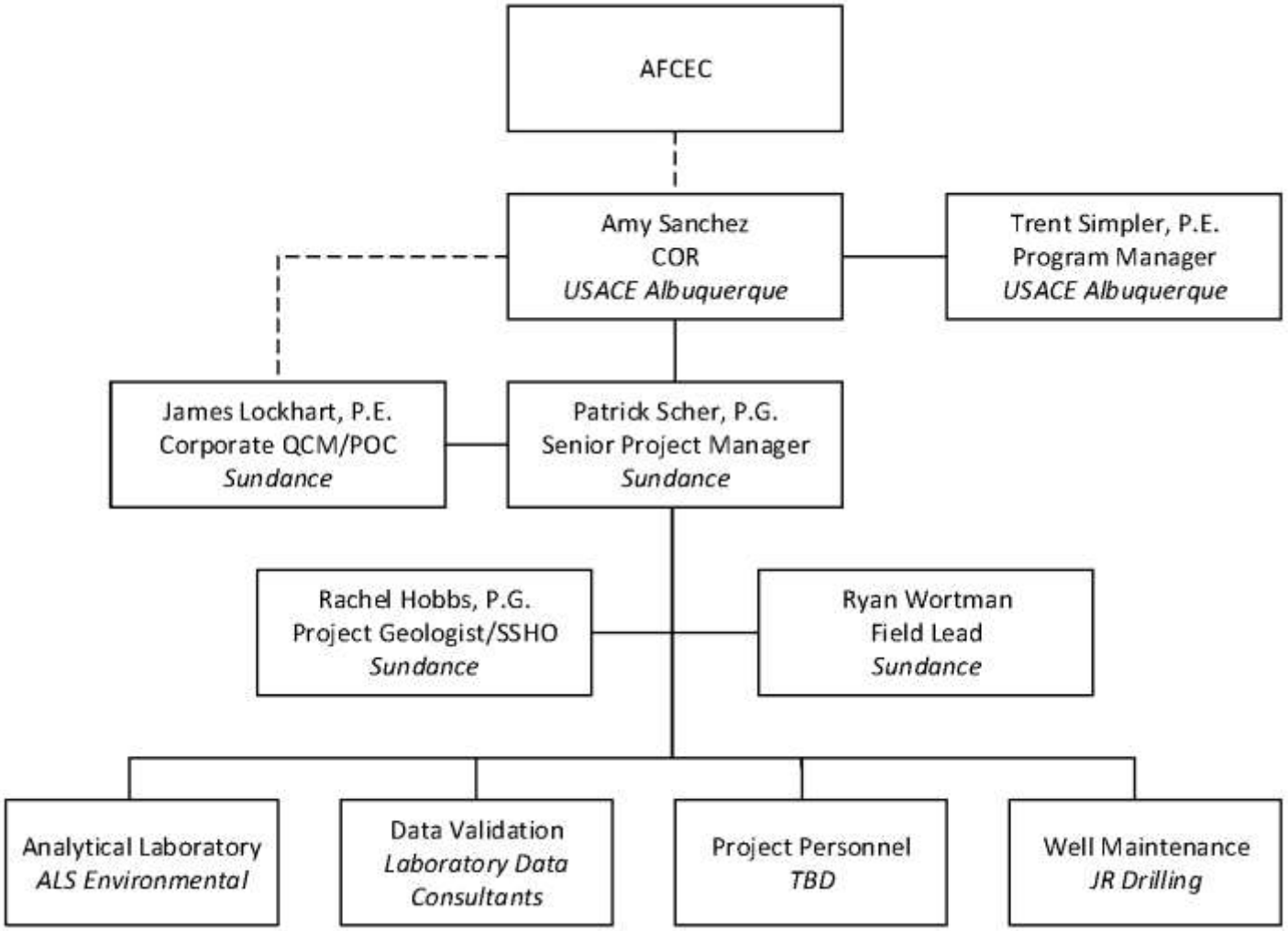
- Sample four drinking water supply wells monthly for EDB by EPA method 504.1, and benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Method 524.2 (Figure 2-3).

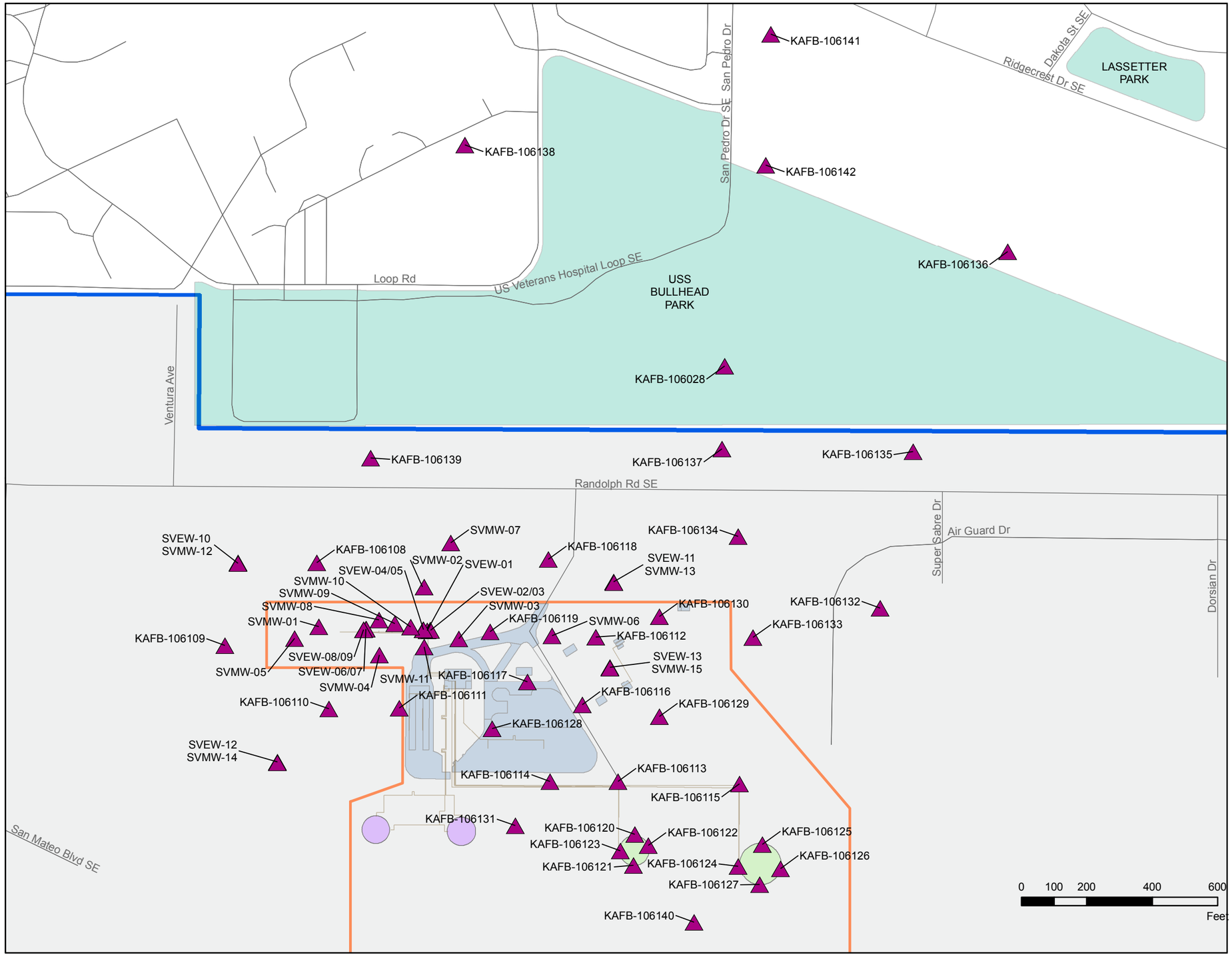
- Perform annual maintenance of the SVM network.

- Abandon and install SVMPs as necessary.

- Analyze soil vapor and drinking water supply well samples, and report results for soil vapor and drinking water supply wells in Quarterly Monitoring and Site Investigation Reports.

Figure 2-1. Quality Assurance Organization
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico





Legend

- Kirtland Air Force Base Installation Area
- City of Albuquerque Parks
- Roads
- Bulk Fuels Facility Area
- Soil Vapor Monitoring Location
- Bulk Fuels Facility Infrastructure
- Current Fuel Storage Tanks
- Former Fuel Storage Tanks
- Fuel Transfer Lines

N

Credits: City of Albuquerque

Coordinate System:
NAD 1927 StatePlane New Mexico Central FIPS 3002 Feet

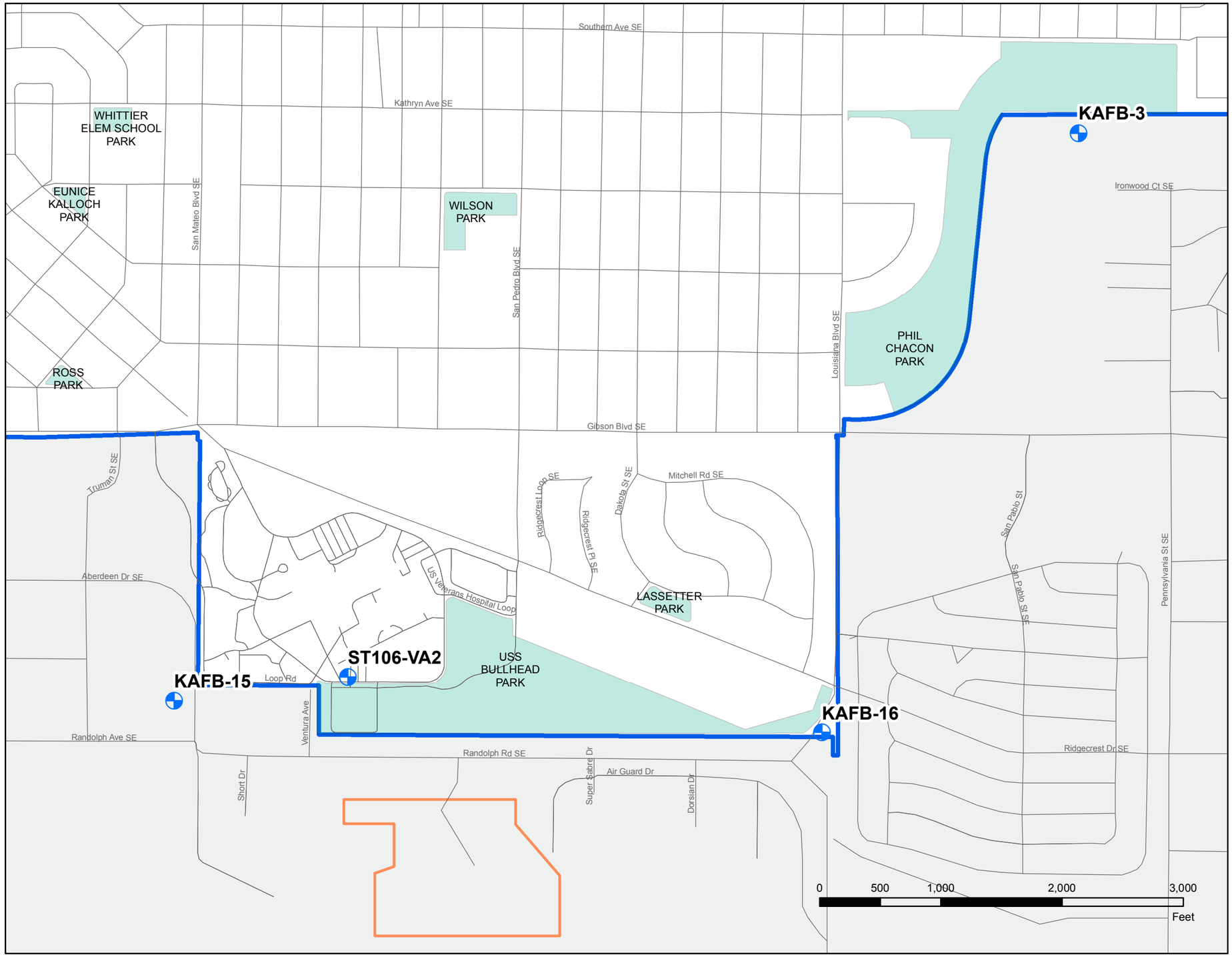
Figure 2-2

Soil Vapor Monitoring Locations
Quality Assurance Project Plan

Soil Vapor Monitoring
and Drinking Water Monitoring

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

Last Revised: 4/19/2016



Legend

- Kirtland Air Force Base Installation Area
- City of Albuquerque Parks
- Roads
- Bulk Fuels Facility Area
- Drinking Water Supply Well

N

Credits: City of Albuquerque

Coordinate System:
NAD 1927 StatePlane New Mexico Central FIPS 3002 Feet

Figure 2-3

Drinking Water Supply Wells
Quality Assurance Project Plan

Soil Vapor Monitoring
and Drinking Water Monitoring

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

Last Revised: 4/19/2016

Table 2-1. Personnel Qualifications
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Position/Staff	Qualifications	Responsibilities	Authority Level
Vice President of Operations: Jim Lockhart, P.E.	• BSME, MBA; • 33 years' experience in environmental remediation and engineering; • 25 years in management of environmental and engineering projects.	• As Sundance Officer, authorized to negotiate and commit resources; • Primary POC for USACE on contractual and programmatic items; • Ensures consistency in deliverables and cost/performance reporting and progress reporting/invoicing; • Coordinates issue resolution as needed with the COR and/or CO.	• Coordinates corrective action at programmatic level.
Project Manager: Patrick Scher, P.G.	• M.S. in Geology; • Registered Professional Geologist in two states; • 30 years' experience in environmental remediation/compliance; • 25 years' experience in DoD Project and Program Management; • 15 years' experience as technical lead/PM on complex environmental projects; • 25-year accident free track record.	• Ensures that all work is accomplished with adequate internal controls; • Main point of contact for USACE on project-specific matters; • Reviews/confirms technical approach from kickoff meeting and throughout project execution to ensure project objectives are met; • Assembles and schedules resources; • Ensures on-schedule and high-quality services are delivered within budget; • Manages subcontractors; • Coordinates Sundance's participation in the public meeting; community relations process; • Identifies and mitigates risks related to execution of the technical aspects of the work and ensures site safety; • Ensures work is performed in accordance with USACE/USAF Guidelines, state/federal regulations; • Applies lessons learned from current and past projects; • Responsible for front and back end transition activities to ensure continuity on the project; • Ensures public relations sensitivities are met.	• Full responsibility and authority to execute Task Orders; • Approves subcontractor invoices, project charges, and deliverables; • Implements corrective action; • Stops work for any reason related to the project.

Table 2-1. Personnel Qualifications
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued, Page 2 of 3)

Position/Staff	Qualifications	Responsibilities	Authority Level
Project Geologist, Technical Lead/SSHO: Rachel Hobbs, P.G.	• M.S. in Geology; • Registered Professional Geologist in the state of Tennessee; • 5 years' experience in environmental remediation; • Past experience coordinating Kirtland BFF project tasks.	• Reports to the PM and serves as the Alternative PM; • Overall responsibility for design, implementation, and management of sampling activities; • Reviews all WP, reporting, and data deliverables; • Coordinates with Field Personnel for oversight and quality control; • Responsible for providing input for the design of the corrective actions and reviews corrective elements specific to sampling; • Oversees development of APP in accordance with Engineer Manual 385-1-1 and Occupational Safety and Health Administration regulations; • Assists PM and procurement staff in verification of safety performance of Sundance staff and subcontractors. Investigates any incidents, accidents, or safety violations Performs safety audits; • Manages monitoring reports.	• Approves APPs/SSHPs and all modifications before issuance to USACE; • Manages Health and Safety Program and directs training and required attendance; • Investigates safety concerns raised by staff; • Investigates any accidents; • Stops work for any reason including noncompliance/safety violation, or quality violations.
Field Team Lead: Ryan Wortman	• B.S. in Geology; • 1+ year past experience coordinating Kirtland BFF project tasks.	• Reports to Technical Lead and/or PM; • Oversees sampling team and sampling activities; • Coordinates with the PM and Project Technical Lead on any deviations from the QAPjP due to changed field conditions such that data quality objectives are met; • Coordinates with SSHO to ensure that project activities are being performed in accordance with the APP.	• Stop sampling work at any time due to safety or quality violations.

Table 2-1. Personnel Qualifications
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Concluded, Page 3 of 3)

Acronyms & Abbreviations:
APP – Accident Prevention Plan
BFF – Bulk Fuels Facility
B.S. – Bachelor of Science Degree
BSME – Bachelor of Science in Mechanical Engineering
CO – Contracting Officer
COR – Contracting Officer's Representative
DoD – Department of Defense
MA – Master of Arts
MBA – Master of Business Administration
M.S. – Master of Science Degree
P.E. – Professional Engineer
P.G. – Professional Geologist
PM – Project Manager
POC – point of contact
QAPjP – Quality Assurance Project Plan
SSHO – Site Safety and Health Officer
SSHP – Site Safety and Health Plan
USACE – United States Army Corps of Engineers
USAF – United States Air Force

3 DATA GENERATION AND ACQUISITION

3.1 Sampling Design

This section discusses the sampling and analysis strategy for drinking water and soil vapor samples required to meet the project data quality objectives (DQOs). SVM locations and drinking water supply wells are shown in Figures 2-2 and 2-3. Soil samples may be collected as part of the installation of soil vapor monitoring points. If soil sampling is performed as part of this project, the text, tables, and figures of this QAPjP will be revised to include necessary information.

Drinking water, and soil vapor samples will be labeled, packaged, and shipped to ALS Environmental Laboratory, Inc. (ALS). ALS maintains a U.S. Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) certification for the analyses required under this contract. Soil vapor samples will be shipped to ALS's laboratory in Simi Valley, California, and samples collected from drinking water supply wells will be shipped to the ALS laboratory in Kelso, Washington. Laboratory Data Consultants, Inc. (LDC) will perform the third party data validation utilizing established data validation procedures (manually or automated) to perform 100 percent (%) review and EPA Level III data validation.

3.1.1 Soil Vapor Monitoring

There are 56 SVM locations, most of which are installed in nested SVM locations that contain multiple monitoring points for a total of 284 SVMPs (Figure 2-2). Based on information that will be collected throughout the implementation of this project, the network may be modified. New SVMPs may be added and some may be removed from the sampling program based on Vadose Zone Working Group recommendations and agreements with NMED. Soil vapor sampling will be performed in accordance with the Soil Vapor Monitoring and Drinking Water Monitoring Work Plan (WP), to which this QAPjP is attached (Appendix C).

Soil vapor samples will be analyzed for the following parameters:

- VOCs and total petroleum hydrocarbon (TPH) gasoline: EPA Method TO-15
- EDB: CARB 422
- APH (C5-C8 and C9-C12): Massachusetts Department of Environmental Protection (MA DEP)
- Fixed gases (hydrogen, oxygen [O_2], nitrogen, carbon monoxide, carbon dioxide, methane): E3C

3.1.2 Drinking Water Supply Well Monitoring

The drinking water supply well investigation activities at the BFF covered under this QAPjP are limited to four drinking water supply wells (KAFB-3, KAFB-15, KAFB-16, and ST106-VA2). These existing drinking water supply wells at KAFB and the Veteran's Administration (VA) Hospital area able to actively provide drinking water to the facilities' employees and inhabitants. All operational drinking water supply well locations will be sampled monthly, and analyzed for EDB using EPA Method 504.1, and for BTEX using EPA Method 524. Drinking water well sampling will be performed in accordance with the WP.

3.1.3 Soil Vapor Monitoring Well Installation, and Analysis

As part of the vadose zone sampling and analysis, one or more additional SVM locations, consisting of up to six SVMPs approximately 450 ft below ground surface (bgs), may need to be installed. Depending on the objectives of the borehole drilling and well installation, soil samples may be collected during borehole advancement. Soil sample collection techniques, analytical methods, and criteria for collection will be specified in the associated WP. Soil and subsequent soil vapor samples are collected for chemical analysis and will be shipped to ALS for analysis in accordance with DoD Quality Systems Manual (QSM) Version 5.0 (DoD 2013) and laboratory-specific standard operating procedures (SOPs).

3.1.4 Investigation-Derived Waste Management

It is not anticipated that any soil or water investigation-derived waste (IDW) will be generated during monitoring. SVM does not generate any containerized waste. In addition, any excess drinking water will be disposed of via KAFB's waste water treatment system or to the ground. Non-reusable personal protective equipment (PPE) will be disposed of in accordance with the project Accident Prevention Plan (APP) (Section 9.0). Any additional waste associated with sampling (plastic bags, paper waste, etcetera) will be collected and disposed of via the City of Albuquerque's (COA) waste management system.

IDW management details pertaining to any SVM well installation or abandonment that may be performed will be provided in future revisions of, or addendums to the WP. Once the drilling techniques and waste streams are determined, specifications will be submitted describing the management of that waste.

3.2 Quality Objectives and Criteria for Measurement Data

The DQO process is designed to ensure that the type, quantity, and quality of environmental data used for decision-making is appropriate for the intended application. The DQOs for the data collected in association with soil vapor and drinking water well monitoring includes the following:

- Support ongoing monitoring of the SVM network to evaluate soil vapor contamination in the vadose zone

- Support ongoing monitoring to ensure that dissolved phase EDB and BTEX have not impacted the existing drinking water wells

Soil vapor and drinking water well monitoring was initiated in the first quarter of calendar year (CY) 2016.

3.2.1 Comparison Criteria

Analytical methods selected for the project will provide sufficient sensitivity to meet the DQOs and NMED requirements, and will achieve the respective regulatory standard for all analytes in soil vapor, drinking water, and soil.

There are currently no applicable screening standards for soil vapor contamination used for the SWMU ST-106/SS-111 project.

Analytical results from the drinking water supply well monitoring events will be compared to EPA maximum contaminant levels (MCL) and New Mexico Water Quality Control Commission (NMWQCC) standards contained in New Mexico Administrative Code Title 20 – Environmental Protection, Chapter 6 – Water Quality, Part 2 – Ground and Surface Water Protection Section 20.6.2.3103.

Soil samples associated with SVM well installation or abandonment will be compared to EPA residential regional soil screening levels (RSL) (EPA, 2015) and NMED soil screening levels for residential receptors (NMED, 2015). Currently, there are no established regulatory standards for soil vapor. Regulatory limits are summarized in Attachment A with the laboratory analytical methods reporting limits.

Analytical methods, reporting limits, and screening criteria are presented in Attachment A, Tables A-1 and A-2. Analytical methods used by ALS and reporting limits will provide sufficient sensitivity to meet the DQOs, EPA MCLs, and NMWQCC standards.

3.2.2 Project Performance and Acceptance Criteria

To limit uncertainty in obtained environmental data, criteria for the sensitivity, precision, bias, representativeness, completeness, and comparability (PARCC) parameters were developed and are presented in this QAPjP. Measurement errors will be controlled by using appropriate sampling and analytical methods, adhering to the DoD QSM (2013), following established SOPs, and having data review to verify laboratory processes. Field crews will be trained in appropriate sample collection procedures and will review the QAPjP before sample collection to limit sample collection errors. Subcontract analytical laboratories will have a copy of the QAPjP and will adhere to DoD QSM guidance to limit measurement errors. Following DoD QSM requirements, laboratories will conduct detection limit studies to verify method sensitivity. In addition, laboratories will perform limit of quantitation (LOQ) studies to verify precision and bias at the LOQ. For each matrix and each method, laboratories will analyze applicable QC samples, including laboratory method blanks, surrogates, laboratory control samples (LCS)/laboratory control sample duplicates (LCSD), matrix spike (MS)/matrix spike duplicates (MSD), and internal standards to determine that results of these QC samples are within acceptable precision and bias limits. Acceptance criteria for precision, bias, and sensitivity are presented in Attachment B. The data that meet these criteria will be of definitive quality and of less uncertainty than data which was acquired with a less rigorous approach.

3.3 Monitoring Methods

Soil vapor and drinking water monitoring will be performed in accordance with sampling methodologies presented in Sections 3.2 and 3.3 of the WP and the KAFB Basewide Plans (USAF, 2004).

3.3.1 Equipment Decontamination Procedure

The objective of field decontamination is to remove contaminants of concerns (CoC) from monitoring, and field equipment to concentrations that will not impact study objectives.

Decontamination procedures specific to SMV are outlined in Section 3.2.1.2 of the WP. It is not anticipated that any additional decontamination procedures will be required for this project. If reusable sampling materials are used for drinking water supply well sampling, then KAFB Base-Wide SOP B.1-11 (Equipment Decontamination) will be used by field personnel responsible for determination of appropriate decontamination procedures.

3.4 Sample Handling and Custody

The following sections describe sample packaging and shipment, sample numbering and labeling, and chain-of-custody (COC) requirements associated with collecting soil vapor and drinking water samples.

3.4.1 Sample Packaging and Shipment

Soil vapor and drinking water samples will be collected in the appropriate certified clean sample containers provided by ALS, and in accordance with the specific WP procedures and Table 3-1.

The primary objective of sample packaging and shipping requirements is to maintain sample integrity from the time a sample is collected until it is received at the analytical laboratory. Specific procedures for packaging and shipping of environmental samples are presented below:

Step 1. A sample label is attached to the sample bottle and completed with indelible ink;

Step 2. For water samples, a cooler will be used as a shipping container. In preparation for shipping samples, the drain plug will be taped shut so that no fluids, such as melted ice, will drain out of the cooler during shipment. A large plastic bag may be used as a liner for the cooler and packing material, such as bubble wrap, or Styrofoam beads, will be placed in the bottom of the liner. All water samples for chemical analysis must be shipped cooled to 4 degrees Celsius (°C) with ice. All samples will require icing prior to shipment. A temperature blank will be placed in every cooler shipment.

Step 3. Soil vapor samples will be returned to the lab in the soil vapor container boxes in which they were received. There are no temperature or preservative requirements for shipping of soil vapor samples.

Step 4. The soil vapor container liner will be taped closed, if used, and sufficient packing material will be used to prevent sample containers from making contact or rolling around during shipment.

Step 5. A copy of the COC form will be placed inside the sample cooler or box.

Step 6. The sample cooler or box will be closed and taped shut with packing tape.

Step 7. Custody seals will be placed on the sample cooler or box.

Step 8. The sample cooler or box will be shipped in accordance with the particular sample media and corresponding hold times.

3.4.2 Soil Vapor Monitoring Well and Drinking Water Supply Well Field Sample Identification

Field sample identification (ID) will be assigned consistent with the established KAFB sample ID nomenclature for soil vapor monitoring well and drinking water supply well field sample IDs. This will ensure that monitoring data associated with the BFF investigation will be recognizable and easily identified once uploaded to the USAF data repository.

3.4.2.1 Monitoring Well IDs

SVM well IDs will follow the format of the base designator (KAFB), the SWMU identifier (106) and the sequential monitoring well number (XXX). Well numbers will follow sequentially those wells that have already been installed at the BFF site.

3.4.2.2 Field Sample IDs

Sample IDs for soil vapor and drinking water samples will be assigned with a consistent and sequential sample number such that the laboratory will not be able to distinguish between samples of the same events. The designation for field samples will be as follows:

- Soil vapor – VA (last two digits of current year) then XXXX. Soil vapor samples collected in 2016 will be labeled VA16XXXX.
- Drinking water – GW (last two digits of current CY) then XXX. Drinking water supply well samples collected in 2016 will be labeled GW16XXX.

3.4.2.3 Field Quality Control Sample IDs

Field duplicate samples will have designations consistent with the sequential field sample IDs such that they will not be distinguishable by the laboratories as being a duplicate sample. Matrix spike (MS) and matrix spike duplicates (MSD) samples, trip blank, and field blank, samples will have sample designations as listed below:

- MS: GW16XXX-MS or -MSD
- Trip blanks (VOCs): GW16TB01, VA16TB01
- Field blanks/ambient blanks (VOCs): GW16AB01, VA16AB01

3.4.3 Sample Custody and Documentation

Sampling information will be recorded on a COC form and sample collection forms for tracking. All entries will be legible and recorded in indelible ink. Because samples may be analyzed at multiple laboratories, the terms laboratory and sample custodian are generic. The custody procedures described herein apply to all laboratories that are involved in the analysis of soil vapor, drinking water, and soil samples.

3.4.3.1 Chain of Custody Records

A blank example COC form is included in Appendix A of the WP. In addition to providing a custody exchange record for the samples, the COC serves as a formal request for sample analyses. The COC form will be completed and signed, thus becoming the COC record and distributed as follows:

- One copy retained by the sample coordinator for inclusion in the project files
- The original sent to the analytical laboratory with the sample shipment

After the laboratory receives field samples, the sample custodian will inventory each shipment before signing for it, and note on the original COC record any discrepancy in the number of samples, temperature of the cooler, or presence of broken samples. The Sundance PM and/or technical lead will be notified immediately of any problems identified with shipped samples, and will determine the appropriate course of action and if project budget or schedule may be impacted.

The laboratory will initiate an internal COC that will track the sample within the various areas of the laboratory. The relinquishing signature of the sample custodian and the custody acceptance signature of the laboratory personnel document that custody of the sample has been transferred appropriately. This procedure will be followed each time a sample changes hands. The laboratory will archive the samples

and maintain them in custody as required by the contract or until further notification from Sundance, at which time the samples will either be returned to the project for disposal, or disposed of by the laboratory.

3.4.3.2 Field Sample Custody

The COC form or record will be the controlling document to ensure that sample custody is maintained. Upon collecting a sample, sampling personnel will initiate the COC in the field. Each individual who has the sample(s) in their possession will sign the COC. Each time the sample custody is transferred, the former custodian will sign the COC on the "Relinquished by" line, and the new custodian will sign the COC on the "Received by" line. The date, time, and name of their project or company affiliation will accompany each signature.

The waybill number or courier name will be recorded on the COC form when a commercial carrier is used. The shipping container will be secured with two custody seals, thereby allowing shipping personnel to maintain custody until receipt by the laboratory.

If the laboratory sample custodian judges sample custody to be invalid (e.g., custody seals have been broken), the laboratory will notify the Sundance PM and/or technical lead who will in turn contact the field team to resolve any discrepancies with field sample documentation. Any corrections required to be made to COC forms will be made by the field team, reviewed by the Sundance PM and/or technical lead to determine impact to sample custody, and transferred to the laboratory. Sample receipt discrepancies will be noted by the laboratory upon sample login.

3.4.3.3 Sample Collection Log

The Sample Collection Log form will be used to document all samples collected in the field. A copy of this form for soil vapor and drinking water can be found in Appendix A of the WP. All entries will be recorded in indelible ink. The sample team will cross out any unused portions and sign each page.

3.4.3.4 Vapor Purge Log

The Vapor Purge Log form will be used to document field sample collection information associated with SVM. A copy of this form can be found in Appendix A of the WP. All entries will be recorded in indelible ink, and will be reviewed by the sampling team. At a minimum, the vapor purge log will contain the following information:

- Project name and site
- SVMP identification number
- Field team /personnel name
- Sample date and time
- Weather conditions
- SVMP observations
- Purge calculations
- Purge volume
- Field measurements (carbon dioxide, O_2, and hydrocarbons [HC])

The Vapor Purge Log will undergo an independent QC review by a field team member other than the author or designee before shipping the samples to the offsite laboratory.

3.4.3.5 Document Corrections

Changes or corrections to any project, field, or analytical documentation will be made by crossing out the item with a single line, initialing by the person performing the correction, and dating the correction. The original item, although erroneous, will remain legible beneath the cross out. The new information will be written above the crossed-out item. Corrections will be written clearly and legibly with indelible ink.

3.5 Analytical Methods

Analytical methods, container, and preservative requirements for soil vapor and drinking water samples are summarized in Tables 3-2 and 3-3. The required target analytes for each method, applicable regulatory limits, project reporting limits, and laboratory LOQs are presented in Attachments A and B.

3.6 Quality Control

This section discusses field and laboratory QC requirements.

3.6.1 Field Quality Control Samples

Field QC samples will be collected and analyzed during the project to assess the precision and accuracy of the sampling program. Field QC samples for this project will include MS/MSD samples, field duplicates, trip blanks for VOC samples, and temperature blanks, and QA split samples if requested by USACE and NMED as discussed below.

3.6.1.1 Matrix Spike and Matrix-Spike Duplicate

MS/MSD samples will be collected at one pair per 20 drinking water samples; at least one per sampling event. MS/MSD analyses will not be performed on soil vapor samples as MS/MSD analysis for these methods and matrix are not applicable. Accuracy for these analyses will be assessed through a review of field duplicates, laboratory duplicates, and surrogate recoveries (when applicable). Field personnel will collect extra volumes for water for MS/MSD analysis and designate the MS/MSD sample(s) on the COC record (Appendix A of the WP).

3.6.1.2 Field Duplicates

Field duplicate pairs consist of two samples of the same matrix (a primary and a duplicate) collected at the same time and location to the extent possible, using the same sampling techniques. The purpose of field duplicate samples is to evaluate sampling precision. Field duplicate samples will be collected for soil vapor monitoring and drinking water sampling. Field duplicate samples will be collected at a frequency of 10% and will be analyzed for the same analytical parameters as their corresponding primary samples. For this project, the acceptance criteria for field duplicate precision is established at less than or equal to 35% for drinking water samples, and 50% for soil vapor samples. Field duplicate precision will be calculated when target analytes are detected above the reporting limit in both the primary and duplicate sample.

No field duplicates will be collected for IDW characterization purposes.

3.6.1.3 Performance Evaluation Samples

Use and anaylsis of performance evaluation samples will be implemented by the client or designee if deemed necessary. Performance evaluation samples are independent clean matrix samples that are spiked with project-specific target compounds and introduced into the sampling program by the field team.

Performance evaluation samples are then submitted to the project laboratory for analysis as blind samples to be evaluated by the USAF upon receipt of data deliverables. These results may serve as an independent QA check for the field sampling and analytical method protocol precision.

3.6.1.4 Trip Blanks

Trip blank samples will accompany each shipment containing soil vapor, drinking water and soil samples for VOC analysis. Trip blanks for drinking water samples will be 40-milliliter (mL) volatile organic analysis vials that contain analyte-free water, which are kept with the field samples during sampling and shipment to an offsite laboratory. Trip blanks for soil vapor samples are 1-liter Bottle-Vacs that are kept with field samples during soil vapor sampling and shipment to an offsite laboratory. The vacuum of the Bottle-Vac will be recorded, but the valve will not be opened, and the container will be returned to the lab with the shipment of soil vapor samples. Results of trip blank samples will be used to determine if samples have been contaminated with VOCs during sampling or shipment to the laboratory.

3.6.1.5 Temperature Blanks

Each cooler containing drinking water samples will be shipped with a temperature blank. A temperature blank is a sample container filled with tap water and shipped in the cooler to the offsite laboratory. The laboratory will record the temperature of the blank upon receipt of the samples. The temperature blank is to ensure that the temperature of the samples when received at the laboratory is less than or equal to 4°C. Temperature blanks are not required to accompany soil vapor samples to the offsite laboratory.

3.6.2 Laboratory Quality Control Samples

To ensure acceptable data quality, laboratory QC analysis will be performed for each method and for each matrix. Laboratory QC samples will include method blanks, initial and continuing calibration blanks, surrogates, LCSs, and internal standards. Tables 3-4 and 3-5 present these QC samples, acceptance criteria, and corrective actions. These QC requirements are consistent with the DoD QSM (2013) guidance. The DoD QSM and laboratory in-house control limits are presented in Attachment B.

3.7 Instrument/Equipment Testing, Inspection, and Maintenance

Field and analytical instrument testing, inspection, and maintenance requirements are described in this section. All requirements are presented in tabular format on Table 3-6 (Field Instrument Quality Control), Table 3-7 (Laboratory Instrument Quality Control – Drinking Water Monitoring), and Table 3-8 (Laboratory Instrument Quality Control – Soil Vapor Monitoring), and in Attachment B.

Other activities such as well installation and abandonment may be performed as part of this project. When designs for these activities are finalized, any additional field measurement specifications for soil boring logs, well reports, and surveying will be included in a subsequent revision to this QAPjP.

3.8 Laboratory Instrument/Equipment Calibration and Frequency

Laboratory instrument calibration requirements, frequencies, and corrective actions for each method in this section. These calibration requirements are established in accordance with the DoD QSM requirements. Calibration is a reproducible reference point to which all sample measurements can be correlated. Instrumentation calibration is necessary for accurate sample quantitation. Calibrations establish the dynamic range of an instrument, establish response factors to be used for quantitation, and demonstrate instrument sensitivity.

All calibration requirements are presented in tabular format in Table 3-9 (Analytical Instrument Calibration - Gas Chromatography/Mass Spectrometry), and Table 3-10 (Analytical Instrument Calibration (Gas Chromatography), and Attachment B.

3.9 Inspection/Acceptance of Supplies and Consumables

The accuracy of sample target analyte quantitation is directly related to the accuracy of the standards used for instrument calibration. To ensure the highest quality standard, primary reference standards used by laboratories are obtained from reliable commercial sources. Inorganic standards must be traceable to the National Institute of Standards and Technology (NIST); organic standards must be traceable to NIST or American Association of Laboratory Accreditation vendors when available. When standards are received at the laboratory, the date received, supplier, lot number, purity and concentration, and expiration date are recorded in a standard preparation log book. Vendor certifications sent with the standards are also filed and are available upon request.

Standards purchased by the laboratory may be in a pure form, in a stock, or in a working standard solution. All standards made are given a standard identification number and have the following information recorded in a standards log book: source of standard used to prepare dilution; preparer's initials; initial concentration; final concentration; solvent; source and lot number of solvent; volume of final solution; and volume of standard diluted. Records must unambiguously trace the preparation of standards, their use in calibration, and the quantitation of sample results. After preparation and before routine use, the identity and concentration of standards are verified. Verification procedures include a check for chromatographic purity (if applicable) and verification of the concentration of the standard using a standard prepared at a different time or obtained from a different source. Reagents are also examined for purity by subjecting an aliquot or subsample to the analytical method in which it will be used. Standards are routinely checked for signs of deterioration (e.g., discoloration, formation of precipitates, or changes in concentration) and are discarded if deterioration is suspected or their expiration date has passed. Expiration dates may be taken from the vendor recommendation, the analytical methods, or from internal research.

Table 3-1. Sample Requirements for Analytical Testing
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Drinking Water and Soil Vapor Samples					
Matrix	**Parameter[1]**	**Container[2,3]**	**Preservation**	**Maximum Holding Times[4]**	
				Extraction	**Analysis**
Water	BTEX	3 x 40-mL G, Septa Vial	Ice to 4°C 4 drops conc. HCl to pH<2	---	14 days
Water	EDB	3 x 40-mL G, Septa Vial	Ice to 4°C	---	14 days
Vapor	VOCs/APH	1 x 1-L Bottle Vac	None	N/A	28 days
Vapor	Fixed gases	1 x 1-L Bottle Vac	None	N/A	30 days
Vapor	CARB 422	1 x 1-L Bottle Vac	None	N/A	30 days

Acronyms and Abbreviations:
< = less than
°C = degrees Celsius; APH = air-phase petroleum hydrocarbon
BTEX = benzene, toluene, ethylbenzene, and xylenes
CARB = California Air Resources Board
EDB = ethylene dibromide
G = glass
HCl = hydrochloric acid
L = liter
mL = milliliter
pH = potential hydrogen
VOC = volatile organic compound

1. All containers must have Teflon-lined seals.
2. (Teflon-lined septa for volatile organic analysis [VOA] vials).
3. Sample preservation will be completed in the field immediately upon sample collection.
4. When only one holding time is given, it implies total holding time from sampling until analysis.

Table 3-2. Analytical Method, Preservation, and Holding Time Requirements - Drinking Water Monitoring
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Volume	Container (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Water	BTEX – EPA 524.2	Preparation: EPA 524.2 Analysis: EPA 524.2	40 mL	3 X 40 mL VOA with Teflon® septa	HCL to pH <2 Cool at 0-4°C	14 days for analysis
Water	EDB – EPA 504.1	Preparation: EPA 504.1 Analysis: EPA 504.1	40 mL	3 X 40 mL VOA with Teflon® septa	Cool at 0-4°C	14 days for analysis

Acronyms and Abbreviations:
< = less than
°C = degrees Celsius
BTEX = benzene, toluene, ethylbenzenes, and xylenes
EDB = ethylene dibromide
EPA = United States Environmental Protection Agency
HCl = hydrochloric acid
mL = milliliter
NA = not applicable
pH = potential hydrogen
SOP = standard operating procedure
SVOC = semi volatile organic compound
VOA = volatile organic analysis

Table 3-3. Analytical Method, Preservation, and Holding Time Requirements – Soil Vapor Monitoring
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Volume	Container (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Vapor	VOCs EPA TO15	Preparation: EPA TO15 Analysis: EPA TO15	1 L	1 L Bottle Vac Canister; 1L for Vapor	NA	30 days for analysis
Vapor	APH – Method MA DEP	Preparation: Method MA DEP Analysis: Method MA DEP	1 L	1 L Bottle Vac Canister	NA	28 days for analysis
Vapor	Fixed Gases – ASTM D2504	Preparation: ASTM D2504 Analysis: ASTM D2504	1 L	1 L Bottle Vac Canister	NA	30 days for analysis
Vapor	CARB 422	Preparation: CARB 422 Analysis: CARB 422	1 L	1 L Bottle Vac Canister	NA	30 days for analysis

Acronyms & Abbreviations:
APH = air-phase petroleum hydrocarbon
ASTM = ASTM International
CARB = California Air Resources Board
EPA = U.S. Environmental Protection Agency
L = liter
MA DEP = Massachusetts Department of Environmental Protection
NA = not applicable
SOP = standard operating procedure
TPH = total petroleum hydrocarbon
VOC = volatile organic compound

Table 3-4. Laboratory QC Samples - Gas Chromatography/Mass Spectrometry
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Matrix	**Drinking Water and Soil Vapor**					
Analytical Group	**VOCs, BTEX, and APH**					
Analytical Method	**Methods 524.2, MA DEP, and TO15**					
QC Sample	**Frequency**	**QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicators**	**Measurement Performance Criteria**
Internal standards	Every field sample and QC samples	RT within ±30 seconds from RT of initial calibration midpoint standard; area counts within -50% to +100% of initial calibration midpoint standard	Correct problem, then re- reanalyze affected samples.	Lab Manager/Analyst	Bias	RT within ±30 seconds and area count within -50% to +100%
Method blank	One per preparation batch	No target analytes detected greater than one-half RL and 1/10 the amount measured in any sample or 1/10 regulatory limit (whichever is greater). No laboratory common contaminants detected greater than RL.	Correct problem, then re- reanalyze method blank and all samples processed with the contaminated blank.	Lab Manager/Analyst	Representativeness	No target analytes detected greater than one-half RL and 1/10 the amount measured in any sample or 1/10 regulatory limit (whichever is greater). No laboratory common contaminants detected greater than RL.

Table 3-4. Laboratory QC Samples - Gas Chromatography/Mass Spectrometry
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued, Page 2 of 5)

Matrix	**Drinking Water and Soil Vapor**					
Analytical Group	**VOCs, BTEX, and APH**					
Analytical Method	**EPA Methods 524.2, MA DEP, and TO15**					
QC Sample	**Frequency**	**QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicators**	**Measurement Performance Criteria**
MS/MSD for all analytes	One MS/MSD pair per preparation batch per matrix *Not performed on vapor samples	EPA 524.2 and 504.1, MA DEP: LCS control limits specified by laboratory SOP	Identify problem; if not related to matrix interference, re-reanalyze MS/MSD and all associated batch samples .	Lab Manager/Analyst	Precisions and Bias	EPA 524.2 and 504.1, MA DEP: LCS control limits specified by laboratory SOP
LCS or LCS/LCSD pair for all analytes	One LCS or LCS/LCSD pair per preparation batch per matrix	EPA 524.2 and 504.1, MA DEP: LCS control limits specified by laboratory SOP TO15: LCS control limits specified in the DOD QSM	Correct problem, then re-reanalyze the LCS and all associated batch samples.	Lab Manager/Analyst	Precisions and Bias	EPA 524.2 and 504.1, MA DEP: LCS control limits specified by laboratory SOP TO15: LCS control limits specified in the DOD QSM

Table 3-4. Laboratory QC Samples - Gas Chromatography/Mass Spectrometry
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued, Page 3 of 5)

Matrix	**Drinking Water and Soil Vapor**					
Analytical Group	**VOCs, BTEX, and APH**					
Analytical Method	**EPA Methods 524.2, MA DEP, and TO15**					
QC Sample	**Frequency**	**QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicators**	**Measurement Performance Criteria**
Surrogate standards	Every field sample and QC sample	EPA 524.2 and 504.1: Surrogate recovery acceptance criteria specified in laboratory SOP TO15: Specified in DOD QSM	Correct problem, then re-reanalyze all affected samples.	Lab Manager/Analyst	Bias	EPA 524.2 and 504.1: Surrogate recovery acceptance criteria specified in laboratory SOP TO15: Specified in DOD QSM
Sample duplicate	Every 20 samples	TO15: Specified in DOD QSM MA DEP: Surrogate recovery acceptance criteria specified in laboratory SOP	NA	Lab Manager/Analyst	Bias	TO15: Specified in DOD QSM MA DEP: Surrogate recovery acceptance criteria specified in laboratory SOP
MDL study	Initial setup *Not run for MA APH	Detection limits established will be below the LOQs .	Correct problem, then repeat the MDL study.	Lab Manager/Analyst	Sensitivity	

Table 3-4. Laboratory QC Samples - Gas Chromatography/Mass Spectrometry
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued, Page 4 of 5)

Matrix	**Drinking Water and Soil Vapor**					
Analytical Group	**VOCs, BTEX, and APH**					
Analytical Method	**EPA Methods 524.2, MA DEP, and TO15**					
QC Sample	**Frequency**	**QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicators**	**Measurement Performance Criteria**
LOD study	Initial setup and quarterly LOD verification *Not run for MA APH	Signal to noise ratio at the LOD will be greater than 3 and meet method requirements.	Correct problem, then repeat detection limit study and LOD verification at a higher concentration, or pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration in accordance with DoD QSM requirements.	Lab Manager/Analyst	Sensitivity	
LOQ study	Annually and quarterly LOQ verification	LOQ will be greater than LOD and within calibration range. Laboratory procedure for establishing the LOQ will empirically demonstrate precision and bias at the LOQ LOQ>LOD>DL		Lab Manager/Analyst	Sensitivity	

Table 3-4. Laboratory QC Samples - Gas Chromatography/Mass Spectrometry
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Concluded, Page 5 of 5)

Acronyms and Abbreviations:
% = percent
APH = air-phase petroleum hydrocarbon
DL = detection limit
DoD = U.S. Department of Defense
EPA = U.S. Environmental Protection Agency
LCS = laboratory control sample
LCSD =laboratory control sample duplicate
LOD = limit of detection
LOQ = limit of quantitation
MA APH = Massachusetts Air-Phase Petroleum Hydrocarbon
MA DEP = Massachusetts Department of Environmental Protection
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
NA = not applicable
QC = quality control
QSM = Quality Systems Manual
RL = reporting limit
RPD = relative percent difference
RT = retention time
SVOC = semi volatile organic compound
VOC = volatile organic compound

Table 3-5. Laboratory QC Samples - Gas Chromatography
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Matrix	**Drinking Water and Soil Vapor**					
Analytical Group	**EDB, TPH, Fixed Gases**					
Analytical Method	**EPA Method 504.1, MA DEP, CARB422**					
QC Sample	**Frequency**	**QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicators**	**Measurement Performance Criteria**
Method blank	One per preparation batch	No target analytes detected greater than one-half RL and >1/10 amount detected in project samples or 1/10 the regulatory limit (whichever is greater)	Correct problem, then re-extract and reanalyze method blank and all samples processed with the contaminated blank	Lab Manager/Analyst	Representativeness	No target analytes detected greater than one-half RL and >1/10 amount detected in project samples or 1/10 the regulatory limit (whichever is greater)
MS/MSD for all analytes	One MS/MSD pair per preparation batch per matrix *Not performed on vapor samples	EPA 504.1, MA DEP: Laboratory in-house LCS control limits RPD less than 30% between MS and MSD	Identify problem; if not related to matrix interference, re-extract and reanalyze MS/MSD and all associated batch samples	Lab Manager/Analyst	Precisions and Bias	EPA 504.1, MA DEP: Laboratory in-house LCS control limits RPD less than 30% between MS and MSD

Table 3-5. Laboratory QC Samples - Gas Chromatography
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued, Page 2 of 5)

Matrix	**Drinking Water and Soil Vapor**					
Analytical Group	**EDB, TPH, Fixed Gases**					
Analytical Method	**EPA Method 504.1, MA DEP, CARB422**					
QC Sample	**Frequency**	**QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicators**	**Measurement Performance Criteria**
LCS or LCS/LCSD pair for all analytes	One LCS or LCS/LCSD pair per preparation batch per matrix	EPA 524.2 and 504.1, MA-DEP: Laboratory in-house LCS control limits	Correct problem, then re-extract and reanalyze the LCS and all associated batch samples.	Lab Manager/Analyst	Precisions and Bias	EPA 524.2 and 504.1, MA-DEP: Laboratory in-house LCS control
Surrogate standards	Every field sample and QC sample *Not added to CARB422 or fixed gasses	EPA 524.2 and 504.1, MA-DEP: Laboratory in-house surrogate acceptance criteria	Correct problem, then re-extract and reanalyze all affected samples.	Lab Manager/Analyst	Bias	EPA 524.2 and 504.1, MA-DEP: Laboratory in-house surrogate acceptance criteria

Table 3-5. Laboratory QC Samples - Gas Chromatography
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued, Page 3 of 5)

Matrix	**Drinking Water and Soil Vapor**					
Analytical Group	**EDB, TPH, Fixed Gases**					
Analytical Method	**EPA Method 504.1, MA DEP, CARB422**					
QC Sample	**Frequency**	**QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicators**	**Measurement Performance Criteria**
Confirmation of positive results using second column or second detector	All positive results must be confirmed	Same calibration and QC requirements as for initial or primary column analysis. RPD between primary and second column results less than 40%	NA	Lab Manager/Analyst	Precision	RPD between primary and second column results less than 40%
MDL study	Initial setup *Not run for fixed gasses	Detection limits established will be below the LOQs	Correct problem, then repeat the MDL study in accordance with DoD QSM requirements.	Lab Manager/Analyst	Sensitivity	

Table 3-5. Laboratory QC Samples - Gas Chromatography
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued, Page 4 of 5)

Matrix	**Drinking Water and Soil Vapor**					
Analytical Group	**EDB, TPH, Fixed Gases**					
Analytical Method	**EPA Method 504.1, MA DEP, CARB422**					
QC Sample	**Frequency**	**QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**	**Data Quality Indicators**	**Measurement Performance Criteria**
LOD study	Initial setup and quarterly LOD verification *Not run for CARB422 or fixed gasses	Signal to noise ratio at the LOD will be greater than 3 and meet method requirements.	Correct problem, then repeat detection limit study and LOD verification at a higher concentration, or pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration per DoD QSM.	Lab Manager/Analyst	Sensitivity	
LOQ study	Annually and quarterly LOQ verification	LOQ will be greater than LOD and within calibration range. Laboratory procedure for establishing the LOQ will empirically demonstrate precision and bias at the LOQ. LOQ>LOD>DL		Lab Manager/Analyst	Sensitivity	

Table 3-5. Laboratory QC Samples - Gas Chromatography
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Concluded, Page 5 of 5)

Acronyms and Abbreviations:
% = percent
ASTM = ASTM International
CARB=California Air Resources Board
DoD = U.S. Department of Defense
EDB = ethylene dibromide
EPA = U.S. Environmental Protection Agency
EPH = extractable petroleum hydrocarbon
LCS = laboratory control sample
LCSD =laboratory control sample duplicate
LOD = limit of detection
LOQ = limit of quantitation
MA DEP = Massachusetts Department of Environmental Protection
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
NA = not applicable
QC = quality control
QSM = Quality Systems Manual
RL = reporting limit
RPD = relative percent difference
SOP = standard operating procedure
TPH = total petroleum hydrocarbon
VPH = volatile petroleum hydrocarbon

Table 3-6. Field Instrument Quality Control
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Field Equipment	Calibration Verification Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Photoionization Detector	Check calibration to 100 parts per million isobutylene.	Once per day before first use	± 5% of standard value	Recalibrate	Sundance Field Personnel	Manufacturer's Operation Manual
Horiba	Check calibration for petroleum hydrocarbons and CO_2 against a calibration standard of known concentrations in a premixed gas cylinder.	Once per day before first use	± 10% of standard value	Recalibrate	Sundance Field Personnel	Manufacturer's Operation Manual – modified per WP
	Check calibration for O_2 against atmospheric concentrations.	Once per day before first use	O_2>22%	Recalibrate	Sundance Field Personnel	Manufacturer's Operation Manual – modified per WP
YSI 556 Multi-Probe System Water Quality Meter	Check calibration for multi-probe meters against manufacturer provided calibration standards.	Once per day before first use	Manufacturer's Standard	Recalibrate	Sundance Field Personnel	Manufacturer's Operation Manual – modified per WP

Acronyms and Abbreviation
> = greater than
% = percent
CO_2 = carbon dioxide
O_2 = oxygen
SOP = standard operating procedure
Sundance = Sundance Consulting, Inc.
WP = Work Plan
YSI = Yellow Springs Instruments

Table 3-7. Laboratory Instrument Quality Control – Drinking Water Monitoring
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[2]	SOP Reference
GC/MS	Check pressure and gas supply daily. Bake out trap and column, manual tune if BFB not in criteria, change septa as needed, cut column as needed, change trap as needed.	Water samples	Ion source, injector liner, column, column flow, purge lines, purge flow, trap	Prior to initial calibration and/or as necessary	Acceptable tune and calibration or CCV	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	ALS Analyst and Laboratory Manager	ALS SOP VOC-524.2
MS	Change the injection port liner, column ferrule, and autosampler syringe as needed. Liners should be changed when recent sample analyses predict a problem with chromatographic performance. The autosampler should be cleaned periodically. This includes turret cleaning and cleaning or replacing the syringe.	Water Samples	injection port liner, column ferrule, and autosampler syringe	Prior to initial calibration and/or as necessary	Acceptable tune and calibration or CCV	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	ALS Analyst and Laboratory Manager	ALS SOP SDV-504.1

Table 3-7. Laboratory Instrument Quality Control – Drinking Water Monitoring
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Concluded, Page 2 of 2)

Acronyms and Abbreviations:
ALS = ALS Environmental Laboratory
BFB = bromofluorobenzene
CCV = continuing calibration verification
GC/MS = gas chromatography/mass spectrometry
SOP = standard operating procedure
VOC = volatile organic compound

Table 3-8. Laboratory Instrument Quality Control – Soil Vapor Monitoring
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS	Daily/regular as specified	Air samples	Instrument operating parameters	Daily	Per SOP	Recalibrate/ stop for service on failure	ALS Laboratory Analyst and Laboratory Manager	VOA-TO-15 Rev 22 VOA-MAPH Rev 9
GC	Daily during use.	Air/gas samples	Instrument operating parameters	Daily	Per SOP	Recalibrate/ stop for service on failure	ALS Laboratory Analyst and Laboratory Manager	VOA-EPA 3C Rev 13 SVO-CARB422 Rev 5

Acronyms and Abbreviations:
ALS = ALS Environmental Laboratory, Inc.
CARB = California Air Resources Board
EPA = U.S. Environmental Protection Agency
GC = gas chromatography
GC = gas chromatography
MS = mass spectrometry
SOP = standard operating procedure
VOA = volatile organic compound

Table 3-9. Analytical Instrument Calibration - Gas Chromatography/Mass Spectrometry
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Matrix	**Drinking Water and Soil Vapor**				
Analytical Group	**VOCs, BTEX, and APH**				
Analytical Method	**EPA Methods 524.2, MA DEP, and TO15**				
Instrument	**Calibration Procedure**	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**
GC/MS	Check of mass spectral ion intensities (tuning procedure) using bromofluorobenzene	Prior to initial calibration and meet frequency requirements specified in the method	Must meet the method requirements before samples are analyzed	Retune instrument and verify the tune acceptability, rerun the affected samples.	Lab Manager/Analyst
	Five-point initial calibration for target analytes, lowest calibration standard at or near the LOQ in accordance with DoD QSM requirements	Initial calibration prior to sample analysis	TO15 and MA DEP: RSD is less than 30%per method requirements 524.2: RSD is less than 20% per method requirements	Correct problem, then rerun initial calibration in accordance with DoD QSM/method requirements.	Lab Manager/Analyst

Table 3-9. Analytical Instrument Calibration - Gas Chromatography/Mass Spectrometry
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued, Page 2 of 3)

Matrix	**Drinking Water and Soil Vapor**				
Analytical Group	**VOCs, BTEX, and APH**				
Analytical Method	**EPA Methods 524.2, MA DEP, and TO15**				
Instrument	**Calibration Procedure**	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**
GC/MS	Second-source calibration verification in accordance with DoD QSM requirements	Once per five-point initial calibration	EPA 524.2: Less than 30% difference for all target analytes in accordance with method requirements MA DEP: Less than 25% difference for all target analytes in accordance with method requirements	Correct problem, then rerun second source calibration verification in accordance with DoD QSM/method requirements.	Lab Manager/Analyst
	Daily calibration verification in accordance with DoD QSM requirements	Before sample analysis and every 12 hours of analysis	EPA 524.2 and TO15: Less than 30% difference for all target analytes in accordance with method requirements MA DEP: Less than 25% difference for all target analytes per method requirements	Correct problem, then rerun calibration verification in accordance with DoD QSM/method requirements.	Lab Manager/Analyst
	Breakdown check	Before sample analysis and every 12 hours of analysis		Correct problem, then rerun breakdown check.	Lab Manager/Analyst

Table 3-9. Analytical Instrument Calibration - Gas Chromatography/Mass Spectrometry
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Concluded, Page 3 of 3)

Acronyms and Abbreviations:
% = percent
APH = air phase petroleum hydrocarbon
DDT = dichlorodipheyl trichloroethane
DoD = U.S. Department of Defense
EPA = U.S. Environmental Protection Agency
GC/MS = gas chromatography/mass spectrometry
LCS = laboratory control sample
LOQ = limit of quantitation
MA APH = Massachusetts Air-Phase Petroleum Hydrocarbon
MA DEP = Massachusetts Department of Environmental Protection
QSM = Quality Systems Manual
RSD = relative standard deviation
SVOC = semi volatile organic compound
VOC = volatile organic compound

Table 3-10. Analytical Instrument Calibration- Gas Chromatography
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Matrix	**Drinking Water and Soil Vapor**				
Analytical Group	**EDB, TPH, Fixed Gases**				
Analytical Method	**EPA Method 504.1, MA DEP, CARB422**				
Instrument	**Calibration Procedure**	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**
GC	Minimum five-point initial calibration for target analytes, lowest calibration standard at or near the LOQ in accordance with DoD QSM requirements Stable Isotope: Perform external calibration of working standard per laboratory SOPs	Initial calibration prior to sample analysis	EPA 504.1: RSD less than or equal to 20% for all target analytes in accordance with DoD QSM requirements MA DEP: RSD less than 25% for all target analytes per method requirements	Correct problem, then rerun initial calibration in accordance with DoD QSM requirements.	Lab Manager/Analyst
	Second-source calibration verification	Once per five-point initial calibration	EPA 504.1: Less than 20% of expected values from the initial calibration for all target analytes in accordance with DoD QSM requirements MA DEP: Less than 25% of expected values from the initial calibration for all target analytes per method requirements	Correct problem, then rerun second source calibration verification in accordance with DoD QSM requirements.	Lab Manager/Analyst

Table 3-10. Analytical Instrument Calibration - Gas Chromatography
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Concluded, Page 2 of 2)

Matrix	**Drinking Water and Soil Vapor**				
Analytical Group	**EDB, TPH, Fixed Gases**				
Analytical Method	**EPA Method 504.1, MA DEP, CARB422**				
Instrument	**Calibration Procedure**	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**Person(s) Responsible for Corrective Actions**
GC	Daily calibration verification.	EPA 524.2 and 504.1, MA DEP, Before sample analysis and at frequency specified in the method	MA DEP: Less than 25% of expected values from the initial calibration for all target analytes per method requirements	Correct problem, then rerun calibration verification in accordance with DoD QSM requirements.	Lab Manager/ Analyst

Acronyms and Abbreviations:
% = percent
ASTM = ASTM International
DoD = U.S. Department of Defense
EDB = ethylene dibromide
EPA = U.S. Environmental Protection Agency
EPH = extractable petroleum hydrocarbon
GC = gas chromatography
LOQ = limit of quantitation
MA DEP = Massachusetts Department of Environmental Protection
QSM = Quality Systems Manual
RSD = relative standard deviation
SOP = standard operating procedure
TPH = total petroleum hydrocarbon
VPH = volatile petroleum hydrocarbon

4 DATA VALIDATION AND USABILITY

4.1 Analytical Data Review, Verification, and Validation

The laboratory analyst who generates the analytical data will have primary responsibility for the correctness and completeness of data. Each step of this verification and review process will involve the evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of data is essential in ensuring that data of known quality is consistently generated. All data generated and reduced will follow well-documented in-house protocols.

4.1.1 Level 1: Technical or Peer Data Review

Analysts will review the quality of their work based on an established set of guidelines, including the QC criteria established in each method, in this QAPjP, and as stated within the laboratory QA manual (Attachment C). This review will, at a minimum, ensure that the following conditions have been met:

- Sample preparation information is correct and complete.
- Analysis information is correct and complete.
- Appropriate SOPs have been followed.
- Calculations are verified.
- There are no data transposition errors.
- Analytical values are correct and complete.
- QC samples results are within established control limits.
- Blank results are within appropriate QC limits.
- LCS results are within appropriate QC limits.
- Special sample preparation and analytical requirements have been met.
- Documentation is complete; for example, any anomalies and holding times have been documented and forms have been completed.

4.1.2 Level 2: Technical Data Review

A supervisor or data review specialist whose function is to provide an independent review of data packages will perform this review. This review will also be conducted according to an established set of guidelines and will be structured to verify the Level 1 data review. This review will, at a minimum, ensure that the following conditions have been met:

- Appropriate laboratory SOPs are followed.
- Calibration data are scientifically sound and appropriate to the method.
- QC samples results are within established guidelines.
- Qualitative identification of contaminants is correct.
- Manual integrations are justified and documented.
- Quantitative results and calculations are correct.
- Data is qualified correctly.

- Documentation is complete.
- The data package is complete and complies with contract requirements.

The Level 2 review will be structured so that all calibration data and QC sample results are reviewed and all of the analytical results from at least 10% of the samples are checked back to the sample preparation and analytical bench sheets. If no problems are found with the data package, the review will be considered complete. If discrepancies are identified, additional data evaluation is required.

4.1.3 Level 3: Administrative Quality Assurance Data Review

The laboratory QA Manager will review 10% of all data packages. This review should be similar to the review as provided in Level 2, except that it will provide a total overview of the data package to ensure its consistency and compliance with project requirements. All errors noted will be corrected and documented.

4.2 Analytical Data Verification and Validation

Sundance will subcontract a third party data validator utilizing established data validation procedures (manually or automated) to perform EPA 100% review and Level III data validation. The review will be performed for drinking water, and soil vapor analytical data obtained from each of the field tasks.

The data review will be performed using the QC criteria specified in the following analytical method and data validation guidelines:

- Project-specific QAPjP
- *DoD Quality Systems Manual for Environmental Laboratories, Version 5.0* (July 2013)
- *USEPA Test Methods for Evaluating Solids Waste, Physical/Chemical Methods* (SW 846, 2006 and updates)
- *USEPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)* (January 1999)
- MA DEP, *Method for the Determination of Extractable Petroleum Hydrocarbons (EPH)* (May 2004a)
- MA DEP, *Method for the Determination of Volatile Petroleum Hydrocarbons (VPH)* (May 2004b)
- MA DEP, *Method for the Determination of Air-Phase Petroleum Hydrocarbons (APH)* (December 2009)
- American Public Health, Association, American Water Works Association, and Water Environment Federation, *Standard Methods for the Examination of Water and Wastewater, 21st Edition* (2005)
- *USEPA Contract Laboratory Program, National Functional Guidelines for Superfund Organic Methods Data Review* (August 2014)

- *USEPA Contract Laboratory Program, National Functional Guidelines for Inorganic Superfund Data Review, Final* (August 2014)

The following QC elements will be included in the EPA 100% review and Level III data validation:

- Sample extraction and analysis holding times
- Laboratory method blanks
- Surrogate spike recoveries
- LCS/LCSD recoveries
- MS/MSD recoveries
- Laboratory Duplicate, LCS/LCSD and MS/MSD Relative percent differences (RPD)
- Initial calibrations
- Continuing and initial calibration verifications
- Trip, rinse, and ambient field blank results
- Field duplicate sample precision
- For GCMS:
    - Instrument Tune
    - Internal Standards
- Serial Dilutions

Data will be validated and flagged with the following data qualifiers as applicable:

- **J+ qualifier** denotes the analyte was positively identified, but the associated numerical value is estimated with a potential high bias.
- **J- qualifier** denotes the analyte was positively identified, but the associated numerical value is estimated with a potential low bias.
- **U qualifier** denotes the analyte was analyzed for, but was not detected above the MDL.
- **UJ qualifier** denotes that the analyte was not detected above the reported sample LOQ; however, the reported LOQ is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- **R qualifier** denotes the data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria and DQOs.

As a result of the Level III data validation process, EPA qualifiers will be generated and applied to the affected sample results that exceeded the established QC criteria. EPA 100% review and level III data validation findings will be summarized and documented with each monitoring report.

4.3 Reconciliation with User Requirements

Based on data review and data qualification, the Data Validator will determine if the project DQOs have been met, and data completeness will be calculated. To reconcile the collected data with project DQOs and to establish and document data usability, the data will be reviewed against data quality indicators discussed below.

The Data Validator will prepare a data quality assessment (DQA) report for each of the monitoring events. The DQA report will document:

- Implementation of sampling design and analysis according to the approved QAPjP (or sample completeness and representativeness)
- Proper frequency of field QC samples and the adequacy of field decontamination procedures
- Accuracy and precision of the data
- Data comparability, if applicable
- Data usability for project decisions

4.3.1 Data Quality Indicators

This section defines the data quality indicators and their use for assessment of data quality. These indicators include the PARCC parameters of precision, accuracy, representiveness, comparability and completeness.

4.3.1.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. The following equation illustrates the method for calculating relative percent difference (RPD) to assess a method's precision:

Precision as RPD	=	$\frac{\text{Absolute (Result – Duplicate Result)}}{\text{Average (Result + Duplicate Result)}}$	x	100%

The laboratory uses MS/MSD samples to assess the precision of analytical procedures. According to USACE requirements, analytical laboratories perform MS/MSD on the project samples to determine whether matrix interferences may be present.

In addition, LCS/LCSD samples can be used to determine analytical method precision when MS/MSD samples are not practical due to the nature of sample or analytical method used. Laboratories will use precision limits specified in the DoD QSM for both LCS and MS analyses (DoD, 2013). When precision limits are not available in the DoD QSM, laboratories may use statistically-based acceptability limits for RPDs established for each method of analysis and sample matrix. The laboratory will review the QC samples to ensure that internal QC data achieve limits of acceptability. Any suspect trends will be investigated and corrective actions taken.

4.3.1.2 Accuracy

Accuracy measures the bias of an analytical system by comparing the difference of a measurement with a reference value. The percent recovery of an analyte, which has been added to the environmental samples at a known concentration before extraction and analysis, provides a quantitation tool for analytical accuracy. The spiking solutions used for accuracy determinations are not used for instrument calibrations. The following equation illustrates how accuracy is evaluated:

Accuracy as Percent Recovery	=	$\frac{\text{Spiked Sample Result} - \text{Sample Result}}{\text{Spiked Sample True Value}}$	x	100%

Percent recoveries for MS, MSD, and LCS serve as a measure of analytical accuracy. Surrogate standards are added to all samples, blanks, MS, MSD, and LCS analyzed for gas chromatography and mass spectrometry analytical methods to evaluate accuracy of the method and help to determine matrix interferences.

Laboratories will use LCS limits specified in the DoD QSM for both LCS and MS analyses (DoD 2013). When LCS limits are not available in the DoD QSM, the laboratory may use in-house, statistically-based, control limits or control limits specified in EPA methods.

4.3.1.3 Representativeness

Unlike precision and accuracy, which can be expressed in quantitative terms, representativeness is a qualitative parameter. Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. A qualitative parameter depends on proper design of the sampling program.

Field personnel will be responsible for ensuring that samples are representative of field conditions by collecting and handling samples according to the approved QAPjP and WP. Errors in sample collection, packaging, preservation, or COC procedures may result in samples being judged non-representative and may form a basis for rejecting the data.

Data generated by the laboratory must be representative of the laboratory database of accuracy and precision measurements for analytes in different matrices. Laboratory procedures for sample preparation will ensure that aliquots used for analysis are representative of the whole sample. Aliquots to be analyzed for volatile parameters (if any) will be removed before the laboratory composites/homogenizes the samples, to avoid losing volatile compounds during mixing.

4.3.1.4 Comparability

Comparability is a qualitative parameter expressing the confidence where one data set can be compared with another, whether it was generated by a single laboratory or during laboratory studies. The use of standardized field and analytical procedures ensures comparability of analytical data.

Sample collection and handling procedures will adhere to EPA-approved protocols. Laboratory procedures will follow standard analytical protocols, use standard units and standardized report formats, follow the calculations as referenced in approved analytical methods, and use a standard statistical approach for QC measurements.

4.3.1.5 Completeness

Completeness goals for each sampling round are defined in the following section.

4.3.1.5.1 Contractual Completeness

The contractual completeness goal is set at 95% for all methods and is calculated as defined below. The following QC elements are evaluated for the purpose of determining completeness calculation:

- Holding time
- Laboratory blank contamination
- Initial calibration verification
- Continuing calibration verification
- LCSs

% Contract Completeness	=	Number of Unqualified Results* / Number of Results Reported	x	100%

* *Determined by subtracting the results qualified based on contractual deficiencies from the total number of results*

4.3.1.5.2 Analytical Completeness

The analytical completeness goal is set at 90% for all methods and is calculated as defined below. The following QC elements will be considered analytical deficiencies for the purposes of the analytical completeness calculation:

- Holding time
- Laboratory blank contamination
- Field blank contamination (trip, equipment, ambient, and rinse)
- Initial calibration verification
- Continuing calibration verification
- LCS recovery
- MS recovery
- MS precision
- Surrogate recovery

% Analytical Completeness	=	Number of Unqualified Results* / Number of Results Reported	x	100%

* *Determined by subtracting results qualified for any of the deficiencies from the total number of results.*

4.3.1.5.3 Technical Completeness

The technical completeness goal is set at 95% for all methods and is calculated as defined below. Results considered unusable (or rejected) for the intended purpose based on contractual or technical deficiencies will be included for the purposes of the technical completeness calculation:

% Technical Completeness	=	$\frac{\text{Number of Useable Results*}}{\text{Number of Results Reported}}$	X	100%

** Technical completeness (i.e., usability) will be determined by subtracting results rejected for any reason from the total number of results reported.*

4.3.2 Project-Required Reporting Limits – Sensitivity

Following the DoD QSM requirements, the laboratory will determine the method detection limits (MDL) for each method, instrument, analyte, and matrix by using the procedure described in Title 40 Code of Federal Regulations Part 136B. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero.

Following MDL studies, the laboratory will establish the reporting limit or LOQ for each method, analyte, matrix, and instrument in accordance with the DoD QSM requirements. The LOQ is the lowest concentration of a substance that produces a quantitative result within specific limits of precision and bias. The laboratory will perform LOQ verifications to verify precision and bias at the LOQ. The LOQ is greater than the LOD and must be within the calibration range prior to sample analysis. For this project, the laboratory will report positive results down to the MDL and results between the DL and LOQ will be flagged with a J-qualifier and reported as estimated data.

5 ASSESSMENT AND OVERSIGHT

Performing assessments and conducting QA oversight of project activities are vital to verifying that project objectives are being met and assuring the continued quality of the work performed. Assessments will take the form of field surveillances. QA oversight will regularly be performed onsite and is intended to be an interactive part of the field work performed. QA oversight will be performed by the Sundance Project Technical Lead, or designee. QA oversight includes inspections of work performed, verification of field documentation, and site walk-downs.

5.1 Quality Assurance Assessments

Independent assessments shall be planned and conducted to measure item and service quality, evaluate the adequacy of work performance, and promote improvement. The purpose of these assessments is to evaluate the performance of work processes with regard to regulatory, contract, and project requirements and expectations of the client. The group performing independent assessments shall have sufficient authority and freedom from the Sundance project staffing and management line to carry out its responsibilities. Persons conducting independent assessments must be technically qualified and knowledgeable in the areas assessed.

The independent assessment program may include periodic field surveillances of field activities (e.g., soil vapor and drinking water sampling, etcetera). Special emphasis will focus on areas with the highest risk and the greatest benefit from improvement. The surveillance processes will consist of monitoring or observing an item, activity, system, or process to verify that it conforms to specified requirements. These types of assessments are intended to facilitate the frequent monitoring of work in progress to determine and document compliance with established requirements and procedures.

5.2 Quality Assurance Oversight

QA oversight will be performed onsite and is intended to be an interactive part of the field work performed. QA oversight will be performed by the Sundance QA Lead or designee. QA oversight includes inspections of work performed, verification of field documentation, and site walk-downs.

5.2.1 Inspections

Inspection activities will be used to monitor project activities and materials to ensure compliance with established requirements. The objective of inspections is to determine whether the properties, composition, and performance of activities or materials are within established requirements. Inspections shall be performed periodically during the work process to prevent unintended use or installation, to provide monitoring, to minimize delays in work, and to identify nonconformances while they are still correctible without impacting work.

5.2.2 Verification of Field Documentation

Field documentation (e.g., Field Activity Daily Logs, Sample Collection Logs, etcetera) will be reviewed and verified for accuracy and completeness on a regular basis. This verification process is an informal process performed as part of report preparation; allowing for the quick and efficient correction of documentation deficiencies.

5.2.3 Site Walk-downs

Site walk-downs are informal observations of field work being performed. The intent of a site walk-down is to verify that the work is being performed as planned in a safe and orderly manner. Any deficiencies

identified during a walk-down are immediately pointed out to the field crew and corrected. Walk-downs are performed on a daily basis by the Technical Lead/SSHO, but may also be performed by the Sundance PM, or any other senior Sundance personnel.

5.3 Nonconformances and Response Actions

Processes for detecting, preventing, and correcting quality problems are discussed in this section. Items and processes that do not meet established criteria shall be identified, controlled, and corrected, as applicable. Personnel at all levels are responsible for identifying problems and process improvement opportunities and are encouraged to offer solutions.

5.3.1 Problem Identification and Reporting

It is the responsibility of all Sundance and subcontractor personnel to assess activities and inspect items used within the project to verify that each meets specified requirements and to document incidences of nonconforming items, activities, or conditions on a Nonconformance Report (NCR) (Attachment D). It is the responsibility of the project management staff to promptly report, respond to, and resolve nonconforming conditions and to foster a "no-fault" attitude that encourages the identification of nonconforming items and processes.

Personnel who identify a nonconforming condition that is potentially hazardous to workers, the public, or the environment or that jeopardizes the integrity of the program or project have the responsibility and authority to suspend work and report the condition to the responsible manager.

5.3.2 Control and Disposition of Nonconforming Items

Items that do not meet specified requirements, known as nonconforming items, shall be identified by marking, tagging, or other methods that do not adversely affect their end use. Nonconforming items shall be segregated, when practical, by placing them in a clearly identified and designated hold area until properly dispositioned. If segregation is impractical or impossible due to physical conditions, then other administrative controls and precautions should be employed to preclude inadvertent use of nonconforming items.

5.3.3 Nonconforming Activities

Activities or documentation identified as out of compliance with requirements shall be documented as a nonconformance for the purpose of identification of corrective actions and evaluation of the effect on the project objectives. When the integrity of the work is left in question, the work should be performed again, if possible. When not possible, limitations of the results of the work must be documented in the final report of the work.

5.3.4 Cause Analysis

Cause analysis will be performed whenever the understanding of the basic underlying cause is important to the prevention of similar or related problems or when the nonconformance relates to safety. The extent of the cause analysis should be based on the possible negative consequences of a repeat occurrence of a problem. A cause analysis will be used to gain an understanding of the deficiency, its causes, and the necessary corrective actions to prevent recurrence. This analysis should be a systematic process of investigation that uncovers the most basic cause. A summary of the cause analysis shall be documented on the NCR.

5.3.5 Corrective Actions

Responsible managers shall develop and document corrective actions, as applicable, for identified nonconformances. Corrective actions should be targeted at the primary causes of the problem rather than the resulting conditions or secondary causes. These actions shall be reviewed for adequacy and effectiveness in correcting the problem and approved by the PM or a designee.

5.3.6 Improvements and Efficiencies

It is important to identify and report process improvements and efficiency gains. Successful techniques and processes will be evaluated by the Sundance PM, or designee, to determine the potential for performance improvements in other areas or projects.

5.4 Reports to Management

Reports to management may include assessment reports, inspection reports, and NCRs.

5.4.1 Assessment Reports

Surveillance activities will be documented in surveillance reports. Surveillance reports will identify the project activities that were observed/reviewed, the associated requirements documents, and the results of the surveillances, including deficiencies identified and noteworthy practices. Surveillance reports will be prepared/approved by the Sundance Corporate Quality Control Manager (QCM) and presented to the PM within 30 days of performance. Surveillance checklists used during the performance of the surveillance may be included with the final surveillance report. A copy of the final surveillance report shall be placed in the project files.

5.4.2 Nonconformance Reports

Nonconformance reporting will include a description of the nonconforming item or activity, a summary of the corrective action to be taken, assignment of who is responsible for completing the corrective action, and verification that the corrective action is completed. Nonconformance reports will be tracked by the Sundance QA Manager and evaluated by the Sundance PM. A copy of the NCR shall be placed in the project files.

6 DATA MANAGEMENT

Data management is discussed in Section 6.0 of the WP to which this QAPjP is included as an appendix. The WP provides the data management process and procedures to be implemented for the field and for handling laboratory data generated from work activities in support of SVM and drinking water monitoring.

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ATTACHMENT A

LABORATORY ANALYTICAL METHOD REPORTING LIMITS

Table A-1. Method Reporting Limits – Drinking Water

Table A-2. Method Reporting Limits – Soil Vapor

Table A-1. Method Reporting Limits – Drinking Water (ALS Global - Environmental, Simi Valley, CA)
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Analytical Method	Analyte	CAS Number	Units	NMWQCC [1]	EPA MCL [2]	EPA Tap water		Project Screening Level [4]	Achievable Laboratory Limits [5]		
						RSL [3]	c/nc		LOQ	LOD	DL
BTEX by EPA 524.2	Benzene	71-43-2	µg/L	10.00	5.00	4.500	c	5.00	0.50	0.800	0.022
	Ethylbenzene	100-41-4	µg/L	750.00	700.00	15.000	c	700.00	0.50	0.800	0.023
	m, p-Xylenes	179601-23-1	µg/L	NS	10,000.00	190.000	nc	10,000.00	0.50	0.160	0.045
	o-Xylene	95-47-6	µg/L	NS	10,000.00	190.000	nc	10,000.00	0.50	0.800	0.023
	Toluene	108-88-3	µg/L	750.00	1000.00	1100.000	nc	750.00	0.50	0.200	0.050
EDB by EPA 504.1	Ethylene dibromide	1832-54-8	µg/L	0.10	0.05	0.075	c	0.05	0.01	0.007	0.003

NOTES:
[1] NMWQCC standards per the New Mexico Administrative Code Title 20.6.2.3101A, Standards for Ground Water of 10,000 mg/L Total Dissolved Solids Concentration or Less (NMAC 2004).
For metals, the NMWQCC standard applies to dissolved metals and total mercury.
[2] EPA National Primary Drinking Water Regulations, Maximum Contaminant Levels and Secondary Maximum Contaminant Levels, Title 40CFR Part 141, 143 (May 2009).
[3] EPA Region 6 Regional Screening Levels for Tap water (June 2015) for hazard index = 1.0 for noncarcinogens and a 10^{-5} cancer risk level for carcinogens.
[4] The project screening level was selected to satisfy the requirements of the KAFB Hazardous Waste Permit No. NM9570024423 as the lowest of 1) NMWQCC standard or 2) EPA MCL.
If no MCL or NMWQCC standard exists for any analyte, then the project screening level will be the EPA Tap water RSL.
[5] Achievable laboratory limits are for ALS Environmental Laboratories, Kelso, Washington.

Acronyms and Abbreviations:
µg/L = Microgram(s) per liter
mg/L = Milligram(s) per liter
c/nc = Carcinogenic/ noncarcinogenic
CA = California
CAS = Chemical Abstracts Service

Table A-1. Method Reporting Limits – Drinking Water (ALS Global - Environmental, Simi Valley, CA)
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Concluded, Page 2 of 2)

DL = Detection limit
EDB = ethylene dibromide
EPA = U.S. Environmental Protection Agency
LOD = Limit of detection
LOQ = Limit of quantitation
MCL = Maximum Contaminant Level
NMWQCC = New Mexico Water Quality Control Commission
NS = no standard
RSL = regional screening level
VOC = volatile organic compound

Table A-2. Method Reporting Limits - Soil Vapor (ALS Global - Environmental, Simi Valley, CA)
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico

Analytical Group/ Method	Analyte	CAS Number	Units	Project Screening Level	Achievable Laboratory Limits		
					LOQ	LOD	DL
VOCs/TPH EPA TO-15	1,1,1-Trichloroethane	71-55-6	ppbv	Note 1	0.23	0.19	0.078
	1,1,2,2-Tetrachloroethane	79-34-5	ppbv	Note 1	0.18	0.15	0.055
	1,1,2-Trichloroethane	79-00-5	ppbv	Note 1	0.23	0.20	0.073
	1,1-Dichloroethane	75-34-3	ppbv	Note 1	0.31	0.27	0.099
	1,1-Dichloroethene	75-35-4	ppbv	Note 1	0.32	0.28	0.110
	1,2,4-Trichlorobenzene	120-82-1	ppbv	Note 1	0.17	0.15	0.054
	1,2,4-Trimethylbenzene	95-63-6	ppbv	Note 1	0.25	0.22	0.076
	1,2-Dibromoethane	106-93-4	ppbv	Note 1	0.16	0.14	0.052
	1,2-Dichlorobenzene	95-50-1	ppbv	Note 1	0.21	0.18	0.062
	1,2-Dichloroethane	107-06-2	ppbv	Note 1	0.31	0.27	0.099
	1,2-Dichloropropane	78-87-5	ppbv	Note 1	0.27	0.24	0.087
	1,3,5-Trimethylbenzene	108-67-8	ppbv	Note 1	0.25	0.22	0.081
	1,3-Butadiene	106-99-0	ppbv	Note 1	0.57	0.47	0.250
	1,3-Dichlorobenzene	541-73-1	ppbv	Note 1	0.21	0.19	0.062
	1,4-Dichlorobenzene	106-46-7	ppbv	Note 1	0.21	0.17	0.058
	2-Butanone (MEK)	78-93-3	ppbv	Note 1	4.20	0.37	0.180
	2-Hexanone	591-78-6	ppbv	Note 1	0.31	0.27	0.098
	4-Methyl-2-pentanone	108-10-1	ppbv	Note 1	0.31	0.27	0.098
	Acetone	67-64-1	ppbv	Note 1	5.30	2.30	0.810
	Benzene	71-43-2	ppbv	Note 1	0.39	0.35	0.130
	Benzyl Chloride	100-44-7	ppbv	Note 1	0.24	0.22	0.053
	Bromodichloromethane	75-27-4	ppbv	Note 1	0.19	0.16	0.056

Table A-2. Method Reporting Limits- Soil Vapor (ALS Global - Environmental, Simi Valley, CA)
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued, Page 2 of 4)

Analytical Group/ Method	Analyte	CAS Number	Units	Project Screening Level	Achievable Laboratory Limits		
					LOQ	LOD	DL
VOCs/TPH EPA TO-15	Bromoform	75-25-2	ppbv	Note 1	0.12	0.11	0.036
	Bromomethane	74-83-9	ppbv	Note 1	0.32	0.26	0.120
	Carbon Disulfide	75-15-0	ppbv	Note 1	4.00	0.34	0.120
	Carbon Tetrachloride	56-23-5	ppbv	Note 1	0.20	0.18	0.060
	Chlorobenzene	108-90-7	ppbv	Note 1	0.27	0.24	0.087
	Chloroethane	75-00-3	ppbv	Note 1	0.47	0.38	0.160
	Chloroform	67-66-3	ppbv	Note 1	0.26	0.23	0.087
	Chloromethane	74-87-3	ppbv	Note 1	0.61	0.48	0.180
	cis-1,2-Dichloroethene	156-59-2	ppbv	Note 1	0.32	0.28	0.100
	cis-1,3-Dichloropropene	10061-01-5	ppbv	Note 1	0.28	0.23	0.077
	Cyclohexane	110-82-7	ppbv	Note 1	0.73	0.62	0.210
	Dibromochloromethane	124-48-1	ppbv	Note 1	0.15	0.13	0.047
	Dichlorodifluoromethane (CFC 12)	75-71-8	ppbv	Note 1	0.25	0.19	0.086
	Ethyl Acetate	141-78-6	ppbv	Note 1	0.69	0.60	0.240
	Ethylbenzene	100-41-4	ppbv	Note 1	0.29	0.25	0.092
	Hexachlorobutadiene	87-68-3	ppbv	Note 1	0.12	0.11	0.033
	m,p-Xylenes	179601-23-1	ppbv	Note 1	0.58	0.50	0.170
	Methyl tert-Butyl Ether	1634-04-4	ppbv	Note 1	0.35	0.31	0.120
	Methylene Chloride	75-09-2	ppbv	Note 1	0.36	0.32	0.120
	Naphthalene	91-20-3	ppbv	Note 1	0.24	0.21	0.086
	n-Heptane	142-82-5	ppbv	Note 1	0.31	0.27	0.100
	n-Hexane	110-54-3	ppbv	Note 1	0.35	0.31	0.110
	o-Xylene	95-47-6	ppbv	Note 1	0.29	0.24	0.086
	Propene	115-07-1	ppbv	Note 1	0.73	0.58	0.200
	Styrene	100-42-5	ppbv	Note 1	0.29	0.26	0.088
	Tetrachloroethene	127-18-4	ppbv	Note 1	0.18	0.15	0.052
	Tetrahydrofuran (THF)	109-99-9	ppbv	Note 1	0.42	0.37	0.170

Table A-2. Method Reporting Limits- Soil Vapor (ALS Global - Environmental, Simi Valley, CA)
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Continued, Page 3 of 4)

Analytical Group/ Method	Analyte	CAS Number	Units	Project Screening Level	Achievable Laboratory Limits		
					LOQ	LOD	DL
VOCs/TPH EPA TO-15	Toluene	108-88-3	ppbv	Note 1	0.33	0.29	0.110
	trans-1,2-Dichloroethene	156-60-5	ppbv	Note 1	0.32	0.26	0.120
	trans-1,3-Dichloropropene	10061-02-6	ppbv	Note 1	0.28	0.23	0.088
	Trichloroethene	79-01-6	ppbv	Note 1	0.23	0.20	0.065
	Trichlorofluoromethane	75-69-4	ppbv	Note 1	0.22	0.19	0.076
	Trichlorotrifluoroethane	76-13-1	ppbv	Note 1	0.16	0.14	0.055
	Vinyl Acetate	108-05-4	ppbv	Note 1	3.60	1.50	0.460
	Vinyl Chloride	75-01-4	ppbv	Note 1	0.49	0.39	0.170
APH Method MA DEP	C5-C8 Aliphatic Hydrocarbons	NA	µg/m^3	Note 1	50.00	NA	NA
	C9-C12 Aliphatic Hydrocarbons	NA	µg/m^3	Note 1	25.00	NA	NA
	C9-C10 Aromatic Hydrocarbons	NA	µg/m^3	Note 1	6.30	NA	NA
Fixed Gases ASTM D2504	Oxygen	7782-44-7	%	Note 1	0.10	NA	NA
	Nitrogen	7727-37-9	%	Note 1	0.10	NA	NA
	Carbon Monoxide	630-08-0	%	Note 1	0.10	NA	NA
	Carbon Dioxide	124-38-9	%	Note 1	0.10	NA	NA
	Methane	74-82-8	%	Note 1	0.10	NA	NA
EDB CARB 422	Ethylene Dibromide	1832-54-8	ppbv	Note 1	0.50	NA	0.180

Notes:
Project comparison limits not established.
In accordance with the U.S. Department of Defense Quality Systems Manual requirements, the most current version of the EPA methods will be implemented for each sampling event.

Table A-2. Method Reporting Limits- Soil Vapor (ALS Global - Environmental, Simi Valley, CA)
Bulk Fuels Facility Area
Kirtland Air Force Base, Albuquerque, New Mexico (Concluded, Page 4 of 4)

Acronyms and Abbreviations:
% = percent
APH = air- phase petroleum hydrocarbon
ASTM = ASTM International
CA = California
CAS = Chemical Abstract Service
DL = Detection Limit
MDL = method detection limit
EPA = U.S. Environmental Protection Agency
LOD = limit of detection
LOQ = limit of quantitation
MA DEP = Massachusetts Department of Environmental Protection
NE = not established
ppbv = parts per billion by volume
RL = reporting limit
TPH = total petroleum hydrocarbon
VOC = volatile organic compound

ATTACHMENT B

LABORATORY METHOD CONTROL LIMITS

B-1. Laboratory Control Limits – Drinking Water

B-2. Laboratory Control Limits – Soil Vapor

Table B-1. Method Reporting Limits - Drinking Water

METHOD	ANALYTE	CAS No.	MATRIX	MDL	MRL	UNITS	Accuracy (LCS %Rec)	Matrix Spike (%Rec.)	Precision (% RPD)		DOD LOD	DOD LOQ	UNITS
504.1	Ethylene Dibromide (EDB)	106-93-4	DW	0.003	0.01	ug/L	70-130	65-135	NA		0.007	0.01	ug/L
524.2	Benzene	71-43-2	DW	0.022	0.50	ug/L	70-130	NA	NA		0.080	0.50	ug/L
524.2	Ethylbenzene	100-41-4	DW	0.023	0.50	ug/L	70-130	NA	NA		0.080	0.50	ug/L
524.2	m,p-Xylenes	179601-23-1	DW	0.045	0.50	ug/L	70-130	NA	NA		0.160	0.50	ug/L
524.2	o-Xylene	95-47-6	DW	0.023	0.50	ug/L	70-130	NA	NA		0.080	0.50	ug/L
524.2	Toluene	108-88-3	DW	0.05	0.50	ug/L	70-130	NA	NA		0.200	0.50	ug/L

Acronyms and Abbreviations:

% = percent
ug/L = microgram(s) per liter
DoD = U.S. Department of Defense
DW = drinking water
EDB = ethylene dibromide
LCS = laboratory control sample
LOD = limit of detection
LOQ = limit of quantitation
MDL = method detection limit
MRL = method reporting limit
NA = not applicable
RPD = relative percent difference

ALS ENVIRONMENTAL

LABORATORY CONTROL SAMPLE SUMMARY

Client:

Client Sample ID: Lab Control Sample ALS Project ID: P1504757

Client Project ID: Kirtland AFB / 140705 ALS Sample ID: P151119-LCS

Test Code:	Massachusetts APH, Revision 1, December 2009	Date Collected:	NA
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Binert/6890N/MS13	Date Received:	NA
Analyst:	Evelyn Alvarez	Date Analyzed:	11/19/15
Sample Type:	1.0 L Bottle-Vac™	Volume(s) Analyzed:	0.125 Liter(s)

Test Notes:

Compound	Spike Amount µg/m³	**Result µg/m³**	**% Recovery**	ALS Acceptance Limits	**Data Qualifier**
C5 - C8 Aliphatic Hydrocarbons	216	**200**	**93**	70-130	
C9 - C12 Aliphatic Hydrocarbons	202	**197**	**98**	70-130	
C9 - C10 Aromatic Hydrocarbons	422	**388**	**92**	70-130	

Verified By:_____Date:_____

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client:

Client Sample ID: **Method Blank**
Client Project ID: **Kirtland AFB / 140705**

ALS Project ID: P1504757
ALS Sample ID: P151119-MB

Test Code:	Massachusetts APH, Revision 1, December 2009	Date Collected:	NA
Instrument ID:	Tekmar AUTOCAN/Agilent 5975Binert/6890N/MS13	Date Received:	NA
Analyst:	Evelyn Alvarez	Date Analyzed:	11/19/15
Sample Type:	1.0 L Bottle-Vac™	Volume(s) Analyzed:	0.40 Liter(s)

Test Notes:

Compound	**Result µg/m³**	MRL µg/m³	**Data Qualifier**
C_5 - C_8 Aliphatic Hydrocarbons[1,2]	50	50	**U**
C_9 - C_{12} Aliphatic Hydrocarbons[1,3]	25	25	**U**
C_9 - C_{10} Aromatic Hydrocarbons	6.3	6.3	**U**

Significant non-petroleum related peaks (i.e. halogenated, oxygenated, terpenes, etc.) are subtracted from the hydrocarbon range areas when present.

[1]Hydrocarbon Range data from total ion chromatogram excluding any internal/tuning standards eluting in that range.

[2]C_5-C_8 Aliphatic Hydrocarbons exclude the concentration of Target APH analytes eluting in that range.

[3]C_9-C_{12} Aliphatic Hydrocarbons exclude concentration of Target APH Analytes eluting in that range and concentration of C_9-C_{10} Aromatic Hydrocarbons.

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By:_____Date:_____

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client:

Client Project ID: Kirtland AFB / 140705

ALS Project ID: P1504757

1,2-Dibromoethane

Test Code: CARB 422 Modified
Instrument ID: HP5890 II/GC21/ECD
Analyst: Madeleine Dangazyan
Sample Type: 1.0 L Bottle-Vac™(s)
Test Notes:

Date(s) Collected: 11/2/15
Date Received: 11/5/15
Date Analyzed: 11/13/15

Client Sample ID	ALS Sample ID	Injection Volume ml(s)	Canister Dilution Factor	**Result µg/m³**	MRL µg/m³	MDL µg/m³	**Result ppbV**	MRL ppbV	MDL ppbV	Data Qualifier
VA5432	P1504757-001	1.0	1.61	6.2	6.2	2.2	0.81	0.81	0.29	**U**
VA5433	P1504757-002	1.0	1.57	**11**	6.0	2.2	**1.4**	0.79	0.28	
VA5434	P1504757-003	1.0	1.60	6.1	6.1	2.2	0.80	0.80	0.29	**U**
Method Blank	P151113-MB	1.0	1.00	3.8	3.8	1.4	0.50	0.50	0.18	**U**

U = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ALS ENVIRONMENTAL

LABORATORY CONTROL SAMPLE SUMMARY

Client:

Client Sample ID: **Lab Control Sample**
Client Project ID: **Kirtland AFB / 140705**

ALS Project ID: P1504757
ALS Sample ID: P151113-LCS

Test Code: CARB 422 Modified
Instrument ID: HP5890 II/GC21/ECD
Analyst: Madeleine Dangazyan
Sample Type: 1.0 L Bottle-Vac™
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 11/13/15
Volume(s) Analyzed: NA ml

CAS #	Compound	Spike Amount ppbV	Result ppbV	% Recovery	ALS Acceptance Limits	Data Qualifier
106-93-4	1,2-Dibromoethane	50.0	**38.2**	**76**	70-130	

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client:

Client Sample ID: **Method Blank**
Client Project ID: **Kirtland AFB / 140705**

ALS Project ID: P1504757
ALS Sample ID: P151120-MB

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Nalini Lall
Sample Type: 1.0 L Bottle-Vac™
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 11/20/15
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
7782-44-7	Oxygen*	0.10	0.10	U
7727-37-9	Nitrogen	0.10	0.10	U
630-08-0	Carbon Monoxide	0.10	0.10	U
74-82-8	Methane	0.10	0.10	U
124-38-9	Carbon Dioxide	0.10	0.10	U

U = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
* = The oxygen result may include argon due to coelution. Ambient air includes 0.93% argon.

ALS ENVIRONMENTAL

LABORATORY CONTROL SAMPLE SUMMARY

Client:

Client Sample ID: **Lab Control Sample**
Client Project ID: **Kirtland AFB / 140705**

ALS Project ID: P1504757
ALS Sample ID: P151120-LCS

Test Code: EPA Method 3C Modified
Instrument ID: HP5890 II/GC1/TCD
Analyst: Nalini Lall
Sample Type: 1.0 L Bottle-Vac™
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 11/20/15
Volume(s) Analyzed: NA ml(s)

CAS #	Compound	Spike Amount ppmV	**Result ppmV**	**% Recovery**	ALS Acceptance Limits	Data Qualifier
7782-44-7	Oxygen*	219,000	**219,000**	**100**	84-121	
7727-37-9	Nitrogen	781,000	**779,000**	**100**	88-122	
630-08-0	Carbon Monoxide	2,000	**2,310**	**116**	87-118	
74-82-8	Methane	1,600	**1,680**	**105**	85-116	
124-38-9	Carbon Dioxide	2,000	**2,150**	**108**	84-117	

* = The oxygen result may include argon due to coelution. Ambient air includes 0.93% argon.

ALS ENVIRONMENTAL

LABORATORY CONTROL SAMPLE SUMMARY

Client:

Client Sample ID: **Lab Control Sample** ALS Project ID: P1504757

Client Project ID: **Kirtland AFB / 140705** ALS Sample ID: P151119-LCS

Test Code: EPA TO-15 Modified Date Collected: NA

Instrument ID: Tekmar AUTOCAN/Agilent 5975Binert/6890N/MS13 Date Received: NA

Analyst: Evelyn Alvarez Date Analyzed: 11/19/15

Sampling Media: 1.0 L Bottle-Vac™ Volume(s) Analyzed: 0.125 Liter(s)

Test Notes:

CAS #	Compound	Spike Amount ppbV	Result ppbV	% Recovery	DOD Acceptance Limits	Data Qualifier
115-07-1	Propene	114	**119**	**104**	57-136	
75-71-8	Dichlorodifluoromethane (CFC 12)	38.0	**32.4**	**85**	59-128	
74-87-3	Chloromethane	96.9	**76.8**	**79**	59-132	
75-01-4	Vinyl Chloride	78.3	**63.7**	**81**	64-127	
106-99-0	1,3-Butadiene	93.2	**86.8**	**93**	66-134	
74-83-9	Bromomethane	52.0	**46.2**	**89**	63-134	
75-00-3	Chloroethane	75.8	**66.7**	**88**	63-127	
67-64-1	Acetone	454	**424**	**93**	58-128	
75-69-4	Trichlorofluoromethane	38.5	**30.2**	**78**	62-126	
75-35-4	1,1-Dichloroethene	54.5	**49.3**	**90**	61-133	
75-09-2	Methylene Chloride	63.9	**52.7**	**82**	62-115	
76-13-1	Trichlorotrifluoroethane	28.7	**24.4**	**85**	66-126	
75-15-0	Carbon Disulfide	67.5	**46.6**	**69**	57-134	
156-60-5	trans-1,2-Dichloroethene	53.0	**50.3**	**95**	67-124	
75-34-3	1,1-Dichloroethane	52.4	**47.1**	**90**	68-126	
1634-04-4	Methyl tert-Butyl Ether	59.9	**57.0**	**95**	66-126	
108-05-4	Vinyl Acetate	295	**317**	**107**	56-139	
78-93-3	2-Butanone (MEK)	74.6	**73.2**	**98**	67-130	
156-59-2	cis-1,2-Dichloroethene	55.0	**52.5**	**95**	70-121	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

Verified By:_____Date:_____

ALS ENVIRONMENTAL

LABORATORY CONTROL SAMPLE SUMMARY

Client: **CB&I Federal Services**
Client Sample ID: **Lab Control Sample** ALS Project ID: P1504757
Client Project ID: **Kirtland AFB / 140705** ALS Sample ID: P151119-LCS

Test Code: EPA TO-15 Modified Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5975Binert/6890N/MS13 Date Received: NA
Analyst: Evelyn Alvarez Date Analyzed: 11/19/15
Sampling Media: 1.0 L Bottle-Vac™ Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	Compound	Spike Amount ppbV	Result ppbV	% Recovery	DOD Acceptance Limits	Data Qualifier
141-78-6	Ethyl Acetate	119	**130**	**109**	65-128	
110-54-3	n-Hexane	60.2	**58.0**	**96**	63-120	
67-66-3	Chloroform	45.9	**40.6**	**88**	68-123	
109-99-9	Tetrahydrofuran (THF)	74.6	**71.8**	**96**	64-123	
107-06-2	1,2-Dichloroethane	52.9	**50.5**	**95**	65-128	
71-55-6	1,1,1-Trichloroethane	38.5	**34.1**	**89**	68-125	
71-43-2	Benzene	70.8	**66.0**	**93**	69-119	
56-23-5	Carbon Tetrachloride	36.6	**31.1**	**85**	68-132	
110-82-7	Cyclohexane	123	**117**	**95**	70-117	
78-87-5	1,2-Dichloropropane	46.8	**43.5**	**93**	69-123	
75-27-4	Bromodichloromethane	32.6	**30.6**	**94**	72-128	
79-01-6	Trichloroethene	40.2	**34.9**	**87**	71-123	
142-82-5	n-Heptane	52.7	**51.1**	**97**	69-123	
10061-01-5	cis-1,3-Dichloropropene	45.8	**46.5**	**102**	70-128	
108-10-1	4-Methyl-2-pentanone	53.7	**57.6**	**107**	67-130	
10061-02-6	trans-1,3-Dichloropropene	46.3	**48.3**	**104**	75-133	
79-00-5	1,1,2-Trichloroethane	39.6	**37.3**	**94**	73-119	
108-88-3	Toluene	57.9	**51.0**	**88**	66-119	
591-78-6	2-Hexanone	53.7	**69.8**	**130**	62-128	**L**
124-48-1	Dibromochloromethane	25.8	**24.3**	**94**	70-130	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.
L = Laboratory control sample recovery outside the specified limits, results may be biased high.

Verified By:_____Date:_____

ALS ENVIRONMENTAL

LABORATORY CONTROL SAMPLE SUMMARY

Client: **CB&I Federal Services**
Client Sample ID: **Lab Control Sample** ALS Project ID: P1504757
Client Project ID: **Kirtland AFB / 140705** ALS Sample ID: P151119-LCS

Test Code: EPA TO-15 Modified Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5975Binert/6890N/MS13 Date Received: NA
Analyst: Evelyn Alvarez Date Analyzed: 11/19/15
Sampling Media: 1.0 L Bottle-Vac™ Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	Compound	Spike Amount ppbV	Result ppbV	% Recovery	DOD Acceptance Limits	Data Qualifier
106-93-4	1,2-Dibromoethane	28.4	**26.3**	**93**	74-122	
127-18-4	Tetrachloroethene	29.8	**25.3**	**85**	66-124	
108-90-7	Chlorobenzene	47.8	**41.8**	**87**	70-119	
100-41-4	Ethylbenzene	50.2	**46.8**	**93**	70-124	
179601-23-1	m,p-Xylenes	98.6	**95.0**	**96**	61-134	
75-25-2	Bromoform	22.1	**17.4**	**79**	66-139	
100-42-5	Styrene	52.2	**48.9**	**94**	73-127	
95-47-6	o-Xylene	48.4	**46.9**	**97**	67-125	
79-34-5	1,1,2,2-Tetrachloroethane	30.6	**30.3**	**99**	65-127	
108-67-8	1,3,5-Trimethylbenzene	43.5	**42.6**	**98**	67-130	
95-63-6	1,2,4-Trimethylbenzene	44.4	**45.6**	**103**	66-132	
100-44-7	Benzyl Chloride	42.5	**43.8**	**103**	50-147	
541-73-1	1,3-Dichlorobenzene	37.9	**35.9**	**95**	65-130	
106-46-7	1,4-Dichlorobenzene	34.6	**31.5**	**91**	60-131	
95-50-1	1,2-Dichlorobenzene	36.6	**36.3**	**99**	63-129	
120-82-1	1,2,4-Trichlorobenzene	31.0	**24.8**	**80**	55-142	
91-20-3	Naphthalene	41.6	**42.3**	**102**	57-138	
87-68-3	Hexachlorobutadiene	21.6	**16.1**	**75**	56-138	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

Verified By:_____Date:_____

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client:

Client Sample ID: **Method Blank** ALS Project ID: P1504757

Client Project ID: **Kirtland AFB / 140705** ALS Sample ID: P151119-MB

Test Code: EPA TO-15 Modified Date Collected: NA

Instrument ID: Tekmar AUTOCAN/Agilent 5975Binert/6890N/MS13 Date Received: NA

Analyst: Evelyn Alvarez Date Analyzed: 11/19/15

Sampling Media: 1.0 L Bottle-Vac™ Volume(s) Analyzed: 0.40 Liter(s)

Test Notes:

Canister Dilution Factor: 1.00

CAS #	Compound	Result ppbV	LOQ ppbV	LOD ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	0.73	0.73	0.58	0.20	**U**
75-71-8	Dichlorodifluoromethane (CFC 12)	0.25	0.25	0.19	0.086	**U**
74-87-3	Chloromethane	0.61	0.61	0.48	0.18	**U**
75-01-4	Vinyl Chloride	0.49	0.49	0.39	0.17	**U**
106-99-0	1,3-Butadiene	0.57	0.57	0.47	0.25	**U**
74-83-9	Bromomethane	0.32	0.32	0.26	0.12	**U**
75-00-3	Chloroethane	0.47	0.47	0.38	0.16	**U**
67-64-1	Acetone	5.3	5.3	2.3	0.81	**U**
75-69-4	Trichlorofluoromethane	0.22	0.22	0.19	0.076	**U**
75-35-4	1,1-Dichloroethene	0.32	0.32	0.28	0.11	**U**
75-09-2	Methylene Chloride	0.36	0.36	0.32	0.12	**U**
76-13-1	Trichlorotrifluoroethane	0.16	0.16	0.14	0.055	**U**
75-15-0	Carbon Disulfide	4.0	4.0	0.34	0.12	**U**
156-60-5	trans-1,2-Dichloroethene	0.32	0.32	0.26	0.12	**U**
75-34-3	1,1-Dichloroethane	0.31	0.31	0.27	0.099	**U**
1634-04-4	Methyl tert-Butyl Ether	0.35	0.35	0.31	0.12	**U**
108-05-4	Vinyl Acetate	3.6	3.6	1.5	0.46	**U**
78-93-3	2-Butanone (MEK)	4.2	4.2	0.37	0.18	**U**
156-59-2	cis-1,2-Dichloroethene	0.32	0.32	0.28	0.10	**U**

U = Undetected: The associated data value is the limit of quantitation, adjusted by any dilution factor used in the analysis.

LOQ = Limit of Quantitation - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By:_____Date:_____

Client: **CB&I Federal Services**
Client Sample ID: **Method Blank** ALS Project ID: P1504757
Client Project ID: **Kirtland AFB / 140705** ALS Sample ID: P151119-MB

Test Code: EPA TO-15 Modified Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5975Binert/6890N/MS13 Date Received: NA
Analyst: Evelyn Alvarez Date Analyzed: 11/19/15
Sampling Media: 1.0 L Bottle-Vac™ Volume(s) Analyzed: 0.40 Liter(s)
Test Notes:

Canister Dilution Factor: 1.00

CAS #	Compound	Result ppbV	LOQ ppbV	LOD ppbV	MDL ppbV	Data Qualifier
141-78-6	Ethyl Acetate	0.69	0.69	0.60	0.24	**U**
110-54-3	n-Hexane	0.35	0.35	0.31	0.11	**U**
67-66-3	Chloroform	0.26	0.26	0.23	0.087	**U**
109-99-9	Tetrahydrofuran (THF)	0.42	0.42	0.37	0.17	**U**
107-06-2	1,2-Dichloroethane	0.31	0.31	0.27	0.099	**U**
71-55-6	1,1,1-Trichloroethane	0.23	0.23	0.19	0.078	**U**
71-43-2	Benzene	0.39	0.39	0.35	0.13	**U**
56-23-5	Carbon Tetrachloride	0.20	0.20	0.18	0.060	**U**
110-82-7	Cyclohexane	0.73	0.73	0.62	0.21	**U**
78-87-5	1,2-Dichloropropane	0.27	0.27	0.24	0.087	**U**
75-27-4	Bromodichloromethane	0.19	0.19	0.16	0.056	**U**
79-01-6	Trichloroethene	0.23	0.23	0.20	0.065	**U**
142-82-5	n-Heptane	0.31	0.31	0.27	0.10	**U**
10061-01-5	cis-1,3-Dichloropropene	0.28	0.28	0.23	0.077	**U**
108-10-1	4-Methyl-2-pentanone	0.31	0.31	0.27	0.098	**U**
10061-02-6	trans-1,3-Dichloropropene	0.28	0.28	0.23	0.088	**U**
79-00-5	1,1,2-Trichloroethane	0.23	0.23	0.20	0.073	**U**
108-88-3	Toluene	0.33	0.33	0.29	0.11	**U**
591-78-6	2-Hexanone	0.31	0.31	0.27	0.098	**U**
124-48-1	Dibromochloromethane	0.15	0.15	0.13	0.047	**U**

U = Undetected: The associated data value is the limit of quantitation, adjusted by any dilution factor used in the analysis.
LOQ = Limit of Quantitation - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By:_____Date:_____

ALS ENVIRONMENTAL

RESULTS OF ANALYSIS

Client: **CB&I Federal Services**
Client Sample ID: **Method Blank** ALS Project ID: P1504757
Client Project ID: **Kirtland AFB / 140705** ALS Sample ID: P151119-MB

Test Code: EPA TO-15 Modified Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5975Binert/6890N/MS13 Date Received: NA
Analyst: Evelyn Alvarez Date Analyzed: 11/19/15
Sampling Media: 1.0 L Bottle-Vac™ Volume(s) Analyzed: 0.40 Liter(s)
Test Notes:

Canister Dilution Factor: 1.00

CAS #	Compound	Result ppbV	LOQ ppbV	LOD ppbV	MDL ppbV	Data Qualifier
106-93-4	1,2-Dibromoethane	0.16	0.16	0.14	0.052	**U**
127-18-4	Tetrachloroethene	0.18	0.18	0.15	0.052	**U**
108-90-7	Chlorobenzene	0.27	0.27	0.24	0.087	**U**
100-41-4	Ethylbenzene	0.29	0.29	0.25	0.092	**U**
179601-23-1	m,p-Xylenes	0.58	0.58	0.50	0.17	**U**
75-25-2	Bromoform	0.12	0.12	0.11	0.036	**U**
100-42-5	Styrene	0.29	0.29	0.26	0.088	**U**
95-47-6	o-Xylene	0.29	0.29	0.24	0.086	**U**
79-34-5	1,1,2,2-Tetrachloroethane	0.18	0.18	0.15	0.055	**U**
108-67-8	1,3,5-Trimethylbenzene	0.25	0.25	0.22	0.081	**U**
95-63-6	1,2,4-Trimethylbenzene	0.25	0.25	0.22	0.076	**U**
100-44-7	Benzyl Chloride	0.24	0.24	0.22	0.053	**U**
541-73-1	1,3-Dichlorobenzene	0.21	0.21	0.19	0.062	**U**
106-46-7	1,4-Dichlorobenzene	0.21	0.21	0.17	0.058	**U**
95-50-1	1,2-Dichlorobenzene	0.21	0.21	0.18	0.062	**U**
120-82-1	1,2,4-Trichlorobenzene	0.17	0.17	0.15	0.054	**U**
91-20-3	Naphthalene	0.24	0.24	0.21	0.086	**U**
87-68-3	Hexachlorobutadiene	0.12	0.12	0.11	0.033	**U**
1330-20-7	Xylenes, Total	0.58	0.58	0.50	0.17	**U**

U = Undetected: The associated data value is the limit of quantitation, adjusted by any dilution factor used in the analysis.
LOQ = Limit of Quantitation - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By:_____Date:_____

ATTACHMENT C

ALS ENVIRONMENTAL QUALITY ASSURANCE MANUAL AND STANDARD OPERATING PROCEDURES

C-1. ALS Environmental Quality Assurance Manual, Kelso, Washington Laboratory (Drinking Water Analyses)

C-2. ALS Environmental Standard Operating Procedures, Kelso, Washington Laboratory (Drinking Water Analyses)

C-3. ALS Environmental Quality Assurance Manual, Simi Valley, California Laboratory (Soil Vapor Analyses)

C-4. ALS Environmental Standard Operating Procedures, Simi Valley, California Laboratory (Soil Vapor Analyses)

ALS Environmental

QUALITY ASSURANCE MANUAL

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QUALITY ASSURANCE MANUAL

Doc ID:	ALSKL-QAM	Rev. Number:	24.1	Effective Date:	09/01/2015

Approved By: _____ Date: 8/28/15
Laboratory Director – Jeff Grindstaff

Approved By: _____ Date: 8/28/15
QA Manager – Carl Degner

Approved By: _____ Date: 8/29/15
Technical Director, Metals – Jeff Coronado

Approved By: _____ Date: 8/28/15
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Approved By: _____ Date: 8/28/15
Technical Director, Organics GC – Loren Portwood

Approved By: _____ Date: 8/28/15
Technical Director, Organics GC/MS, HPLC – Jon James

Archival Date:	_____	Doc Control ID#:	_____	Editor:	_____

TABLE OF CONTENTS

Current Data Quality Objectives (DQOs) may be requested from the laboratory for specified methods or projects.

QA MANUAL CROSS REFERENCE TABLE

ALS QA Manual	ISO 17025:2005 Section	TNI Standard 2009 Volume 1, Module 2 Section
2	4.1	4.1
3	4.2	4.2
4	4.3	4.3
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21	5.10	5.10

1) Introduction and Scope

ALS Environmental, Kelso is a professional analytical services laboratory which performs chemical and microbiological analyses on a wide variety of sample matrices, including drinking water, groundwater, surface water, wastewater, soil, sludge, sediment, tissue, industrial and hazardous waste, air, and other material.

We recognize that quality assurance requires a commitment to quality by everyone in the organization - individually, within each operating unit, and throughout the entire laboratory. Laboratory management is committed to ensuring the effectiveness of its quality systems and to ensure that all tests are carried out in accordance to customer requirements. Key elements of this commitment are set forth in SOP CE-GEN001, *Laboratory Ethics and Data Integrity* and in this Quality Assurance Manual. ALS - Kelso is committed to operate in accordance with these requirements and those of regulatory agencies, accrediting authorities, and certifying organizations. The laboratory also strives for improvement through varying continuous improvement initiatives and projects.

Quality Management Systems are established, implemented and maintained by management. Policies and procedures are established in order to meet requirements of accreditation bodies and applicable programs, such as the Department of Defense (DOD) Environmental Laboratory Accreditation Program, as well as client's quality objectives. Systems are designed so that there will be sufficient Quality Assurance (QA) activities conducted in the laboratory to ensure that all analytical data generated and processed will be scientifically sound, legally defensible, of known and documented quality, and will accurately reflect the material being tested. Quality Systems are applicable to all fields of testing in which the laboratory in involved.

Quality Control (QC) procedures are used to continually assess performance of the laboratory and quality systems. The laboratory maintains control of analytical results by adhering to written standard operating procedures (SOPs), using analytical control parameters with all analyses, and by observing sample custody requirements. All analytical results are calculated and reported in units consistent with project specifications to allow comparability of data.

This QAM is applicable to the facility listed on the title page. The information in this manual has been organized according to requirements found in the National Environmental Laboratory Accreditation Program (NELAP) Quality Systems Standards (2003 and 2009), the EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5, USEPA, 2001; and General Requirements for the Competence of Testing and Calibration Laboratories, ISO/IEC 17025:2005. A glossary of pertinent terms and acronyms is included in Appendix A.

2) Organization

The ALS Environmental, Kelso staff, consisting of approximately 110 employees, includes chemists, technicians and support personnel. They represent diverse educational backgrounds and experience, and provide the comprehensive skills that the laboratory requires. During seasonal workload increases, additional temporary employees may be hired to perform specific tasks. All employees share the responsibility for maintaining and improving the quality of our analytical services.

ALS – Kelso is legally identifiable as ALS Group USA, Corp., dba ALS Environmental. ALS Group USA, Corp. is a component of ALS Limited, a publicly held Australian company. The ALS global website may be referred to for corporate ownership information (www.alsglobal.com/Our-Company). The laboratory is divided into operational and managerial units based upon specific disciplines. Each department is responsible for establishing, maintaining and documenting QA and QC practices meeting laboratory needs. Organizational charts of the laboratory, as well as the resumes of these key personnel, can be found in Appendix B. This laboratory organization is designed so that potential conflict of interest is avoided, and such

that an adequate amount of supervisory personnel are in place to provide oversight and supervision of day to day operations.

3) Management

The purpose of the QA program at ALS Environmental, Kelso is to ensure that our clients are provided with analytical data that is scientifically sound, legally defensible, and of known and documented quality. The concept of Quality Assurance can be extended, and is expressed in the mission statement:

> "The mission of ALS Environmental, Kelso is to provide high quality, cost-effective, and timely professional testing services to our customers. We recognize that our success as a company is based on our ability to maintain customer satisfaction. To do this requires constant attention to customer needs, maintenance of state-of-the-art testing capabilities and successful management of our most important asset - our people - in a way that encourages professional growth, personal development and company commitment."

3.1 Quality Management Systems

In support of this mission, the laboratory has developed a Quality Management System to ensure all products and services meet our client's needs. The system is implemented and maintained by the Quality Assurance Manager with corporate oversight by the Manager of Quality Assurance, USA. These systems are based upon ISO 17025:2005 standards, upon which fundamental programs (NELAC 2003, 2009 and DoD QSM) are based. Implementation and documentation against these standards are communicated in corporate policy statements, this QAM, and SOPs. Actual procedures, actions and documentation are defined in both administrative and technical SOPs. Quality systems include:

- Accreditation and certification program compliance
- Standard Operating Procedures
- Sample management and Chain of Custody procedures
- Document control
- Demonstration of Capability
- Analytical traceability
- Ethics training and data integrity processes
- Corrective action procedures
- Statistical control charting
- Management reviews

The effectiveness of the quality system is assessed in several ways, including:

- Internal and external audits
- Periodic reports to management
- Analysis of customer feedback
- Proficiency testing

The responsibilities of key positions within the laboratory are described below. Table 3-1 lists the ALS - Kelso personnel assigned to these key positions. Managerial staff members are provided the authority and resources needed to perform their duties. In the event that work is stopped in response to quality problems, as described below, only the Laboratory Director or Quality Assurance Manager has the authority to resume work.

Laboratory Director – The role of the Laboratory Director is to provide technical, operational, and administrative leadership through planning, allocation and management of personnel and equipment resources. The Laboratory Director provides leadership and support for the QA program and is responsible for overall laboratory efficiency and financial performance. The Laboratory Director has the authority to stop work in response to quality problems. The Laboratory Director also provides resources for implementation of the QA program, reviews and approves this QA Manual, reviews and approves standard operating procedures (SOPs), and provides support for business development by identifying and developing new markets through continuing support of the management of existing client activities.

Quality Assurance Manager (QAM) – The Quality Assurance Manager has the authority and responsibility for implementing, maintaining, and improving the quality system. This includes coordination of QA activities in the laboratory, ensuring that personnel understand the quality system, ensuring communication takes place in the laboratory regarding implementation of the quality system, ensuring adequate staff training, and monitoring overall quality system compliance. The QAM continually evaluates potential improvements in the quality system. Audit and surveillance results, control charts, proficiency testing results, data analysis, corrective and preventive actions, customer feedback, and management reviews are used to support quality system implementation. The QAM is responsible for ensuring compliance with all applicable regulatory compliance quality standards (i.e. NELAP/TNI, ISO, DoD QSM, etc.). The QAM works with laboratory staff to establish effective quality control and assessment processes and has the authority to stop work in response to quality problems. The QAM is responsible for maintaining the laboratory's certifications and approvals, for maintaining the QA Manual and performing an annual review of it, reviewing and approving SOPs and ensuring the annual review of technical SOPs, maintaining QA records (metrological records, archived logbooks, PT results, etc.), document control, conducting proficiency testing studies, approving nonconformity and corrective action reports, and performing internal QA audits.

The QAM reports directly to the Laboratory Director and reports indirectly to the ALS Manager of Quality Assurance, USA. It is important to note that when evaluating data, the QAM does so in an objective manner and free of outside, or managerial, influence.

The Manager of Quality Assurance, USA is responsible for the overall QA program at all the ALS Environmental Group laboratories. The Manager of Quality Assurance, USA is responsible for oversight of QAM's regulatory compliance efforts (NELAP, ISO, DOD, etc.) and may perform internal audits to evaluate compliance. The Manager of Quality Assurance, USA approves company-wide SOPs and provides assistance to the laboratory QA staff and laboratory managers as necessary.

Deputy Laboratory Director and QA Manager – In the case of absence of the Laboratory Director or QAM, deputies are assigned to act in that role. Default deputies for these positions are the Client Services Manager or Metals Department Manager (for the Laboratory Director) and the Laboratory Director (for the QAM).

Environmental Health and Safety (EH&S) Officer – The EH&S officer is responsible for the administration of the laboratory health and safety policies. This includes the formulation and implementation of safety policies, the supervision of new-employee safety training, the review of accidents, incidents and prevention plans, the monitoring

of hazardous waste disposal and the conducting of departmental safety inspections. The EH&S officer is also designated as the Chemical Hygiene Officer. The EH&S Officer has a dotted-line reporting responsibility to the ALS North America EH&S Manager.

Client Services Manager (CSM) – The CSM is responsible for the Client Services Department defined for the laboratory. This includes management and oversight of Project Managers, electronic deliverables, and support functions. The Client Services Department provides a complete interface with clients from initial project specification to final deliverables. The Client Services Manager has the responsibility and authority to stop work in response to accreditation/certification or quality problems, or in response to similar subcontractor quality problems.

Department Managers and Supervisors – Each manager or supervisor has the responsibility to ensure that QA and QC functions are carried out as specified when executing the analyses and related tasks and to ensure the production of high quality data. Managers and bench-level supervisors monitor the day-to-day operations to ensure that productivity and data quality objectives are met. A department manager has the authority to stop work in response to quality problems in their area. Managers and supervisors are responsible for ensuring that analysts perform testing according to applied methods, SOPs, and QC guidelines particular to the laboratory department.

Sample Management Office (SMO) – The Sample Management Office plays a key role in the laboratory QA program by handling all activities associated with receiving, storage, and disposal of samples, and maintaining documentation for all samples received. SMO staff is also responsible for the proper disposal of samples after analysis. The Support Services Manager oversees SMO and bottle preparation functions.

Information Technology (IT) – IT staff is responsible for the administration of the Laboratory Information Management System (LIMS) and other necessary support services. Other functions of the IT staff include laboratory network maintenance, IT systems development and implementation, education of analytical staff in the use of scientific software, Electronic Data Deliverable (EDD) support, and data back-up, archival and integrity operations.

3.2 Ethics, Professional Conduct and Data Integrity

One of the most important aspects of the success of ALS - Kelso is the emphasis placed on the integrity of the data provided and the services rendered. This success is reliant on both the professional conduct of all employees within ALS - Kelso as well as established laboratory practices. All personnel involved with environmental testing and calibration activities must familiarize themselves with the quality documentation and implement the policies and procedures in their work.

All employees are required to sign and adhere to the requirements set forth in the *ALS Code of Conduct Policy* and agree to the *Confidentiality Agreement (*Appendix C).

3.2.1 Professional Conduct

To promote quality ALS - Kelso requires certain standards of conduct and ethical performance among employees. The following examples of documented ALS policy are representative of these standards, and are not intended to be limiting or all-inclusive:

- Under no circumstances is the willful act of fraudulent manipulation of analytical data condoned. Such acts are to be reported immediately to senior management for appropriate corrective action.

- Unless specifically required in writing by a client, alteration, deviation or omission of written contractual requirements is not permitted. Such changes must be in writing and approved by senior management.
- Falsification of data in any form will not be tolerated. While much analytical data is subject to professional judgment and interpretation, outright falsification, whenever observed or discovered, will be documented, and appropriate remedies and punitive measures will be taken toward those individuals responsible.

3.2.2 Confidentiality

It is the responsibility of all laboratory employees to safeguard sensitive company information, client data, records, and information; and matters of national security concern should they arise. The nature of our business and the well-being of our company and of our clients is dependent upon protecting and maintaining confidential and/or proprietary company and client information. All information, data, and reports (except that in the public domain) collected or assembled on behalf of a client is treated as confidential.

Information may not be given to third parties without the consent of the client. Unauthorized release of confidential information about the company or its clients is taken seriously and is subject to formal disciplinary action. All employees sign a confidentiality agreement upon hire to protect the company and client's confidentiality and proprietary rights.

3.2.3 Prevention and Detection of Improper, Unethical or Illegal Actions

It is the intention of ALS - Kelso to proactively prevent and/or detect any improper, unethical or illegal action conducted within the laboratory. This is performed by the implementation of a program designed for not only the detection but also prevention. Prevention consists of educating all laboratory personnel in their roles and duties as employees, company policies, inappropriate practices, and their corresponding implications as described here.

In addition to education, appropriate and inappropriate practices are included in SOPs such as manual integration, data review and specific method procedures. Electronic and hardcopy data audits are performed regularly, including periodic audits of chromatographic electronic data. Requirements for internal QA audits are described in SOP CE-QA001, Internal Audits. All aspects of this program are documented and retained on file according to the company policy on record retention.

The ALS Employee Handbook also contains information on the ALS ethics and data integrity program, including mechanisms for reporting and seeking advice on ethical decisions.

3.2.4 Laboratory Data Integrity, Ethics, and Computer Security Training

Each employee receives data integrity and ethics training on an annual basis. The topics covered and training participation are documented. It is the responsibility of the QAM to ensure that the training is conducted as described. Additionally, new employees are given a QA and data integrity/ethics orientation within the first month of hire, followed by the routine annual training.

Key topics covered are the organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting, record

keeping, and reporting data integrity issues. Training includes discussion regarding all data integrity procedures, data integrity training documentation, in-depth data monitoring and data integrity procedures. Training topics also cover examples of improper actions, legal and liability implications (company and personal), causes, prevention, awareness, and reporting options. Computer security is also included, covering ALS computing security awareness, passwords and access, and related topics.

Trainees are required to understand that any infraction of the laboratory data integrity procedures will result in an investigation that could lead to serious consequences including immediate termination, or civil/criminal prosecution.

3.2.5 Management and Employee Commitment

ALS - Kelso makes every attempt to ensure that employees are free from any commercial, financial, or other undue pressures that might affect their quality of work. Related policies are described in the ALS Employee Handbook. This includes:

- ALS Open Door Policy (ALS Employee Handbook) – Employees are encouraged to bring any work related problems or concerns to the attention of local management or their Human Resources representative. However, depending on the extent or sensitivity of the concern, employees are encouraged to directly contact any member of upper management.
- Faircall – An anonymous and confidential reporting system available to all employees that is used to communicate misconduct and other concerns. The program shall help minimize negative morale, promote a positive work place, and encourage reporting suspected misconduct without retribution. Associated upper management is notified and the investigations are documented.
- Use of flexible work hours. Within reason and as approved by supervisors, employees are allowed flexible work hours in order to help ease schedule pressures which could impact decision-making and work quality.
- Operational and project scheduling assessments are continually made to ensure that project planning is performed and that adequate resources are available during anticipated periods of increased workloads. Procedures for subcontracting work are established, and within the ALS Environmental laboratory network additional capacity is typically available for subcontracting, if necessary.
- Gifts and Favors (ALS Employee Handbook) – To avoid possible conflict of interest implications, employees do not receive unusual gifts or favors to, nor accept such gifts or favors from, persons outside the Company who are, or may be, in any way concerned with the projects on which the Company is professionally engaged.

Table 3-1
Summary of Technical Experience and Qualifications – Key Personnel

Personnel	Years of Experience	Project Role
Jeff Grindstaff, B.S.	26	Laboratory Director
Carl Degner, M.S.	31	Quality Assurance Manager
Gregory Salata, Ph.D.	28	Client Services Manager
Jeff Coronado, B.S.	25	Metals Department Manager
Harvey Jacky, B.S.	26	General Chemistry Department Manager
Loren Portwood, B.S.	26	Semi-Volatile Organics Department Manager
Jon James, B.A.	24	HPLC, GC/MS Organics Department Manager
Les Kennedy, B.A.	24	Support Services Manager
Eileen Arnold, B.A.	33	Environmental Health and Safety Officer
Mike Sullivan, B.S.	15	Information Technology
Jeff Christian, B.S.	36	Director of Operations, Western USA

4) Document Control

Procedures for control and maintenance of documents are described in SOP CE-GEN005, *Document Control*. The requirements of the SOP apply to all laboratory logbooks (standards, maintenance, run logbooks, etc.), certificates of analysis, SOPs, QAMs, quality assurance project plans (QAPPs), Environmental Health & Safety (EHS) manuals, and other controlled ALS Environmental documents.

Each controlled copy of a controlled document is released after a document control number is assigned and the recipient is recorded on a document distribution list. Filing and distribution is performed by the QAM, or designee, and ensure that only the most current version of the document is distributed and in use. A document control number is assigned to logbooks. Completed logbooks that are no longer in use are archived in a master logbook file. Logbook entries are standardized following SOP CE-QA007, *Making Entries onto Analytical Records*. The logbook entries are reviewed and approved at a regular interval (quarterly).

A records system is used which ensures all laboratory records (including raw data, reports, and supporting records) are retained and available. The archiving system is described in SOP ADM-ARCH, *Data Archiving*.

External documents relative to the management system are managed by the QAM. To prevent the use of invalid and/or outdated external documents, the laboratory maintains a master list of current documents and their availability. The list is reviewed before making the documents available. External documents are not issued to personnel.

5) Review of Requests, Tenders and Contracts

Requests for new work are reviewed prior to signing any contracts or otherwise agreeing to perform the work. The specific methods to be used are agreed upon between the laboratory and the client. A capability review is performed to determine if the laboratory has or needs to obtain certification to perform the work, to determine if the laboratory has the resources (personnel, equipment, materials, capacity, skills, expertise) to perform the work, and if the laboratory is able to meet the client's required reporting and QC limits. The results of this review are communicated to the client and any potential conflict, deficiency, lack of appropriate accreditation status, or concerns of the ability to complete the client's work are resolved. Any differences between the request or tender and the contract shall be resolved before any work commences. The client should be notified at this time if work is expected to be subcontracted. Each contract shall be acceptable both to the laboratory and the client. Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work. If a contract needs to be amended after work has commenced, the contract review process is repeated and any amendments are communicated to all affected personnel. Changes in accreditation status affecting ongoing projects must be reported to the client.

6) Subcontracting of Tests

Analytical services are subcontracted when the laboratory needs to balance workload or when the requested analyses are not performed by the laboratory. Subcontracting is only done with the knowledge and approval of the client and to qualified laboratories. Subcontracting to another ALS Environmental Group laboratory is preferred over external-laboratory subcontracting. Further, subcontracting is done using capable and qualified laboratories. Established procedures are used to qualify external subcontract laboratories. These procedures are described in SOP CE-QA004, *Qualification of Subcontract Laboratories*. The Quality Assurance staff is responsible for maintaining a list of qualified subcontract laboratories.

7) Purchasing Services and Supplies

The quality level of reagents and materials (grade, traceability, etc.) required is specified in analytical SOPs. Department supervisors ensure that the proper materials are purchased. Inspection and verification of material ordered is performed at the time of receipt by receiving personnel. The receiving staff labels the material with the date received. Expiration dates are assigned as appropriate for the material. Storage conditions and expiration dates are specified in the analytical SOP. CE-QA012, Quality of Reagents and Standards and ADM-RLT, Reagent and Standards Login and Tracking provides default expiration requirements. Supplies and services that are critical in maintaining the quality of laboratory testing are procured from pre-approved vendors. The policy and procedure for purchasing and procurement are described in SOP CE-GEN007, *Procurement and Control of Laboratory Services and Supplies*.

Receipt procedures include technical review of the purchase order/request to verify that what was received is identical to the item ordered. The laboratory checks new lots of reagents for unacceptable levels of contamination prior to use in sample preservation, sample preparation, and sample analysis by following SOP ADM-RLT, *Reagent and Standards Login and Tracking*.

8) Service to the Client

ALS - Kelso utilizes a number of processes to ensure that adequate resources exist to meet service demands. Senior staff meetings, tracking of outstanding proposals, and a current synopsis of incoming work all assist the senior staff in properly allocating sufficient resources. Status/production meetings are conducted regularly with the laboratory and Project Managers to inform the staff of the status of incoming work, future projects, or project requirements.

The Project Manager is a scientist assigned to each client to act as a technical liaison between the client and the laboratory. The Project Manager is responsible for ensuring that the analyses performed by the laboratory meet all project and contract requirements. This entails coordinating with the laboratory staff to ensure that client-specific needs are understood and that the services provided are properly executed and satisfy the requirements of the client.

Laboratory management also monitors a number of other indicators to assess the overall ability of the laboratory to successfully perform analyses for its clients. This includes on-time performance, customer complaints, training reports and non-conformity reports. A frequent assessment is made of the laboratory's facilities and resources in anticipation of accepting an additional or increased workload.

All Requests for Proposal (RFP) documents are reviewed by the Project Manager and appropriate managerial staff to identify any project specific requirements that differ from the standard practices of the laboratory. Any requirements that potentially cannot be met are noted and communicated to the client, as well as requesting the client to provide any applicable project specific Quality Assurance Project Plans (QAPPs).

When a client requests a modification to an SOP, policy, or standard specification the Project Manager will discuss the proposed deviation with the Client Services Manager, Laboratory Director, and department manager to obtain approval for the deviation. The QAM may also be involved. All project-specific requirements must be on-file and with the service request upon logging in the samples. The modification or deviation must be documented. A Project-Specific Communication Form, Form V, or similar, may be used to document such deviations.

The laboratory affords clients cooperation to clarify the client's request and to monitor the laboratory's performance in relation to the work performed, provided that the laboratory ensures confidentiality to other clients. The laboratory maintains and documents timely communication with the client for the purposes of seeking feedback and clarifying customer requests. Feedback is used and analyzed to improve the quality of services. The SOP CE-GEN010, *Handling Customer Feedback* is in place for these events.

9) Complaints

In addition to project communication and internal communication of data issues, the laboratory also maintains a system for dealing with customer complaints. The procedure is described in CE-GEN010, Handling Customer Feedback. The person who initially receives feedback in the form of a complaint (typically the Project Manager) is responsible for documenting the complaint. If the Project Manager is unable to satisfy the customer, the complaint is brought to the attention of the Client Services Manager, Laboratory Director, or QAM for final resolution. The complaint and resolution are documented.

10) Facilities and Equipment

The ALS Environmental Kelso laboratory features over 45,000 square feet of laboratory and administrative workspace. The laboratory has been designed and constructed to provide safeguards against cross-contamination of samples and is arranged according to work function, which enhances the efficiency of analytical operations. The ventilation system has been specially designed to meet the needs of the analyses performed in each work space. Also, ALS - Kelso minimizes laboratory contamination sources by employing janitorial and maintenance staff to ensure that good housekeeping and facilities maintenance are performed. In addition, the segregated laboratory areas are designed for safe and efficient handling of a variety of sample types. These specialized areas (and access restrictions) include:

- Shipping and Receiving/Purchasing
- Sample Management Office, including controlled-access sample storage areas
- Inorganic/Metals Sample Preparation Laboratories (2)
- Inorganic/Metals “clean room” sample preparation laboratory
- ICP-AES Laboratory
- ICP-MS Laboratory
- Low-level Mercury Laboratory
- Water Chemistry & General Chemistry Laboratories (3)
- Semi-volatile Organics Sample Preparation Laboratory
- Gas Chromatography and High Performance Liquid Chromatography Laboratories
- Gas Chromatography/Mass Spectrometry Laboratories (2)
- Semi-volatile Organics Drinking Water Laboratory
- Volatile Organics Laboratory
    - Separate sample preparation laboratory
    - Access by semi-volatile sample preparation staff only after removing lab coat and solvent-contaminated gloves, etc.
- Microbiology Laboratory
- Laboratory Deionized Water Systems (2)
- Laboratory Management, Client Service, Report Generation and Administration
- Data Archival, Data Review and support functions areas

In addition, the designated areas for sample receiving, refrigerated sample storage and dedicated sample container preparation and shipping areas provide for the efficient and safe handling of a variety of sample types. The laboratory is equipped with state-of-the-art analytical and administrative support equipment. The equipment and instrumentation are appropriate for the procedures in use. Refer to Appendix D for a Laboratory Floor Plan and Appendix E for a list of major equipment, illustrating the laboratory's overall capabilities and depth.

11) Sample Management

11.1 Sampling and Sample Preservation

The quality of analytical results is highly dependent upon the quality of the procedures used to collect, preserve and store samples. ALS - Kelso recommends that clients follow sampling guidelines described in 40 CFR 136, 40 CFR 141, USEPA SW 846, and state-specific sampling guidelines, if applicable. Sampling factors that must be taken into account to insure accurate, defensible analytical results include:

- Amount of sample taken
- Type of container used
- Type of sample preservation
- Sample storage time
- Proper custodial documentation

The laboratory uses the sample preservation, container, and holding-time recommendations published in a number of documents. The primary documents of reference are: USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, III, IV for hazardous waste samples; USEPA 600/4-79-020, 600/4-91-010, 600/4-82-057, 600/R-93/100, 600/4-88-039, 600/R-94-111, and Supplements; EPA 40CFR parts 136 and 141 and associated Method Update Rules; and Standard Methods for the Examination of Water and Wastewater for water and wastewater samples (see Section 23 for complete references). The container, preservation and holding time information for these references is summarized in Appendix F for soil, water, and drinking water. The current EPA CLP Statement of Work should be referred to for CLP procedures. Where allowed by project sampling and analysis protocols (such as Puget Sound Protocols) the holding time for sediment, soil, and tissue samples may be extended for a defined period when stored frozen at -20˚C.

ALS - Kelso provides clients with sample containers with applicable preservatives. Containers are purchased as pre-cleaned to a level 1 status, and conform to the requirements for samples established by the USEPA. Certificates of analysis for sample containers are available upon request. Reagent water used for sampling blanks (trip blanks, etc.) and chemical preservation reagents are tested by the laboratory to ensure that they are free of interferences and documented. Our sample kits typically consist of pre-cleaned, rinsed, and air-dried shipping coolers with foam liners, specially prepared and labeled sample containers individually wrapped in protective material (VOC vials are placed in a specially made foam holder), chain-of-custody (COC) forms, and custody seals. Container labels and custody seals are provided for each container. Figure 11-1 shows the chain-of-custody form routinely used at ALS - Kelso and included with sample kits. Dry ice or gel ice is the only temperature preservative used. For large sample container shipments the containers may be shipped in their original boxes. Such shipments will consist of labeled and preserved sample containers and sufficient materials (bubble wrap, COC forms, custody seals, shipping coolers, etc.) for return to ALS, unless otherwise instructed by the client.

ALS - Kelso also provides courier service that makes regularly scheduled trips on the I-5 corridor between the Greater Portland, Oregon area and the Great Seattle/Tacoma area, and nearby communities and facilities.

Returning shipping coolers are cleaned and decontaminated. If any such cooler exhibits an odor or other abnormality after receipt and cleaning, a more vigorous decontamination process is employed. Containers which cannot be decontaminated are discarded. ALS - Kelso keeps client-specific shipping requirements on file and utilizes major transportation carriers to necessary to meet sample shipping requirements (same-day, overnight, etc.).

When ALS - Kelso ships samples to other laboratories for analysis, similar sample integrity processes are used to ensure preservation and proper sample handling, and to avoid any possible breakage, cross-contamination of samples, or identification problems. Alternatively, the receiving laboratory's procedures may be specified. Chain of custody is maintained during the process.

11.2 Sample Receipt and Handling

Standard procedures are established for the receiving of samples into the laboratory and are found in SOP SMO-GEN, *Sample Receiving*. These procedures ensure that samples are received and properly logged into the laboratory, and that all associated documentation, including chain of custody forms, is complete and consistent with the samples received.

Once samples are received or delivered to the laboratory the sample management office uses a Cooler Receipt and Preservation Check Form (CRF - Figure 11-2) is used to assess the shipping cooler and its contents as received by the laboratory. Any anomalies or discrepancies observed during the initial assessment are recorded on the CRF and COC documents. Verification of sample integrity includes the following activities:

- Assessment of custody seal presence/absence, location and signature;
- Temperature of sample containers upon receipt;
- Chain of custody documents properly used (entries in ink, signature present, etc.);
- Sample containers checked for integrity (broken, leaking, etc.);
- Sample is clearly marked and dated (bottle labels complete with required information);
- Appropriate containers (size, type) are received for the requested analyses;
- The minimum amount of sample material is provided for the analysis.
- Sample container labels and/or tags agree with chain of custody entries (identification, required analyses, etc.);
- Assessment of proper sample preservation (if inadequate, corrective action is employed); and
- VOC containers are inspected for the presence/absence of bubbles. (Assessment of proper preservation of VOC containers is performed by lab personnel).

Samples are logged into a Laboratory Information Management System (LIMS). Potential problems with a sample shipment are addressed by contacting the client and discussing the pertinent issues. When the Project Manager and client have reached a

satisfactory resolution, the login process may continue and analysis may begin. During the login process each sample container is given a unique laboratory code and a Service Request form is generated which contains client information, sample descriptions, sample matrix information, required analyses, sample collection dates, analysis due dates and other pertinent information. The service request is reviewed by the applicable Project Manager for accuracy and completeness.

Samples are stored as per method requirements until analysis, unless otherwise specified, using various refrigerators, freezers, or designated secure areas. ALS - Kelso has multiple walk-in and refrigerator cold storage units which house the majority of samples, including dedicated refrigerated storage of VOC samples. The VOC storage units are monitored using storage blanks as described in SOP VOC-BLAN, *VOA Storage Blanks*. ALS - Kelso also has multiple sub-zero freezers capable of storing samples at -10 to -30˚C primarily used for tissue and sediment samples. The temperature of each sample storage unit is monitored real time with an electronic temperature monitoring system.

ALS - Kelso adheres to the method-prescribed or project-specified holding times for all analyses. Analysts monitor holding times by obtaining analysis-specific reports from the LIMS. These reports provide holding time information on all samples for the analysis, calculated from the sampling date and the holding time requirement. To document holding time compliance, the date and time analyzed is printed or written on the analytical raw data. Unless other arrangements have been made in advance, upon completion of all analyses and submittal of the final report, aqueous samples are retained at ambient temperature for 30 days, soil samples are retained at ambient temperature for 60 days, and tissue samples are retained frozen for 3 months. Upon expiration of these time limits, the samples are either returned to the client or disposed of according to approved disposal practices. Sample extracts are retained as specified in analytical SOPs. All samples are characterized according to hazardous/non-hazardous waste criteria and are segregated accordingly. All hazardous waste samples are disposed of according to formal procedures outlined in the ALS Environmental Health and Safety Manual and in accordance with applicable laws. Documentation is maintained for each sample from initial receipt through final disposal to ensure that an accurate history of the sample from “cradle to grave” is available.

11.3 Sample Custody

Sample custody transfer at the time of sample receipt is documented using chain-of-custody (COC) forms accompanying the samples. During sample receipt, it is also noted if custody seals were present.

Facility security and access is important in maintaining the integrity of samples received at ALS - Kelso. Access to the laboratory facility is limited by use of locked exterior doors with a coded/card entry, except for the reception area and sample receiving doors, which are staffed during business hours and locked at all other times. In addition, the sample storage area within the laboratory is a controlled access area with locked doors with a coded entry. The facility is equipped with an alarm system and the laboratory employs a private security firm to provide nighttime and weekend security.

A barcoding system is used to document internal sample custody. Each person removing or returning samples from/to sample storage is required to document this custody transfer (via custodian or directly). The system uniquely identifies sample containers and provides an electronic record of the sample custody. Procedures are also defined for sample extracts, digestates, and leachates. The procedures are described in the SOP SMO-SCOC, *Sample Tracking and Internal Chain of Custody*.

11.4 Project Setup

The analytical method(s) used for sample analysis are chosen based on the client's requirements. LIMS codes are chosen to identify the analysis method used for analysis. The Project Manager ensures that the correct methods are selected for analysis, deliverable requirements are identified, and due dates are specified on the Service Request. For SW-846 methods, some projects may require the most recent promulgated version, and some projects may require the most recent published version. The Project Manager will ensure that the correct method version is used. Functionality incorporated in the LIMS is used to communicate and specify project-specific requirements and demographics, including the use of attachments to LIMS delivery group (SDG or SR) such as specification forms, analyte lists, deliverable requirements, and other pertinent information.

Figure 11-1

ALS Environmental Standard Chain of Custody Form

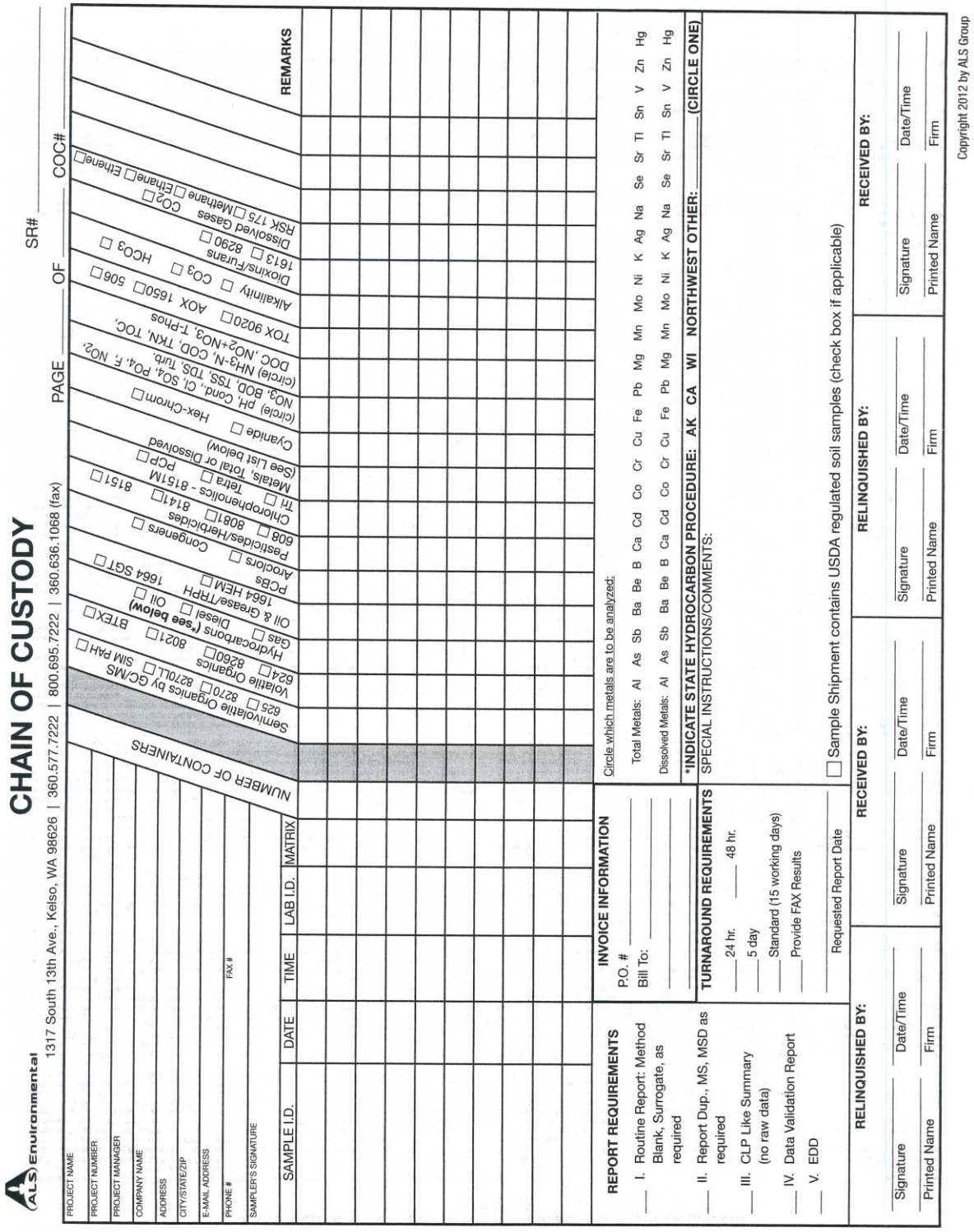

Figure 11-2

ALS Environmental Cooler Receipt and Preservation Form

PC_____

Cooler Receipt and Preservation Form

Client _____ Service Request *K15*_____

Received:_____ Opened:_____ By:_____ Unloaded:_____ By:_____

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other*_____ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where?_____
   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed

4. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* _____
5. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
6. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA Y N
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
12. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

*Notes, Discrepancies, & Resolutions:*_____

_____

_____

_____

Page_____of_____

Cooler Receipt and Preservation Form

Client _____ Service Request *K15*_____

Thermometer ID	Corr. Factor	@20 min, Raw Blank	@20 min, Corr. Blank	@40 min. Raw Blank	@40 min. Corr. Blank	@60 min. Raw Blank	@60 min Corr. Blank

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies & Resolutions:

_____

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Page_____of_____

12) Analytical Procedures

ALS - Kelso employs methods and analytical procedures from a variety of external sources. The primary method references are: USEPA SW-846, Third Edition and Updates I, II, IIA, IIB, III, IVA, IVB, and online updates for hazardous waste samples, and USEPA 600/4-79-020, 600/4-91-010, 600/4-82-057, 600/R-93/100, 600/4-88-039, 600/R-94-111, EPA 40CFR parts 136 and 141 and associated Method Update Rules and Supplements; Standard Methods for the Examination of Water and Wastewater for water and wastewater samples, and American Society for Testing and Materials (ASTM). Complete citations for these references can be found in Section 23. Other published procedures, such as state-specific methods, program-specific methods (such as Puget Sound Protocols), or in-house methods may be used. Several factors are involved with the selection of analytical methods to be used in the laboratory. These include the method detection/reporting limit, the expected concentration of the analyte(s) being measured, method selectivity, accuracy and precision of the method, the type of sample being analyzed, and the regulatory compliance objectives. The implementation of methods by ALS - Kelso is described in SOPs specific to each method. A list of NELAP-accredited methods is given in Appendix J.

12.1 Standard Operating Procedures (SOPs) and Laboratory Notebooks.

ALS Environmental, Kelso maintains SOPs for use in both technical and administrative functions. SOPs are written following standardized format and content requirements as described in CE-GEN009, *Preparation of Standard Operating Procedures*. Each SOP is reviewed and approved by a minimum of two managers (the Laboratory Director and/or Department Manager and the Quality Assurance Manager). All SOPs undergo a documented annual review to make sure current practices are described. The QAM maintains a comprehensive list of current SOPs. The document control process ensures that only the most currently approved version of an SOP is being used. The procedures for document control are described in CE-GEN005, *Document Control*. In addition to SOPs, each laboratory department maintains the current methods used to perform analyses accessible to all laboratory staff. Laboratory notebook entries are standardized using the procedure in SOP CE-QA007, *Making Entries onto Analytical Records*. Laboratory notebook entries are reviewed and approved by the appropriate supervisor at a regular interval. A list of current SOPs is given in Appendix G.

12.2 Deviation from Standard Operating Procedures

When a client requests a modification to an SOP (such as a change in reporting limit, addition or deletion of target analyte(s), etc.), the Project Manager handling that project must discuss the proposed deviation with the department manager in charge of the analysis and obtain their approval to accept the project. The Project Manager is responsible for documenting the approved or allowed deviation from the SOP by placing a description of the deviation attached with the project documents and also providing an instructional comment with the Service Request.

For circumstances when a deviation or departure from company policies or procedures involving any non-technical function is found necessary, approval must be obtained from the appropriate supervisor, manager, the Laboratory Director, or other level of authority. Frequent departure from policy is not encouraged. However, if frequent departure from any policy is noted, the laboratory director will address the possible need for a change in policy.

12.3 Modified Procedures

ALS - Kelso strives to perform published methods as described in the referenced documents. If there is a material deviation from the published method, the method is cited as a “Modified” method in the analytical report. Modifications to the published methods are listed in the standard operating procedure. Standard operating

procedures are available to analysts and are also available to our clients for review. Client approval is obtained for the use of "Modified" methods prior to the performance of the analysis.

12.4 Analytical Batch

The basic unit for analytical quality control is the analytical batch. The definition that ALS - Kelso has adopted for the analytical batch is listed below. The overriding principle for describing an analytical batch is that all the samples in a batch, both field samples and quality control samples are to be handled exactly the same way, and all of the data from each analysis is to be manipulated in exactly the same manner. The minimum requirements of an analytical batch are:

1) The number of (field) samples in a batch is not to exceed 20.

2) All (field) samples in a batch are of the same matrix.

3) The QC samples to be processed with the (field) samples include:

- Method Blank (a.k.a. Laboratory Reagent Blank)
- Laboratory Control Sample
- Matrix Spiked (field) Sample (a.k.a. Laboratory Fortified Sample Matrix)*
- Duplicate Matrix Spiked (field) Sample or Duplicate (field) Sample (a.k.a. Laboratory Duplicate)*

* A sample identified as a field blank, an equipment blank, or a trip blank is not to be matrix spiked or duplicated.

4) A single lot of reagents is used to process the batch of samples.

5) Each operation within the analysis is performed by a single analyst, technician, chemist, or by a team of analysts/technicians/chemists.

6) Samples are analyzed in a continuous manner over a timeframe not to exceed 24-hours between the start of processing of the first and last sample of the batch.

7) Samples are analyzed in a continuous manner over a timeframe not to exceed 24-hours.

8) Field samples are assigned to batches commencing at the time that sample processing begins.

9) The QC samples are to be analyzed in conjunction with the associated field samples prepared with them. However, for tests which have a separate sample preparation step that defines a batch (digestion, extraction, etc.), the QC samples in the batch do not require analysis each time a field sample within the preparation batch is analyzed (multiple instrument sequences to analyze all field samples in the batch need not include re-analyses of the QC samples).

10) The batch is to be assigned a unique identification number that can be used to correlate the QC samples with the field samples.

11) Batch QC refers to the QC samples that are analyzed in a batch of (field) samples.

12) Project-specific requirements may be exceptions. If project, program, or method requirements are more stringent than these laboratory minimum requirements, then the project, program, or method requirements will take

precedence. However, if the project, program, or method requirements are less stringent than these laboratory minimum requirements, these laboratory minimum requirements will take precedence.

12.5 Specialized Procedures

ALS - Kelso not only strives to provide results that are scientifically sound, legally defensible, and of known and documented quality; but also strives to provide the best solution to analytical challenges. Procedures using specialized instrumentation and methodology have been developed to improve sensitivity (provide lower detection limits), selectivity (minimize interferences while maintaining sensitivity), and overall data quality for low concentration applications. Examples are trace-level Mercury and Methyl mercury analyses, reductive precipitation metals analysis, leaching procedures, incremental sampling protocols, specialized GC/MS analyses, LC/MS analyses, and ultra-low level organics analyses (including PAHs, pesticides and PCBs); including those for emerging contaminants of concern.

12.6 Sample Cleanup

The laboratory commonly employs several cleanup procedures to minimize known common interferences prior to analysis. EPA methods (3620, 3630, 3640, 3660, and 3665) for cleanup of sample extracts for organics analysis are routinely used to minimize or eliminate interferences that may adversely affect sample results and data usability.

13) Measurement Traceability and Calibration

All equipment and instruments used at ALS - Kelso are operated, maintained and calibrated according to the manufacturer's recommendations and criteria set forth in the analytical methods. All analytical measurements generated are performed using materials that are traceable to a reference material, unless unavailable. Documentation of calibration information is maintained in appropriate reference files. Brief descriptions of the calibration procedures for our major laboratory equipment are described below. Calibration verification is performed according to the analytical methods and SOPs, and criteria are listed in the SOPs. Documentation of calibration verification is maintained in appropriate reference files. Records are maintained to provide traceability of reference materials and reference equipment.

Laboratory support equipment (thermometers, balances, and weights) are routinely verified on an annual basis by a vendor accredited to ISO/IEC 17025:2005, or more frequently if program-specified. Metrology equipment (analytical balances, thermometers, etc.) is calibrated using reference materials traceable to the National Institute of Standards and Technology (NIST). These primary reference materials are themselves recertified on an annual basis. Vendors used for metrology support are required to verify compliance to International Standards by supplying the laboratory with a copy of their scope of accreditation.

Equipment shown by verification to be malfunctioning or defective is taken out of service until it is repaired. When an instrument is taken out of service, an Out of Service sign is placed by the laboratory on the instrument. The equipment is placed back in service only after verifying, by calibration, that the equipment performs satisfactorily.

13.1 Temperature Control Devices

Temperatures are monitored and recorded each day for all of the temperature-regulating support equipment such as sample refrigerators, freezers, and standards refrigerators/freezers. Temperatures are recorded in either laboratory logbook or through Check Point® Wireless Monitoring System. During weekends and holidays a min/max thermometer may be used.

Laboratory records contain the recorded temperature, identification and location of equipment, acceptance criteria and the initials of the technician who performed the checks. The procedure for performing these measurements is provided in the SOP ADM-SEMC, *Support Equipment Monitoring and Calibration*.

Where the operating temperature is specified as a test condition (such as ovens, incubators, evaporators) the temperature is recorded on the raw data. All thermometers are identified according to serial number, and the calibration is checked annually against a National Institute of Standards and Technology (NIST) certified thermometer. The NIST thermometer is recertified by a vendor accredited to ISO/IEC 17025:2005 on an annual basis.

13.2 Analytical Balances

The calibration of each analytical balance is checked by the user each day of use with three Class S or S-1 weights, which assess the accuracy of the balance at low, mid-level and high levels bracketing the working range. Records are kept which contain the recorded measurements, identification of the balance, acceptance criteria, and the initials of user who performed the check. The procedure for performing these measurements and use of acceptance criteria is described in the SOP ADM-SEMC. The weights are recertified using NIST traceable standards by an accredited metrology organization on an annual basis. As needed, the balances are recalibrated using the manufacturers recommended operating procedures. Analytical balances are serviced on a semi-annual basis by an accredited metrology organization.

13.3 Water Purification Systems

ALS - Kelso uses two independent water purification systems is designed to produce deionized water meeting method specifications. One system consists of a series of pumps, filters, and resin beds designed to yield deionized water meeting the specifications of ASTM Type II water, and Standard Methods for the Examination of Water and Wastewater (SM1080, 20th Ed.) High Quality water. Activated carbon filters are also in series with the demineralizers to produce "organic-free" water. A second system consists of pumps, filters, and treatment components designed to yield deionized water meeting the specifications of ASTM Type I water, and Standard Methods for the Examination of Water and Wastewater (SM1080, 20th Ed.) High Quality water. The status of each system is monitored continuously for conductivity and resistivity with an on-line meter and indicator light, and readings recorded daily. The meter accuracy is verified annually. Deionizers are rotated and replaced on a regular schedule. Microbiology water is checked on a daily basis at a point downstream of the purification system at a tap in the laboratory.

13.4 Standards and Reference Materials

Consumable reference materials routinely purchased by the laboratories (e.g., analytical standards) are purchased from nationally recognized, reputable vendors. All vendors where possible have fulfilled the requirements for 9001 certification and/or are ISO 17025 accredited. ALS - Kelso relies on a primary vendor for the majority of its analytical supplies. Consumable primary stock standards are obtained from certified commercial sources or from sources referenced in a specific method. Supelco, Ultra Scientific, AccuStandard, Chem Services, Inc., Aldrich Chemical Co., Baker, Spex, etc. are examples of the vendors used. Reference material information is recorded in the appropriate logbook(s) and materials are stored under conditions that provide maximum protection against deterioration and contamination. The logbook entry includes such information as an assigned logbook identification code, the source of the material (i.e. vendor identification), solvent (if applicable) and concentration of analyte(s), reference to the certificate of analysis and an assigned expiration date. The

date that the standard is received in the laboratory is marked on the container. When the reference material is used for the first time, the date of usage and the initials of the analyst are also recorded on the container.

Stock solutions and calibration standard solutions are prepared fresh as often as necessary according to their stability. All standard solutions are properly labeled as to analyte concentration, solvent, date, preparer, and expiration date; these entries are also recorded in the appropriate notebook(s) following the SOP for *Reagent Login and Tracking* (SOP ADM-RTL). Prior to sample analysis, all calibration reference materials are verified with a second, independent source of the material.

13.5 Inductively Coupled Plasma-Atomic Emission Spectrograph (ICP-AES)

Each emission line on the ICP is calibrated daily against a blank and against standards whose concentrations fall within the instruments linear range. Analyses of calibration standards, initial and continuing calibration verification standards, and inter-element interference check samples are carried out as specified in the applicable method SOP and analytical method (i.e. EPA 200.7, 6010B, 6010C, CLP SOW, etc.).

13.6 Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)

Each element of interest is calibrated for using a blank and a single standard. Prior to calibration, a short-term stability check is performed on the system. Following calibration, an independent check standard is analyzed, and a continuing calibration verification standard (CCV) is analyzed with every ten samples.

13.7 Atomic Absorption Spectrophotometers (AAS)

These instruments are calibrated daily using a minimum of four standards and a blank. Calibration is validated using reference standards, and is verified at a minimum frequency of once every ten samples. Initial calibration points cannot be “dropped” from the resulting calibration curve.

13.8 GC/MS Systems

All GC/MS instruments are calibrated at multiple concentration levels for the analytes of interest (unless specified otherwise) using procedures outlined in Standard Operating Procedures and/or appropriate USEPA method citations. All reference materials used for this function are vendor-certified standards. Calibration verification is performed at method-specified intervals following the procedures in the SOP. For internal standard and isotope dilution procedures, the internal standard response and/or labeled compound recovery must meet method criteria. Method-specific instrument tuning is regularly checked the method-specified compounds. Mass spectra for the tuning compounds must meet method/SOP criteria before analyses can proceed. Calibration policies for organics chromatographic analyses are described in the SOP SOC-CAL, *Calibration of Instruments for Organics Chromatographic Analyses*.

13.9 Gas Chromatographs and High Performance Liquid Chromatographs

Calibration and standardization follow SOP guidelines and/or appropriate USEPA method citations. All GC and HPLC instruments are calibrated at a minimum of five different concentration levels for the analytes of interest (unless specified otherwise). The lowest standard is equivalent to the method reporting limit; additional standards define the working range of the GC or LC detector. Results are used to establish response factors (or calibration curves) and retention-time windows for each analyte. Calibration is verified at a minimum frequency of once every ten samples, unless otherwise specified by the reference method. Calibration policies for organics chromatographic analyses are described in the SOP SOC-CAL, *Calibration of Instruments for Organics Chromatographic Analyses*.

LC/MS Systems:

Calibration and tuning procedures are included in analytical SOPs written specifically for these tests. In general, multiple concentration levels for the analytes of interest are used to generate calibration curves. All reference materials used for this function are vendor-certified standards. Calibration and tuning verification is performed at SOP-defined intervals. Any other system performance checks are described in the applicable SOP. Calibration policies for organics chromatographic analyses are described in the SOP SOC-CAL, *Calibration of Instruments for Organics Chromatographic Analyses*.

13.10 UV-Visible Spectrophotometer (manual colorimetric analyses)

Routine calibrations for colorimetric and turbidimetric analyses involve generating a 5 point calibration curve including a blank. Initial calibration points cannot be "dropped" from the resulting calibration curve. Correlation coefficients must meet method or SOP specifications before analysis can proceed. Independent calibration verification standards (ICVs) are analyzed with each batch of samples. Continuing calibration is verified at a minimum frequency of once every ten samples. Typical UV-Visible spectrophotometric methods at ALS Environmental, Kelso include total phenolics, phosphates, surfactants and tannin-lignin.

13.11 Flow Injection Analyzer (automated colorimetric analysis)

A minimum of six standards and a blank are used to calibrate the instrument for cyanide analysis. A blank and (minimum of) five standards are used to calibrate the instrument for all other automated chemistries. Initial calibration points cannot be "dropped" from the resulting calibration curve. Standard ALS Environmental, Kelso acceptance limits are used to evaluate the calibration curve prior to sample analysis.

13.12 Discrete Auto-Analyzer (automated absorbance analysis)

A minimum of five standards and a blank are used to calibrate the instrument. Initial calibration points cannot be "dropped" from the resulting calibration curve. Method specific acceptance limits are used to evaluate the calibration curve prior to sample analysis.

13.13 Ion Chromatographs

Calibration of the ion chromatograph (IC) involves generating a calibration curve with the method-specified number of points (or more). Initial calibration points cannot be "dropped" from the resulting calibration curve. A correlation coefficient of > 0.995 for the curve is required before analysis can proceed. Quality Control (QC) samples that are routinely analyzed include blanks and laboratory control samples. The target analytes typically determined by the IC include nitrate, nitrite, chloride, fluoride, sulfate and drinking water inorganic disinfection byproducts. Calibration verification is performed at method-specified intervals following the procedures in the SOP and reference method.

13.14 Turbidimeter

Calibration of the turbidimeter requires analysis of three Nephelometric Turbidity Unit (NTU) formazin standards. Quality Control samples that are routinely analyzed include blanks, Environmental Resource Associates QC samples (or equivalent) and duplicates.

13.15 Ion-selective electrode

The method-prescribed numbers of standards are used to calibrate the electrodes before analysis. The slope of the curve must be within acceptance limits before analysis can proceed. Quality Control samples that are routinely analyzed include blanks, LCSs and duplicates.

13.16 Pipets

The calibration of pipets and autopipettors used to make critical-volume measurements is verified following SOP ADM-VOLWARE, *Checking Volumetric Labware*. Both accuracy and precision verifications are performed, at intervals applicable to the pipet and use. The results of all calibration verifications are recorded in bound logbooks.

13.17 Other Instruments

Calibration for the total organic carbon (TOC), total organic halogen (TOX), and other instruments is performed following manufacturer's recommendations and applicable SOPs.

14) Assuring the Quality of Results

A primary focus of ALS - Kelso's QA Program is to ensure the accuracy, precision and comparability of all analytical results. Prior to using a procedure for the analysis on field samples, acceptable method performance is established by performing demonstration of capability analyses. Performance characteristics are established by performing method detection limit studies and assessing accuracy and precision according to the reference method. ALS - Kelso has established Quality Control (QC) objectives for precision and accuracy that are used to determine the acceptability of the data that is generated. These QC limits are either specified in the test methodology or are statistically derived based on the laboratory's historical data. Quality Control objectives are defined below.

14.1 Quality Control Objectives

14.1.1 Demonstration of Capability - A demonstration of capability (DOC) is made prior to using any new test method or when a technician is new to the method. This demonstration is made following regulatory, accreditation, or method specified procedures. In general, this demonstration does not test the performance of the method in real world samples, but in the applicable clean matrix free of target analytes and interferences.

A quality control sample material may be obtained from an outside source or may be prepared in the laboratory. The analyte(s) is (are) diluted in a volume of clean matrix (for analytes which do not lend themselves to spiking, e.g., TSS, the demonstration of capability may be performed using quality control samples). Where specified, the method-required concentration levels are used. Four aliquots are prepared and analyzed according to the test procedure. The mean recovery and standard deviations are calculated and compared to the corresponding acceptance criteria for precision and accuracy in the test method or laboratory-generated acceptance criteria (if there are not established mandatory criteria). All parameters must meet the acceptance criteria. Where spike levels are not specified, actual Laboratory Control Sample results may be used to meet this requirement, provided acceptance criteria is met.

14.1.2 Accuracy - A measure of the closeness of an individual measurement (or an average of multiple measurements) to a true or expected value and expressed as percent recovery (% REC.) of the measured value, relative to the true or expected value. If a measurement process produces results whose mean is not the true or expected value, the process is said to be biased. Bias is the systematic error either inherent in a method of analysis or caused by an artifact of the measurement system (e.g., contamination). Ongoing accuracy is determined by calculating the mean value of results from ongoing analyses of laboratory control sample, standard reference materials, or standard

solutions. In addition, matrix-spiked samples are also measured and recovery indicates the accuracy or bias in the actual sample matrix.

ALS - Kelso utilizes several quality control measures to eliminate analytical bias, including systematic analysis of method blanks, laboratory control samples and independent calibration verification standards. Because bias can be positive or negative, and because several types of bias can occur simultaneously, only the net, or total, bias can be evaluated in a measurement.

14.1.3 Precision - Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability, or random error, in sampling, sample handling and in laboratory analysis. The American Society of Testing and Materials (ASTM) recognizes two levels of precision: repeatability - the random error associated with measurements made by a single test operator on identical aliquots of test material in a given laboratory, with the same apparatus, under constant operating conditions, and reproducibility - the random error associated with measurements made by different test operators, in different laboratories, using the same method but different equipment to analyze identical samples of test material.

"Within-batch" precision is measured using replicate sample or QC analyses and is expressed as the relative percent difference (RPD) between the measurements. The "batch-to-batch" precision is determined from the variance observed in the analysis of standard solutions or laboratory control samples from multiple analytical batches.

14.1.4 Control Limits - The control limits for accuracy and precision originate from two different sources. For analyses having enough QC data, control limits are calculated at the 99% confidence limits. For analyses not having enough QC data, or where the method is prescriptive, control limits are taken from the method on which the procedure is based. If the method does not have stated control limits, then control limits are assigned method-default or reasonable values based on similar methods. Control limits are reviewed each year and may be updated if new statistical limits are generated for the appropriate surrogate, laboratory control sample, and matrix spike compounds (typically once a year) or when method prescribed limits change. The updated limits are reviewed by the QAM. The new control limits replace the previous limits and data is assessed using the new values. Current *Data Quality Objectives*, including acceptance limits for accuracy and precision are available from the laboratory. For inorganics, the precision limit values listed are for laboratory duplicates. For organics, the precision limit values listed are for duplicate laboratory control samples or duplicate matrix spike analyses. Procedures for establishing control limits are found in SOP CE-QA009, *Control Limits*.

14.1.5 Representativeness - The degree to which the field sample, being properly preserved, free of contamination, and properly analyzed, represents the overall sample site or material. This can be extended to the sample itself, in that representativeness is the degree to which the subsample that is analyzed represents the entire field sample submitted for analysis. ALS - Kelso has sample handling procedures to ensure that the sample used for analysis is representative of the entire sample. These include the SOP for *Subsampling and Compositing of Samples* (GEN-SUBS) and the SOP for *Tissue Sample Preparation* (MET-TISP). Further, analytical SOPs specify sample handling and sample sizes to further ensure the sample aliquot that is analyzed is representative in entire sample.

14.1.6 Comparability – Comparability expresses the confidence with which one data set can be compared to another and is directly affected by data quality (accuracy and precision) and sample handling (sampling, preservation, etc.). Only data of known quality can be compared. The objective is to generate data of known quality with the highest level of comparability, completeness, and usability. This is achieved by employing the quality controls listed below and standard operating procedures for the handling and analysis of all samples. Data is reported in units specified by the client and using ALS Environmental, Kelso or project-specified data qualifiers.

14.2 Method Detection Limits, Method Reporting Limits, Limits of Detection, and Limits of Quantitation

Method Detection Limits (MDL) for methods performed at ALS - Kelso are determined during initial method set up and when significant changes are made. If an MDL study is not performed annually, the established MDL is verified by performing a Limit of Detection (LOD) verification on every instrument used in the analysis. The MDLs are determined by following the SOP CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*, which is based on the procedure in 40 CFR Part 136, Appendix B. As required by NELAP and DoD protocols, the validity of MDLs is verified using LOD verification samples.

The Method Reporting Limit (MRL) is the lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (i.e. Limit of Quantitation- LOQ). LOQ are analyzed at the frequency specified in the SOP CE-QA011, and at specified concentrations (not lower than the lowest calibration standard). Current MDL/LOD and MRL/LOQ values are available from the laboratory.

14.3 Quality Control Procedures

The specific types, frequencies, and processes for quality control sample analysis are described in detail in method-specific standard operating procedures and listed below. These sample types and frequencies have been adopted for each method and a definition of each type of QC sample is provided below. Unique test-specific requirements may also exist and are found in the laboratory SOP.

14.3.1 Method Blank (a.k.a. Laboratory Reagent Blank)

The method blank is an analyte-free matrix (water, soil, etc.) subjected to the entire analytical process. When analyte-free soil is not available, anhydrous sodium sulfate, organic-free sand, or an acceptable substitute is used. The method blank is analyzed to demonstrate that the analytical system itself does not introduce contamination. The method blank results should be below the Method Reporting Limit (MRL) or, if required for DoD projects, < ½ MRL for the analyte(s) being tested. Otherwise, corrective action must be taken. A method blank is included with the analysis of every sample preparation batch, every 20 samples, or as stated in the method, whichever is more frequent.

14.3.2 Calibration Blank

For some methods, calibration blanks are prepared along with calibration standards in order to create a calibration curve. Calibration blanks are free of the analyte of interest and, where applicable, provide the zero point of the calibration curve. Additional project-specific requirements may also apply to calibration blanks.

14.3.3 Continuing Calibration Blank

Continuing calibration blanks (CCBs) are solutions of analyte-free water, reagent, or solvent that are analyzed in order to verify the system is contamination-free when CCV standards are analyzed. The frequency of CCB analysis is either once every ten samples or as indicated in the method, whichever is greater. Additional project-specific requirements may also apply to continuing calibration blanks.

14.3.4 Calibration Standards

Calibration standards are solutions of known concentration prepared from primary standard or stock standard materials. Calibration standards are used to calibrate the instrument response with respect to analyte concentration. Standards are analyzed in accordance with the requirements stated in the particular method being used.

14.3.5 Initial (or Independent) Calibration Verification Standard (ICV)

The ICV standard is prepared from materials obtained from a source independent of that used for preparing the calibration standards ("second-source"). The ICV is analyzed after calibration but prior to sample analysis in order to verify the validity and accuracy of the standards used in calibration. Once it is determined that there is no defect or error in the calibration standard(s), the standards are considered valid and may be used for subsequent calibrations and quantitative determinations (as expiration dates and methods allow). ICVs are also analyzed in accordance with method-specific requirements.

14.3.6 Continuing Calibration Verification Standard

Continuing calibration verification (CCV) standards are midrange standards that are analyzed in order to verify that the calibration of the analytical system is still acceptable. The frequency of CCV analysis is either once every ten samples, or as indicated in the method.

14.3.7 Internal Standards

Internal standards are known amounts of specific compounds that are added to each sample prior to instrument analysis. Internal standards are generally used for GC/MS and ICP/MS procedures to correct sample results that have been affected by changes in instrument conditions or changes caused by matrix effects. The requirements for evaluation of internal standards are specified in each method and SOP.

14.3.8 Surrogates

Surrogates are organic compounds which are similar in chemical composition and analytical behavior to the analytes of interest, but which are not normally found in environmental samples. Depending on the analytical method, one or more of these compounds is added to method blanks, calibration and check standards, and samples (including duplicates, matrix spike samples, duplicate matrix spike samples and laboratory control samples) prior to extraction and analysis in order to monitor the method performance on each sample. The percent recovery is calculated for each surrogate, and the recovery is a measurement of the overall method performance.

$$\text{Recovery (\%)} = (M/T) \times 100$$

Where: M = The measured concentration of analyte,
T = The known concentration of analyte added.

14.3.9 Laboratory Control Samples (a.k.a Laboratory Fortified Blank – LFB)

The laboratory control sample (LCS) is an aliquot of analyte-free water or analyte-free solid (or anhydrous sodium sulfate or equivalent) to which known amounts of the method analyte(s) is (are) added. A reference material of known matrix type, containing certified amounts of target analytes, may also be used as an LCS. An LCS is prepared and analyzed at a minimum frequency of one LCS per 20 samples, with every analytical batch or as stated in the method, whichever is more frequent. The LCS sample is prepared and analyzed in exactly the same manner as the field samples.

The percent recovery of the target analytes in the LCS is compared to established control limits and assists in determining whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements at the required reporting limit. Comparison of batch-to-batch LCS analyses enables the laboratory to evaluate batch-to-batch precision and accuracy.

$$\text{Recovery (\%)} = (M/T) \times 100$$

Where: M = The measured analyte concentration,
T = The known analyte concentration added.

14.3.10 Laboratory Fortified Blank – MRL Level

A laboratory blank fortified at the MRL used to verify that the method reporting limit can be achieved. This LFB is carried through the entire extraction and analytical procedure. A MRL LFB is required with every batch of drinking water samples.

14.3.11 Matrix Spikes (MS)

Matrix spiked samples are aliquots of samples to which a known amount of the target analyte (or analytes) is (are) added. The samples are then prepared and analyzed in the same analytical batch, and in exactly the same manner as are routine samples. For the appropriate methods, matrix spiked samples are prepared and analyzed and at a minimum frequency of one spiked sample (and one duplicate spiked sample, if appropriate) per twenty samples. The spike recovery measures the effects of interferences caused by the sample matrix and reflects the accuracy of the method for the particular matrix in question. Spike recoveries are calculated as follows:

$$\text{Recovery (\%)} = (S - A)/T \times 100$$

Where: S = The measured analyte concentration in the spiked sample,
A = The measured analyte concentration in the parent sample,
T = The known analyte concentration added to the spiked sample.

14.3.12 Laboratory Duplicates and Duplicate Matrix Spikes

Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. Depending on the method of analysis, either a duplicate analysis (and/or a matrix spiked sample) or a matrix spiked sample and duplicate matrix spiked sample

(MS/DMS) are analyzed. The relative percent difference between duplicate analyses or between an MS and DMS is a measure of the precision for a given method and analytical batch. The relative percent difference (RPD) for these analyses is calculated as follows:

Relative Percent Difference (RPD) = (S1 - S2) x 100 ÷ S_{ave}

Where:

S1 and S2 = The analyte concentrations in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike, and,

S_{ave} = The average of analyte concentrations in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike.

Depending on the method of analysis, either duplicates (and/or matrix spikes) or MS/DMS analyses are performed at a minimum frequency of one set per 20 samples. If an insufficient quantity of sample is available to perform a laboratory duplicate or duplicate matrix spikes, duplicate LCSs will be prepared and analyzed.

14.3.13 Interference Check Samples (ICS)

An ICS is a solution containing both interfering and analyte elements of known concentration that can be analyzed to verify background and interelement correction factors in metals analyses. The ICS is prepared to contain known concentrations (method or program specific) of elements that will provide an adequate test of the correction factors. The ICS is analyzed at the beginning and end of an analytical run or at a method-specified frequency. Results must meet method criteria and any project-specific criteria.

14.3.14 Post Digestion Spikes

Post digestion spikes are samples prepared for metals analyses that have an analyte spike added to determine if matrix effects may be a factor in the results. The spike addition should produce a method-specified minimum concentration above the method reporting limit. A post digestion spike is analyzed with each batch of samples and recovery criteria are specified for each method.

14.3.15 Control Charting

The generation of control charts is routinely performed at ALS. Surrogate, Matrix Spike and LCS recoveries are all monitored and charted. In addition, the laboratory also monitors the Relative Percent Difference (RPD) measurement of precision. Control charts are available to each individual laboratory unit to monitor the data generated in its facility using control charts that have been programmed to identify various trends in the analytical results. If trends in the data are perceived, various means of corrective action may then be employed in order to prevent future problems with the analytical system(s). Finally, data quality reports using control charts are generated for specific clients and projects pursuant to contract requirements. The control charting procedure is described in SOP CE-QA009, *Control Limits*.

14.3.16 Glassware Washing

Glassware washing and maintenance play a crucial role in the daily operation of a laboratory. The glassware used at ALS - Kelso undergoes a rigorous

cleansing procedure prior to every usage. A number of SOPs have been generated that outline the various procedures used at ALS; each is specific to the end-use of the equipment as well as to the overall analytical requirements of the project. In addition, other equipment that may be routinely used at the laboratory is also cleaned following instructions in the appropriate SOP.

14.3.17 Uncertainty

Measurement uncertainty is associated with most of the results obtained in laboratory testing. It may be meaningful to estimate the extent of the uncertainty associated with each result generated by the laboratory. It is also useful to recognize that this measurement uncertainty is likely to be much less than that associated with sample collection activities. The uncertainty associated with the analytical measurement processes can be estimated from quality control data. When requested, the laboratory provides uncertainty information as described in the SOP CE-QA010, *Estimate of Uncertainty of Analytical Measurements*. The estimation of uncertainty relates only to measurements conducted in the laboratory.

14.4 When data quality objectives or quality control measures are not met, due to the sample matrix or anomalies, incompatibility of the methodology and sample type, statistical outliers, random error, or other factors, it may be necessary to apply data qualifiers to reported data. A list of standard data qualifiers is given in Appendix H.

15) Control of Non-Conforming Environmental Testing Work

The laboratory takes all appropriate steps necessary to ensure all sample results are reported with acceptable quality control results. When sample results do not conform to established quality control procedures, responsible management will evaluate the significance of the nonconforming work and take corrective action to address the nonconformance.

Nonconforming events such as errors, deficiencies, deviations from SOP, proficiency (PT) failure or results that fall outside of established QC limits are documented using the NCAR database. The procedure and responsibilities for addressing nonconforming work is defined in SOP CE-QA008, *Nonconformance and Corrective Action*. Nonconformances are reported to the client using various means (voice, email, narrative, etc.). When a nonconformance occurs that casts doubt on the validity of the test results or additional client instructions are needed, the Project Manager notifies the client the same business day that the nonconformance is confirmed and reported. The QAM reviews each problem, ensuring that appropriate corrective action has been taken by the appropriate personnel. The QAM periodically reviews all NCARs looking for chronic, systematic problems that need more in-depth investigation and alternative corrective action consideration. In addition, the appropriate Project Manager is promptly notified of any problems in order to inform the client and proceed with any action the client may want to initiate.

Results from non-conforming environmental testing work generally require the need for qualified data on analytical reports. A list of standard data qualifiers is given in Appendix H. Additionally, the report narrative will provide an explanation of the nonconformance and potential impact on results.

16) Corrective Action, Preventive Action, and Improvement

If a quality control measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). Failure to meet established analytical controls, such as the quality control objectives, prompts corrective action. Corrective action may take several forms and may involve a review of the calculations, a check of the instrument maintenance and

operation, a review of analytical technique and methodology, and reanalysis of quality control and field samples. If a potential problem develops that cannot be solved directly by the responsible analyst, the supervisor, team leader, the department manager, and/or the QAM may examine and pursue alternative solutions. In addition, the appropriate Project Manager is notified in order to ascertain if the client needs to be notified.

Part of the corrective action process involves determining the root cause. Identifying the root cause of a nonconformance can be difficult, but important for implementing effective corrective action. Root cause principles are used to determine assignable causes, which leads to corrective action taken to prevent recurrence. Various preventive action processes are used for eliminating a potential problem or averting a problem before it occurs. This is explained in CE-QA008, *Nonconformance and Corrective Action*.

Preventive action is focused on using existing information or experiences to anticipate potential problems and eliminating the likely causes of them. Preventive action is a pro-active process and tied to results from corrective action as well as opportunities for improvement. ALS – Kelso used preventive action processes to avoid errors and implement improvements. The SOP CE-GEN004, *Preventive Action*, describes procedures used. Examples of preventive action are given in the SOP. The laboratory also uses ideas from staff, client feedback, and other input mechanisms to identify potential improvements. The monthly lab-wide meeting regularly includes reports on improvements made or underway.

16.1 Preventive maintenance

Preventive maintenance is a crucial element of the QA program. Equipment and instruments at ALS - Kelso are regularly maintained by qualified laboratory staff or under commercial service contracts. All instruments are operated and maintained according to the instrument operating manuals. All routine and special maintenance activities pertaining to the instruments are recorded in instrument maintenance logbooks. The maintenance logbooks used at ALS Environmental, Kelso contain extensive information about the instruments used at the laboratory, including:

- The equipment's serial number;
- Date the equipment was received;
- Date the equipment was placed into service;
- Condition of equipment when received (new, used, reconditioned, etc.); and
- Prior history of damage, malfunction, modification or repair (if known).

Preventive maintenance procedures, frequencies, etc. are available for each instrument used at ALS. They may be found in the various SOPs for routine methods performed on an instrument and may also be found in the operating or maintenance manuals provided with the equipment at the time of purchase.

Responsibility for ensuring that routine maintenance is performed lies with the section supervisor. In the case of non-routine repair of capital equipment, the section supervisor is responsible for providing the repair, either by performing the repair themselves with manufacturer guidance or by acquiring on-site manufacturer repair. Each laboratory section maintains a critical parts inventory. This inventory or "parts list" also includes the items needed to perform any other routine maintenance and certain in-house non-routine repairs such as gas chromatography/mass spectrometry jet separators and electron multipliers and ICP/MS nebulizer. When performing maintenance on an instrument (whether preventive or corrective), additional information about the problem, attempted repairs, etc. is also recorded in the notebook. Typical logbook entries include the following information:

- Details and symptoms of the problem;

- Repairs and/or maintenance performed;
- Description and/or part number of replaced parts;
- Source(s) of the replaced parts;
- Analyst's signature and date; and
- Demonstration of return to analytical control.

See the Appendix E for a list of equipment and whether primarily maintained by laboratory of service providers.

17) Control of Records

ALS - Kelso maintains a records system which ensures that all laboratory records of analysis data retained and available. Analysis data is retained for 5 years from the report date unless contractual terms or regulations specify a longer retention time. The archiving system is described in the SOP for *Data Archiving* (ADM-ARCH).

17.1 Documentation and Archiving of Sample Analysis Data

The archiving system includes the following items for each set of analyses performed:

- Benchsheets describing sample preparation (if appropriate) and analysis;
- Instrument parameters (or reference to the data acquisition method);
- Sample analysis sequence;
- Instrument printouts, including chromatograms and peak integration reports for all samples, standards, blanks, spikes and reruns;
- Logbook ID number for the appropriate standards;
- Copies of report sheets submitted to the work request file; and
- Copies of Nonconformity and Corrective Action Reports, if necessary.

Individual sets of analyses are identified by analysis date and service request number. Since many analyses are performed with computer-based data systems, the final sample concentrations can be automatically calculated. If additional calculations are needed, they are written on the integration report or securely stapled to the chromatogram, if done on a separate sheet.

For organics analysis, data applicable to all analyses within the batch, such as GCMS tunes, CCVs, batch QC, and analysis sequences; are kept using a separate documentation system. This system is used to archive data on a batch-specific basis and is segregated according to the date of analysis. This system also includes results for the most recent calibration curves, as well as method validation results.

18) Audits

Quality audits are an essential part of the Quality Assurance program. There are two types of audits used at the facility: System Audits are conducted to qualitatively evaluate the operational details of the QA program, while Performance Audits are conducted by analyzing proficiency testing samples in order to quantitatively evaluate the outputs of the various measurement systems.

18.1 System Audits

The system audit examines the presence and appropriateness of laboratory systems. External system audits of ALS/Kelso are conducted regularly by various regulatory

agencies and clients. Appendix J lists the certification and accreditation programs in which ALS/Kelso participates. Programs and certifications are added as required.

Internal system audits of ALS/Kelso are conducted regularly under the direction of the Quality Assurance Manager. The internal audit procedures are described in SOP CE-QA001, *Internal Audits*. The internal audits are performed as follows:

- System audit – this is an annual audit of the implementation of the quality system in the laboratory.
- Process audit – this is an audit of all operational areas in the laboratory to evaluate compliance with operational and technical procedures. Focus is on sample handling, preparation and analysis and technically sound practices. Three primary concepts are 1) is the procedure in use the same as that described in the SOP, 2) the use of sound analytical techniques and practices, and 3) sample handling/preparation. Topics as calibration, sample/analytical batching, standards traceability, QC criteria, instrument operation and maintenance, data interpretation, and reporting results are included. Hardcopy data and/or report audits may be included.

  Process audits may be one larger audit event or a series of audits such that all areas of the laboratory are audited over a one year period. Audits conducted over the four calendar quarters will follow the schedules listed in an audit plan.
- Electronic data audits focus on organic chromatographic data and include an examination of audit trails, peak integrations, calibration practices, GCMS tuning data, use of appropriate files, and other components of the analysis. Each applicable instrument is periodically audited using audit software and randomly selected data files.

All audit findings and corrective actions are documented. The results of each audit are reported to the Laboratory Director and Department Managers for review. Any deficiencies identified are summarized in the audit report. Managers must respond with corrective actions correcting the deficiency within a defined timeframe. Should problems impacting data quality be found during an internal audit, any client whose data is adversely impacted will be given written notification within the corrective action period (if not already provided).

Additional internal audits or data evaluations may be performed as needed to address any potential data integrity issues that may arise.

18.2 Performance Audits

ALS - Kelso participates in the analysis of interlaboratory proficiency testing (PT) samples. Participation in PT studies is performed on a regular basis and is designed to evaluate all analytical areas of the laboratory. General procedures for these analyses are described in SOP CE-QA006, *Proficiency Sample Testing Analysis*. ALS - Kelso routinely participates in the following studies:

- Water Pollution (WP) and additional water parameters, 2 per year.
- Water Supply (WS) PT studies, 2 per year.
- Hazardous Waste/Soil/UST PT studies, 2 per year.
- Microbiology (WS and WP) PT studies, 2 per year.
- State-specific Underground Storage Tank PT studies, 1 per year, or as specified for accreditation.
- Other studies as required for certifications, accreditations, or validations.

PT samples are processed by entering them into the LIMS system as samples and are processed the same as field samples (following the PT provider instructions). The laboratory sections handle samples the same as field samples, performing the analyses following method requirements and performing data review. The laboratory sections submit results to the QA Manager for subsequent reporting to the appropriate agencies or study provider. Results of the performance evaluation samples and audits are received by the QAM and distributed to Laboratory Director and department managers for review. For any results outside acceptance criteria, the analysis data is reviewed to identify a root cause for the deficiency, and corrective action is taken and documented through nonconformance (NCAR) procedures.

19) Management Review

An annual Review of the laboratory's quality system and testing activities is conducted by the laboratory's management team to ensure the continuing suitability and effectiveness of the quality system and testing activities and to introduce any necessary changes or improvements. The review ensures that the quality system of the laboratory continues to conform to the requirements of the ISO 17025:2005 and various accrediting authorities, including NELAP/TNI.

General procedures for the Review are described in SOP CE-QA005, *Laboratory Management Review*. When conducting the review a standard list of items and categories is evaluated. The quality policies and their relation to testing activities are reviewed and any changes that are necessary are identified. The review also notes significant changes that have taken place or need to take place in the quality system; and the organization, facilities, equipment, procedures, and activities of the laboratory.

The Review is documented by the laboratory QA Manager. Action items, including preventive actions and improvements, should be identified. Results should feed into the laboratory's planning process planning.

20) Personnel

20.1 Personnel Training

Job descriptions, including technical position descriptions, are used for all employees, regardless of position or level of seniority. These documents are maintained by the Human Resources personnel and are available for review. In order to assess the technical capabilities and qualifications of a potential employee, all candidates for employment are evaluated, in part, against the appropriate technical description.

Training begins the first day of employment at ALS - Kelso when the company policies are presented and discussed. Safety and Quality System requirements are integral parts of initial and ongoing training processes at the laboratory. Safety training begins with the reading of the ALS Environmental Health and Safety Manual. Employees are also required to attend periodic safety meetings where additional safety training may be performed by the Environmental, Health and Safety Officer.

Quality Systems training begins with QA orientation for new employees which includes and reading the Quality Assurance Manual and ethics/data integrity introductory training. Additional training on laboratory quality systems as they relate to job functions is incorporated into training plans. Employees are responsible for complying with the requirements of the QA Manual and QA/QC requirements associated with their function(s).

ALS - Kelso also encourages its personnel to continue to learn and develop new skills that will enhance their performance and value to the company. Ongoing training occurs for all employees through a variety of mechanisms. The corporate, company-

wide training and development program, external and internal technical seminars and training courses, and laboratory-specific training exercises are all used to provide employees with professional growth opportunities.

All technical training is documented and records are maintained in the QA department. Training requirements and its documentation are described in SOP ADM-TRAIN, *ALS-Kelso Training Procedure*. A training plan is developed whenever an employee starts a new procedure to new position. The training plan includes a description of the step-by-step process for training an employee and for initial demonstration of capability. Where the analyst performs the entire procedure, a generic training plan may be used.

20.2 Initial Demonstration of Capability (IDOC)

Training in analytical procedures typically begins with the reading of the SOP for the method. Hands-on training begins with the observation of an experienced analyst performing the method, followed by the trainee performing the method under close supervision, and culminating with independent performance of the method on quality control samples. Successful completion of the applicable Demonstration of Capability analysis qualifies the analyst to perform the method independently. Demonstration of Capability is performed by one of the following:

- Successful completion of an Initial Precision and Recovery (IPR) study (required where mandated by the method).
- Analysis of 4 consecutive Laboratory Control Samples, with acceptable accuracy and precision.
- Where spiking is not possible but QC standards are used ("non-spiked" LCS), analysis of 4 consecutive LCS analyses with acceptable accuracy and precision.
- Where one of the three above is not possible, special requirements are as follows:
    - Total Settleable Solids: Successful single-blind PT sample analysis and duplicate results with RPD<10%.
    - Color: Four consecutive prepared LCSs with acceptable accuracy and precision of <10% RSD.
    - Physical Tests (Grain size, Corrosivity to Steel, etc.): Supervisor acknowledgement of training and approval.

A flowchart identifying the Demonstration of Proficiency requirements is given in Figure 20-1. The flowchart identifies allowed approaches to assessing Demonstration of Capability when a 4-replicate study is not mandated by the method, when spiking is not an option, or when QC samples are not readily available.

20.3 Continuing Demonstration of Proficiency

A periodic demonstration of proficiency is required to maintain continuing qualification. Continuing Demonstration of Proficiency is required each year, and may be performed one of the following ways:

- Successful performance on external (independent) single-blind sample analyses using the test method, or a similar test method using the same technology. I.e. PT sample or QC sample blind to the analyst.
- Performing Initial Demonstration of Capability as described above, with acceptable levels of precision and accuracy.

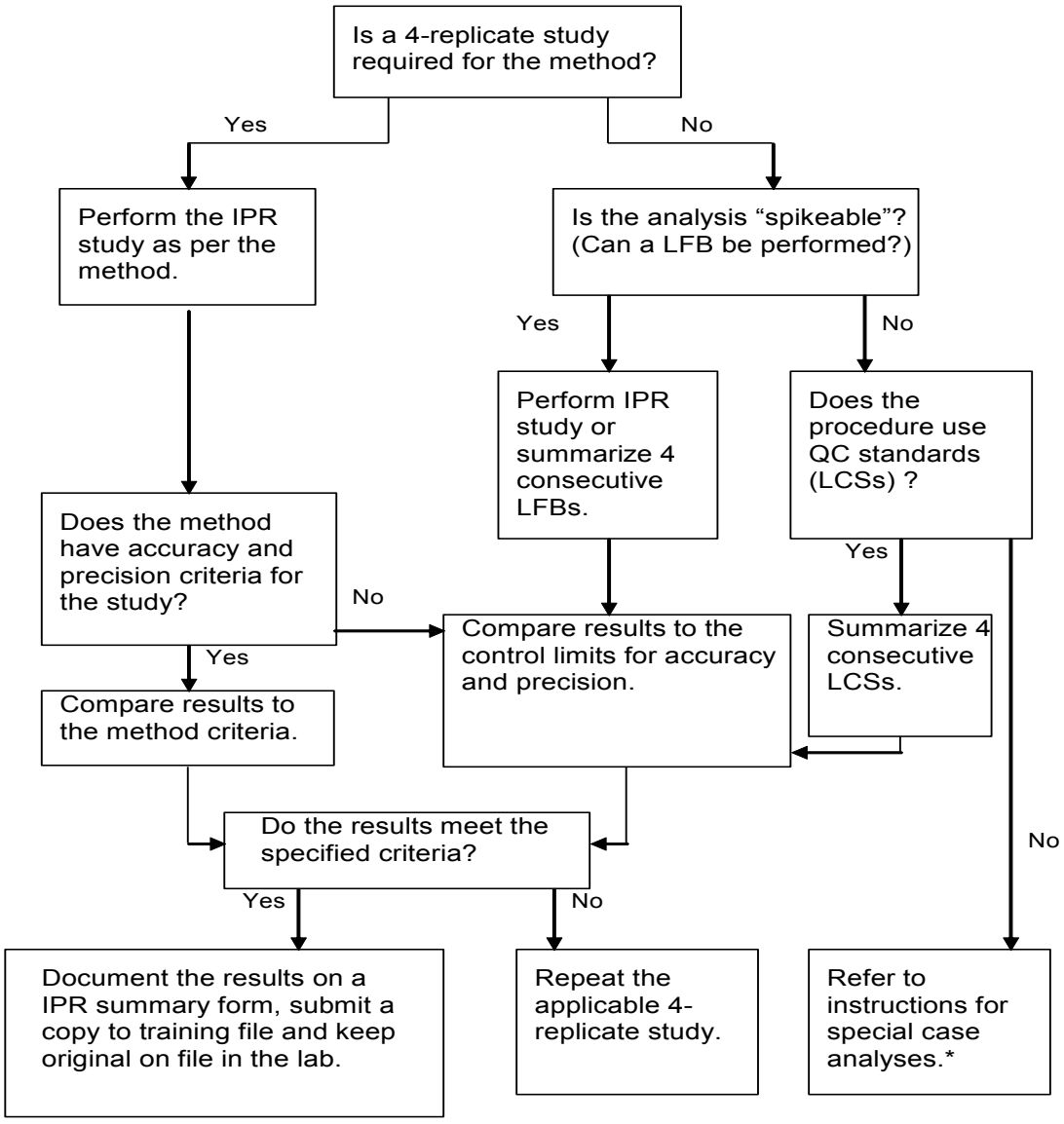
- Analysis of at least 4 consecutive LCSs with acceptable levels of accuracy and precision from in-control analytical batches.
- If the above cannot be performed, analysis of authentic samples with results statistically indistinguishable from those obtained by another trained analyst.
- For methods for which PT samples are not available and a spiked analysis (LFB, MDL, etc.) is not possible, analysis of field samples that have been analyzed by another analyst with statistically indistinguishable results.

20.4 Documentation of Training

Records are maintained to indicate the employee has the necessary training, education, and experience to perform their functions. Information of previously acquired skills and abilities for a new employee is maintained in Human Resources personnel files and internal resumes. The QA department maintains a record of the various technical skills and training acquired while employed by ALS. Information includes the employee's name, a description of the skill including the appropriate method and SOP reference, the mechanism used to document proficiency, and the date the training was completed. General procedures for documenting technical training are described in SOP ADM-TRAIN, *ALS-Kelso Training Procedure*.

Figure 20-1

Demonstration of Proficiency Flowchart



21) Reporting of Results

ALS - Kelso reports the analytical data produced in its laboratories to the client via the Analytical Report. This report includes a transmittal letter, a case narrative, client project information, sample receipt and chain of custody information, specific test results, quality control data (as requested), and any other project-specific support documentation. The following procedures describe the procedures used for data reduction, validation and reporting.

21.1 Data Reduction and Review

Results are generated by the analyst who performs the analysis and works up the raw data. All data is initially reviewed and processed by analysts using appropriate methods (e.g., chromatographic software, instrument printouts, hand calculation, etc.). Equations used for calculation of results are found in the applicable analytical SOPs. Policies and procedures for manual editing of data are established. The analyst making the change must initial and date the edited data entry, without obliteration of the original entry. The policies and procedures are described in the SOP CE-QA007, *Making Entries onto Analytical Records*.

The resulting data set is either manually entered (e.g., titrimetric or microbiological data) into an electronic report form or is electronically transferred into the report. Once the complete data set has been transferred into the proper electronic report form(s), it is then printed. The resulting hardcopy version of the electronic report is then reviewed by the analyst for accuracy. Once the primary analyst has checked the data for accuracy and acceptability, the data and report hardcopy is forwarded to the supervisor or second qualified analyst who reviews the data. Where calculations are not performed using a validated software system, the reviewer rechecks a minimum of 10% of the calculations. Analysts performing routine testing are responsible for generating a data quality narrative or data review document with every analytical batch processed. This report also allows the analyst to provide appropriate notes and/or a narrative if problems were encountered with the analyses. A Nonconformance and Corrective Action Report (NCAR) may also be attached to the data prior to review. Supervisors or qualified analysts review all of the completed analytical batches to ensure that all QC criteria have been examined and any deficiencies noted and addressed. Data review procedures are described in the SOP for *Laboratory Data Review Process* (ADM-DREV).

Policies and procedures for electronic manual integration of chromatographic data are established. The analyst performing the integration must document the integration change by printing both the “before” and “after” integrations and including them in the raw data records. The policies and procedures are described in SOP CE-QA002, *Manual Integration Policy* and SOP ADM-MI, *Manual Integration of Chromatographic Peaks*.

21.1.1 Validation of Results

The validity of the data generated is assessed through the evaluation of the sample results, calibrations, and QC samples (method blanks, laboratory control samples, sample duplicates, matrix spikes, trip blanks, etc.). A brief description of the evaluation of these analyses is described below, with details listed in applicable SOPs. The criteria for evaluation of QC samples are listed within each method-specific SOP. Other data evaluation measures may include (as necessary) a check of the accuracy check of the QC standards and a check of the system sensitivity. Data transcriptions and calculations are also reviewed.

Note: Within the scope of this document, all possible data assessment requirements for various project protocols cannot be included in the listing below. This listing gives a general description of data evaluation practices used in the laboratory in compliance with NELAP Quality Systems requirements. Additional requirements exist for certain programs, such as projects under the DoD QSM protocols, and project-specific QAPPs.

- Initial Calibration – Following the analysis of calibration standards according to the applicable SOP the data is fit to an applicable and allowed calibration model (correlation coefficient, linear, average response factor, quadratic, etc.) and the resulting calibration is compared to specified criteria. If the calibration meets criteria analysis may continue. If the calibration fails, any problems are isolated and corrected and the calibration standards reanalyzed. Following calibration and analysis of the independent calibration verification standard(s) the percent difference for the ICV is calculated. If the percent difference is within the specified limits the calibration is complete. If not, the problem associated with the calibration and/or ICV are isolated and corrected and verification and/or calibration is repeated.
- Continuing Calibration Verification (CCV) – Following the analysis of the CCV standard the percent difference is calculated and compared to specified criteria. If the CCV meets the criteria analysis may continue. If the CCV fails, routine corrective action is performed and documented and a 2nd CCV is analyzed. If this CCV meets criteria, analysis may continue, including any reanalysis of samples that were associated with a failing CCV. If the routine corrective action failed to produce an immediate CCV within criteria, then either acceptable performance is demonstrated (after additional corrective action) with two consecutive calibration verifications or a new initial calibration is performed.
- Method Blank – Results for the method blank are calculated as performed for samples. If results are less than the MRL (<½ MRL for DoD projects), the blank may be reported. If not, associated sample results are evaluated to determine the impact of the blank result. If possible, the source of the contamination is determined. If the contamination has affected sample results the blank and samples are reanalyzed. If positive blank results are reported, the blank (and sample) results are flagged with an appropriate flag, qualifier, or footnote.
- Sample Results (Inorganic) – Following sample analysis and calculations (including any dilutions made due to the sample matrix) the result is verified to fall within the calibration range. If not, the sample is diluted and analyzed to bring the result into calibration range. When sample and sample duplicates are analyzed for precision, the calculated RPD is compared to the specified limits. The sample and duplicate are reanalyzed if the criteria are exceeded. The samples may require re-preparation and reanalysis. For metals, additional measures as described in the applicable SOP may be taken to further evaluate results (dilution tests and/or post-digestion spikes). Results are reported when within the calibration range, or as estimates when outside the calibration range. When dilutions are performed the MRL is elevated accordingly and qualified. Efforts are made to meet the project MRL's including alternative analysis.

- Sample Results (Organic) – For GC/MS analyses, it is verified that the analysis was within the prescribed tune window. If not, the sample is reanalyzed. Following sample analysis and calculations (including any dilutions made due to the sample matrix) peak integrations, retention times, and spectra are evaluated to confirm qualitative identification. Internal standard responses and surrogate recoveries are evaluated against specified criteria. If internal standard response does not meet criteria, the sample is diluted and reanalyzed. Results outside of the calibration range are diluted to within the calibration range. For GC and HPLC tests, results from confirmation analysis are evaluated to confirm positive results and to determine the reported value. The procedure to determine which result to report is described in the SOP for Confirmation Procedure for GC and HPLC Analysis (SOC-CONF). If obvious matrix interferences are present, additional cleanup of the sample using appropriate procedures may be necessary and the sample is reanalyzed. When dilutions are performed the MRL is elevated accordingly and qualified. Efforts are made to meet the project MRL's including additional cleanup.
- Surrogate Results (Organic) – The percent recovery of each surrogate is compared to specified control limits. If recoveries are acceptable, the results are reported. If recoveries do not fall within control limits, the sample matrix is evaluated. When matrix interferences are present or documented, the results are reported with a qualifier that matrix interferences are present. If no matrix interferences are present and there is no cause for the outlier, the sample is reprepared and reanalyzed. However, if the recovery is above the upper control limit with non-detected target analytes, the sample may be reported. All surrogate recovery outliers are appropriately qualified on the report.
- Duplicate Sample and/or Duplicate Matrix Spike Results – The RPD is calculated and compared to the specified control limits. If the RPD is within the control limits the result is reported. If not, an evaluation of the sample is made to verify that a homogenous sample was used. Despite the use of homogenizing procedures prior to sample preparation or analysis, the sample may not be homogenous or duplicate sample containers may not have been sample consistently. If non-homogenous, the result is reported with a qualifier about the homogeneity of the sample. Also, the results are compared to the MRL. If the results are less than five times the MRL, the results are reported with a qualifier that the high RPD is due to the results being near the MRL. If the sample is homogenous and results above five times the MRL, the samples and duplicates are reanalyzed. If re-analysis also produces out-of-control results, the results are reported with an appropriate qualifier.
- Laboratory Control Sample Results – The LCS percent recovery is calculated and compared to specified control limits. If the recovery is within control limits, the analysis is in control and results may be reported. If not, this indicates that the analysis is not in control. Samples associated with the 'out of control' LCS, shall be considered suspect and the samples re-extracted or re-analyzed or the data reported with the appropriate qualifiers. For analysis where a large number of analytes are in the LCS, it becomes more likely that some analytes (marginal exceedences) will be outside the control limits. The

procedure described in the 2003 NELAC standards, Appendix D.1.1.2.1 are used to determine if the LCS is effective in validating the analytical system and the associated samples.

- Matrix Spike Results – The MS percent recovery is calculated and compared to specified control limits. If the recovery is within control limits the results are reported. If not, and the LCS is within control limits, this indicates that the matrix potentially biases analyte recovery. It is verified that the spike level is at least five times the background level. If not, the results are reported with a qualifier that the background level is too high for accurate recovery determination. If matrix interferences are present or results indicate a potential problem with sample preparation, steps may be taken to improve results; such as performing any additional cleanups, dilution and reanalysis, or re-preparation and reanalysis. Results that do not meet acceptance limits are reported with an appropriate qualifier.

21.1.2 Qualitative Data Evaluation

All sample results and QC results are reviewed to ensure correct identification of target analytes, when not inherent to the test method. Details particular to each analysis are given in the analytical SOP.

Identification criteria for GC, LC or GC/MS methods are summarized below:

- GC and LC Methods
  - The analyte must fall within the retention time window specified in the applicable SOP. The retention time window is established prior to analysis and documented.
  - For analyses all positive results are confirmed by a second column, a second detector, a second wavelength (HPLC/UV), or by GC/MS analysis. Details for confirmation analysis are described in the SOP SOC-CONF, *Confirmation Procedures for GC and HPLC Analyses*. Confirmation Data Confirmation data will be provided as specified in the method.
  - When sample results are confirmed by two dissimilar columns or detectors, the agreement between quantitative results must be evaluated. The relative percent difference between the two results is calculated and evaluated against SOP and/or method criteria.
- GC/MS and LC/MS Methods - Two criteria are used to verify identification:
  - Elution of the analyte is at the same relative retention time (as defined by the method) as demonstrated in the standard.
  - The mass spectrum of the analyte in the sample must, in the opinion of a qualified analyst or the department manager, correspond to the spectrum of the analyte in the standard or the current GC/MS reference library.
  - When Tentatively Identified Compounds are to be reported for GC/MS, the spectrum for non-target peaks is compared to the current GC/MS reference library.

21.2 Data Reporting

It is the responsibility of each laboratory unit to provide the Project Manager with a final report of the data for each analysis, accompanied by signature approval. When the entire data set has been found to be acceptable, a final copy of the report is generated and approved by the laboratory supervisor, departmental manager or designated laboratory staff. The entire data package for the analysis is then placed into the service request file, and an electronic copy of the final data package is forwarded to the appropriate personnel for archival. Footnotes and/or narrative notes must accompany any data package if problems were encountered that require further explanation to the client. Each data package is submitted to the appropriate Project Manager.

When all analyses and departmental reports are completed the Project Manager reviews the entire collection of analytical data for completeness and to ensure that any and all client-specified objectives were successfully achieved. A report narrative is written by the Project Manager to explain any unusual problems with a specific analysis or sample, etc. Prior to release of the report to the client, the Project Manager reviews and approves the entire report for completeness and to ensure that any and all client-specified objectives were successfully achieved. The original raw data, along with a copy of the final report, is scanned and archived by service request number.

To the extent possible, samples shall be reported only if all QC measures are acceptable. If a QC measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). The SOP for *Data Reporting and Report Generation* (ADM-RG) addresses the flagging and qualification of data. The ALS-defined data qualifiers, state-specific data qualifiers, or project-defined data qualifiers are used depending on project requirements. A case narrative may be written by the Project Manager to explain problems with a specific analysis or sample, etc.

When requested by the client or relevant to the validity of reported results, the estimation of measurement uncertainty will be provided to a client or regulatory agency. How the uncertainty will be reported may be dictated by the client's reporting specifications. Procedures for determining and reporting uncertainty are given in SOP CE-QA010, *Estimation of Uncertainty of Analytical Measurements*.

For subcontracted analyses, the Project Manager verifies that the report received from the subcontractor is complete. This includes checking that the correct analyses were performed, the analyses were performed for each sample as requested, a report is provided for each analysis, and the report is signed. The Project Manager accepts the report if all verification items are complete. Acceptance is demonstrated by forwarding the report to the client.

21.3 Deliverables

In order to meet individual project needs, ALS - Kelso provides several levels of analytical reports. Standard specifications for each level of deliverable are described in Table 21-1. Variations may be provided based on client or project specifications. This includes (but is not limited to) deliverables for DoD QSM projects and state-specific drinking water formats.

When requested, ALS - Kelso provides Electronic Data Deliverables (EDDs) in the format specified by client need or project specification. ALS - Kelso is capable of generating EDDs with many different formats and specifications. The EDD is prepared by report production staff using the electronic version of the laboratory report to minimize transcription errors. User guides and EDD specification outlines are used in preparing the EDD. The EDD is reviewed and compared to the hard-copy report for accuracy.

Table 21-1
Descriptions of ALS Environmental - Kelso Standard Data Deliverables*
Tier I. Routine Analytical Report includes the following:
• Transmittal letter
• Chain of custody documents and sample/cooler receipt documentation
• Sample analytical results
• Method blank results
• Surrogate recovery results and acceptance criteria for applicable organic methods
• Dates of sample preparation and analysis for all tests
• Case narrative - optional
Tier II. In addition to the Tier I Deliverables, this Analytical Report includes the following:
• Laboratory Control Sample results with calculated recovery and associated acceptance criteria
• Matrix spike results with calculated recovery and associated acceptance criteria
• Duplicate or duplicate matrix spike result(s) (as appropriate to method), with calculated relative percent difference
• Case narrative - optional
Tier III. Data Validation Package. In addition to the Tier II Deliverables, this CAR includes the following:
• Case narrative - required
• Summary forms for all associated QC and Calibration parameters, with associated control criteria/acceptance limits
• Other summary forms specified in QAPPs or project/program protocols, or those related to specialized analyses such as HRGC/MS are included.
Tier IV. Full Data Validation Package.
• All raw data associated with the sample analysis, including but not limited to: • Preparation and analysis bench sheets and instrument printouts, • For organics analyses, all applicable chromatograms, spectral, confirmation, and manual integration raw data. For GC/MS this includes tuning results, mass spectra of all positive results, and the results and spectra of TIC compounds when requested.
• QC data
• Calibration data (initial, verification, continuing, etc.),
• Calibration blanks or instrument blanks (as appropriate to method).

* If a project QAPP or program reporting protocol applies the report will be presented as required for the project.

22) Summary of Changes and Document History

Revision Number	Effective Date	Document Editor	Description of Changes
24.1	9/1/2015	L. Wolf	Update QA Manager to Carl Degner, and related revision of key personnel and organization charts. Updated SOP list. Minor error corrections to existing content.

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

The analytical methods used at ALS Environmental, Kelso generally depend upon the end-use of the data. Since most of our work involves the analysis of environmental samples for regulatory purposes, specified federal and/or state testing methodologies are used and followed closely. Typical methods used at ALS Environmental, Kelso are taken from the following references:

- National Environmental Laboratory Accreditation Program (NELAP), 2003 Quality Standards.
- TNI Standard – Environmental Laboratory Sector, Volume 1, *Management and Technical Requirements for Laboratories Performing Environmental Analysis,* EL-V1-2009.
- Quality Standards. American National Standard *General requirements for the competence of testing and calibration laboratories,* ANSI/ISO/IEC 17025:2005(E)
- *DoD Quality Systems Manual for Environmental Laboratories,* Versions 4.2 and 5.0
- *Good Automated Laboratory Practices, Principles and Guidance to Regulations For Ensuring Data Integrity In Automated Laboratory Operations*, EPA 2185 (August 1995).
- *Manual for the Certification of Laboratories Analyzing Drinking Water*, 5th Edition, EPA 815-B-97-001 (January 2005).
- *Procedure Manual for the Environmental Laboratory Accreditation Program,* Washington Department of Ecology, 10-03-048, September 2010.
- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, Third Edition, (September 1986) and Updates I (July 1992), II (September 1994), IIA (August 1993), IIB (January 1995), III (December 1996), Final Update IV (February 2007), and updates posted online at http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm. See Chapters 1, 2, 3, and 4.
- *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, (Revised March 1983).
- *Methods for the Determination of Inorganic Substances in Environmental Samples*, EPA/600/R-93/100 (August 1993).
- *Methods for the Determination of Metals in Environmental Samples*, EPA/600/4-91/010 (June 1991) and Supplements.
- *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, EPA 600/4-82-057 (July 1982) and 40 CFR Part 136, Appendix A.
- *Methods for the Determination of Organic Compounds in Drinking Water*, EPA/600/4-88/039 (December 1988) and Supplements.

- Standard Methods for the Examination of Water and Wastewater, 20th Edition (1998) and SM On-Line. See Introduction in Part 1000.
- 40 CFR Part 136, Guidelines for Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and EPA Method Update Rule 2007 and 2012.
- 40 CFR Part 141, National Primary Drinking Water Regulations and EPA Method Update Rule 2007.
- Analytical Methods for Petroleum Hydrocarbons, ECY 97-602, Washington State Department of Ecology, June 1997.
- State-specific total petroleum hydrocarbon methods for the analysis of samples for gasoline, diesel, and other petroleum hydrocarbon products (Alaska, Arizona, California, Oregon, Washington, Wisconsin, etc.).
- Annual Book of ASTM Standards, Part 31, Water.
- U. S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA-540/R-94/012 (February 1993).
- U. S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA-540/R-94/013 (February 1994).
- Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, for USEPA and USACE (March 1986), with revisions through April 1997.
- WDOE 83-13, Chemical Testing Methods for Complying with the State of Washington Dangerous Waste Regulations (March 1982) and as Revised (July 1983 and April 1991).
- Identification and Listing of Hazardous Waste, California Code of Regulations, Title 22, Division 4.5, Chapter 11.
- Analytical Methods for the Determination of Pollutants in Pulp and Paper Industry Wastewater, EPA 821-R-93-017 (October 1993).
- Analytical Methods for the Determination of Pollutants in Pharmaceutical Manufacturing Industry Wastewaters, EPA 821-B-98-016 (July 1998).
- National Council of the Pulp and Paper Industry for Air and Stream Improvement (NCASI).

Internal program-level QA documents are listed in Appendix I.

APPENDIX A – Glossary

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

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

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

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

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

Analysis Date: The calendar date of analysis associated with the analytical result reported for an accreditation or experimental field of proficiency testing.

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

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

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation).

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.

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

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

Calibration Standard: A substance or reference material used for calibration.

Certified Reference Material (CRM): Reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability to a national metrology institute.

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

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: second column confirmation, alternate wavelength, derivatization, mass spectral interpretation, alternative detectors, or additional cleanup procedures.

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

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

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

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

Finding: An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement.

Holding Time: The specified maximum time that can elapse between two specified sampling and/or analytical activities.

Internal Standard: 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.

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 or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish evaluate accuracy and bias for associated sample analyses.

Legal Chain of Custody Protocols: Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain of Custody Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory.

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

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

Matrix: The substrate of a test sample.

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

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

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

Measurement System: A method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s).

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

National Institute of Standards and Technology (NIST): A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States National Metrology Institute (NMI).

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator.

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

Primary Accreditation Body (Primary AB): The TNI-NELAP accreditation body responsible for assessing a laboratory's total quality system, on-site assessment, and PT performance tracking for fields of accreditation.

Procedure: A specified way to carry out an activity or process. Procedures can be documented or not.

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

Proficiency Testing Provider (PTP): A person or organization accredited by the TNI-approved Proficiency Testing Provider Accreditor to operate a TNI-compliant PT program.

Proficiency Testing Sample (PT Sample): A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria.

Proficiency Testing Study (PT Study): A single complete sequence of circulation of proficiency testing samples to all participants in a proficiency test program.

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

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

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system.

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance (QA) and quality control (QC) activities.

Quality System Matrix: These matrix definitions be used for purposes of batch and quality control requirements:

Air and Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter, or other device.

Aqueous: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, ground water effluents, and TCLP or other extracts.

Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples are grouped according to type of tissue (i.e. marine vs. plant).

Chemical Waste: A product or by-product of an industrial process that results in a matrix not otherwise defined.

Drinking Water: Any aqueous sample that has been designated a potable or potential potable water source.

Non-Aqueous Liquid: Any organic liquid, product, or solvent not miscible in water and with <15% settleable solids.

Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt water source.

Solids: Includes soils, sediments, sludges and other matrices with >15% settleable solids.

Raw Data: The documentation generated during sampling and analysis that records the original work steps, observations, and measurements, whether performed by an analyst or instrument. This documentation includes, but is not limited to field notes, electronic data, analysis bench sheets, run/injection logs, printouts, chromatograms, instrument outputs, and handwritten records for calibration, sample preparation, and sample analysis for field samples and QC samples.

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

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

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

Secondary Accreditation Body (Primary AB): A TNI-NELAP accreditation body responsible that accredits the laboratory based on the Primary AB accreditation and procedures.

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

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

Standard Operating Procedure (SOP): A written document that details the process for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the procedures for performing certain routine or repetitive tasks.

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

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

Verification: Confirmation by examination and objective evidence that specified requirements have been met.

Acronyms

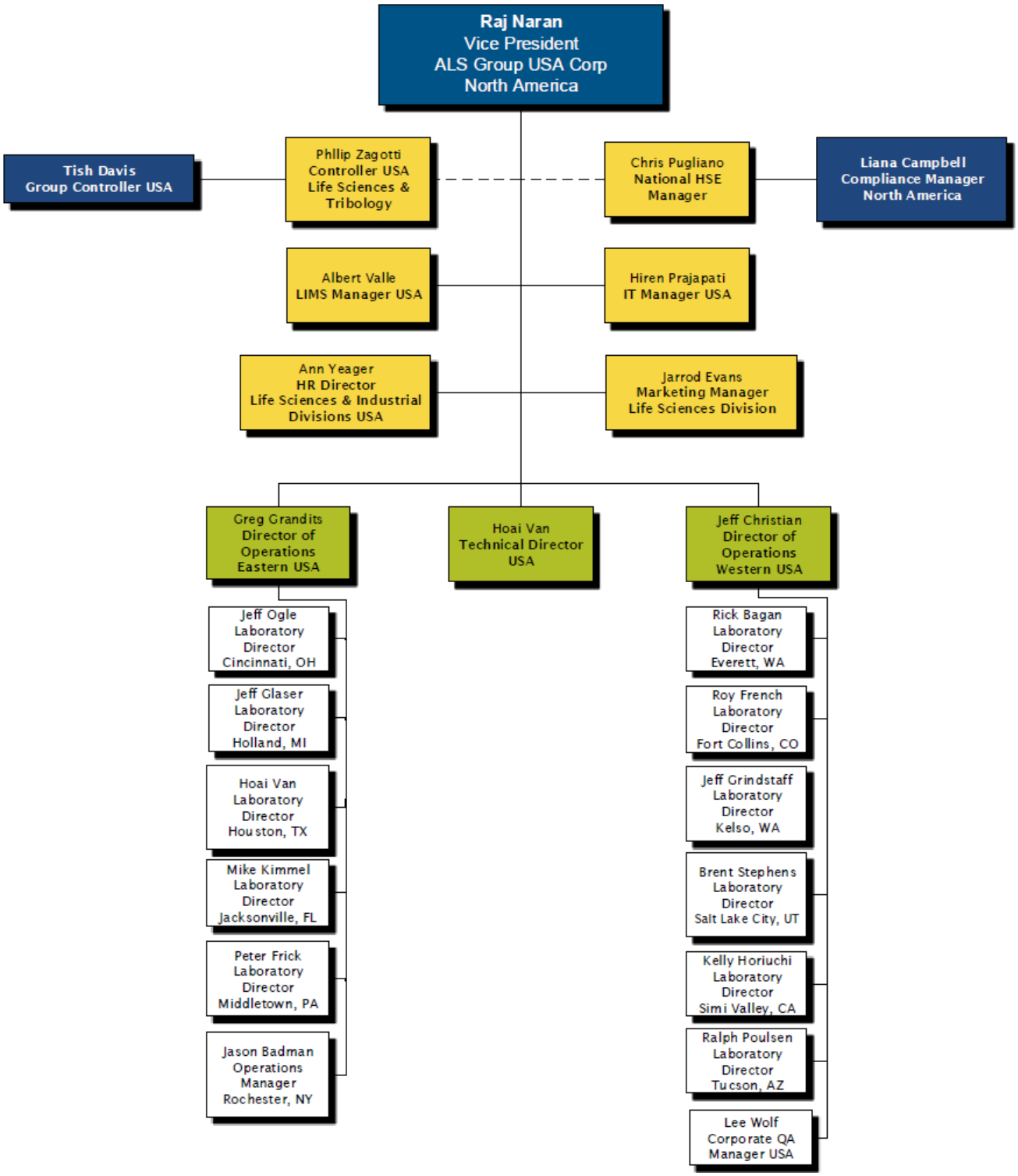
ASTM - American Society for Testing and Materials
A2LA - American Association for Laboratory Accreditation
CARB - California Air Resources Board
CAS - Number Chemical Abstract Service registry Number
CFC - Chlorofluorocarbon
CFU - Colony-Forming Unit
DEC - Department of Environmental Conservation
DEQ - Department of Environmental Quality
DHS - Department of Health Services
DOE - Department of Ecology
DOH - Department of Health
EPA - U. S. Environmental Protection Agency
ELAP - Environmental Laboratory Accreditation Program
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
LOD - Limit of Detection
LOQ - Limit of Quantitation
LUFT - Leaking Underground Fuel Tank
M - Modified
MCL - Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL - Method Detection Limit
MPN - Most Probable Number
MRL - Method Reporting Limit
NA - Not Applicable
NC - Not Calculated
NCASI - National Council of the Paper Industry for Air and Stream Improvement
ND Not Detected
NIOSH - National Institute for Occupational Safety and Health
PQL - Practical Quantitation Limit
RCRA - Resource Conservation and Recovery Act
SIM - Selected Ion Monitoring
TNI – The NELAC Institute
TPH - Total Petroleum Hydrocarbons

APPENDIX B – Organization Charts, Key Personnel, and Report Signatories

ALS Environmental

USA

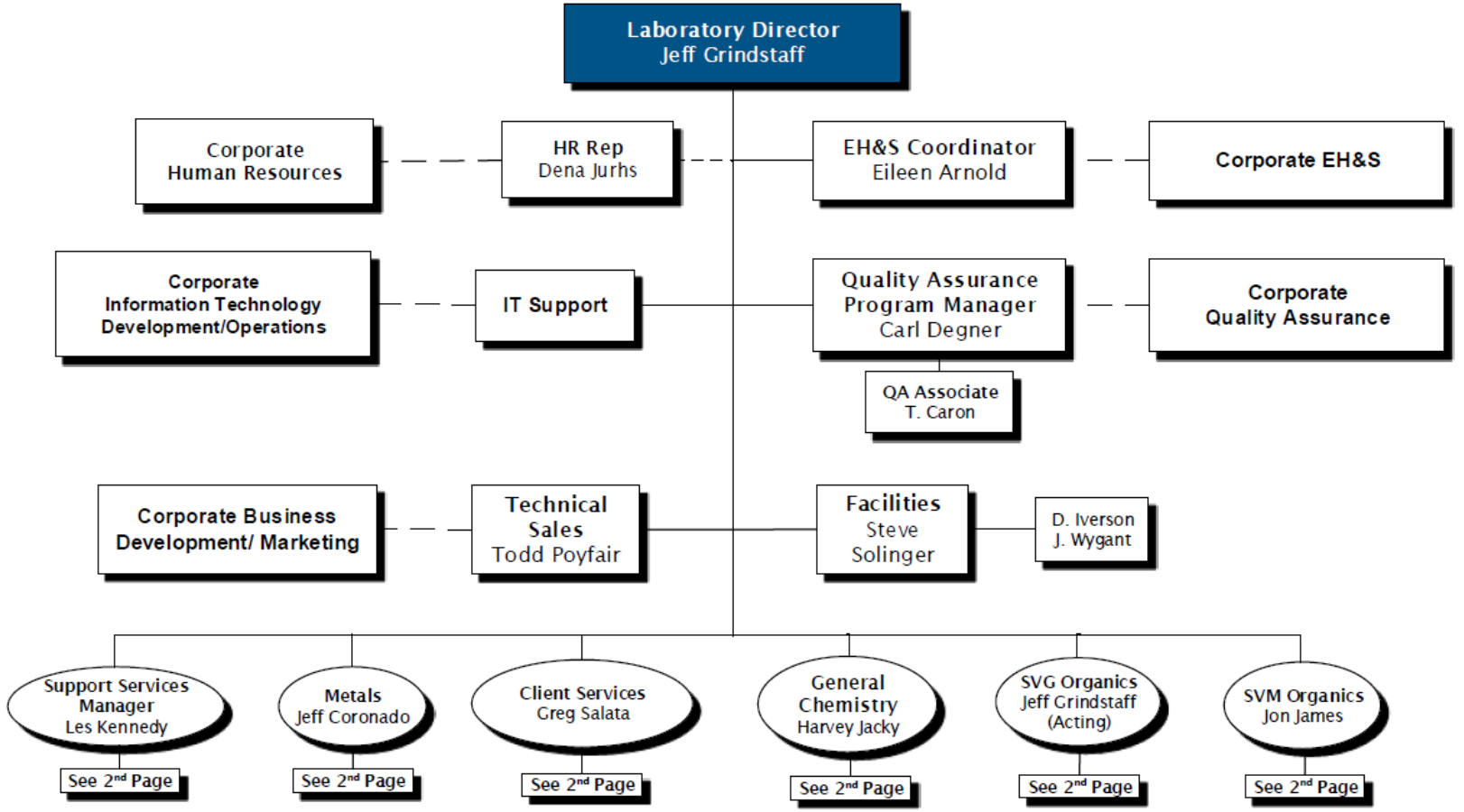
August 28, 2015



Kelso, Washington Laboratory

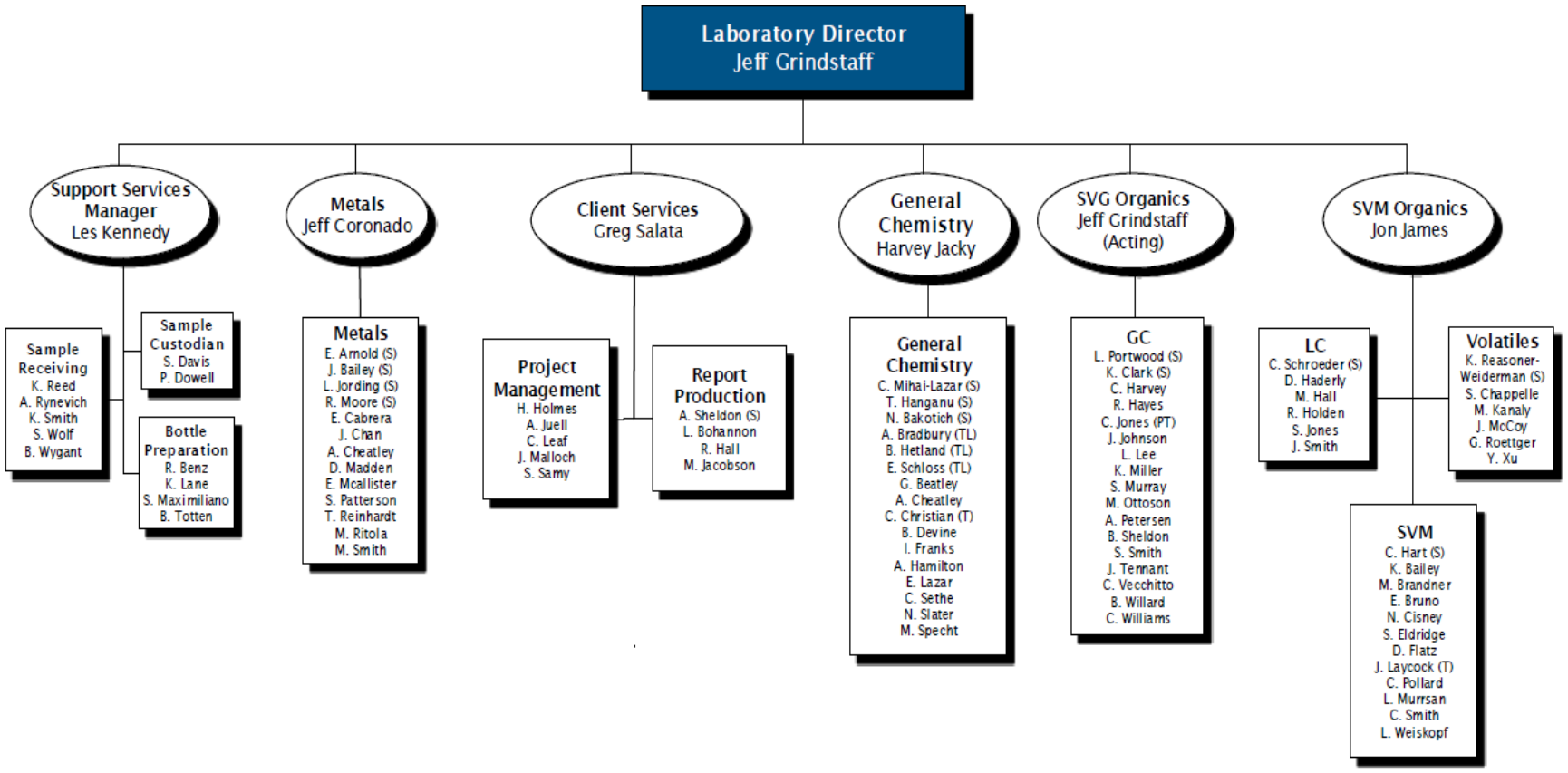
August 28, 2015

ALS Environmental



Kelso, Washington Laboratory

August 28, 2015
Operations



Jeffrey A. Grindstaff

1317 S. 13th Avenue • Kelso, WA 98626 • +1 360 577 7222

ALS Environmental

Education

Allan Hancock College.
Santa Maria, CA
AA, Liberal Arts, 1986

California Polytechnic State University
San Luis Obispo, CA
BS, Chemistry, 1989

Hewlett-Packard Analytical Education Center
Interpretation of Mass Spectra I, 1992

Hewlett-Packard Analytical Education Center
Mass Selective Detector Maintenance 1993

Richard Rogers Group
Leadership Training, 1996

PTI International
Sampling and Testing of Raw Materials, 2004

Affiliations

American Chemical Society, 1989

Publications

Mr. Grindstaff has a number of publications and presentations. For a complete list, contact ALS.

Laboratory Director

2011 - Present

Responsible for all phases of laboratory operations at the Kelso, (WA) facility, including project planning, budgeting and quality assurance. Primary duties include the direct management of the Kelso laboratory

Previous Experience

Columbia Analytical Services, Inc.
Kelso, WA
Laboratory Director, '10-'11

Responsibilities the same as above.

Columbia Analytical Services, Inc.
Kelso, WA
Technical Manager III, Pharmaceutical GC/MS, VOC and SVOC Laboratories, '97-'10

Primary responsibilities include leadership of the Pharmaceutical GC/MS, VOC and SVOC staff, management of method development, training, data review, tracking department workload, scheduling analyses. Responsible for ensuring data quality and timeliness. Also responsible for project management and coordination for pharmaceutical clients.

Columbia Analytical Services, Inc.
Kelso, WA
Manager, GC/MS VOA Laboratory, '94-'97

Responsible for supervision of GC/MS VOA staff development, method development, training, data review, tracking department workload, scheduling analyses, and general maintenance and troubleshooting of GC/MS systems.

Columbia Analytical Services, Inc.
Kelso, WA
Scientist III, GC/MS VOA Laboratory, '91-'94

Responsible included scheduling workload, data review, instrument maintenance and troubleshooting and personnel training and evaluation. Also responsible for supervision of extraction personnel and instrument analysts. Additional supervisory duties included report generation and data review for GC analyses. Responsibilities also included project management and client service.

Enseco-CRL
Ventura, CA
Chemist, '90-'91

Established GC/MS department including inventory maintenance, preparation of state certification data packages, method development, SOPs, and extended data programs. Performed daily maintenance and troubleshooting of GC and GC/MS instrumentation. Scheduled and performed routine and non-routine VOA analyses.

Coast to Coast Analytical Services.
San Luis Obispo, CA
GC/MS Chemist VOA Laboratory, '05-'07

Responsible for Standard Preparation for VOA analyses, instrument calibration, tuning and maintenance. Also implemented and further developed EPA methods for quantitative analysis of pesticides and priority pollutants

Gregory G. Salata, Ph.D.

1317 S. 13th Avenue | Kelso, WA 98626 | +1 360 577 7222

ALS Environmental

Education

University of California-San Diego,
Revelle College,
La Jolla, CA
BA, Chemistry, 1987

Texas A&M University,
College Station, TX
MS, Oceanography, 1993

Texas A&M University,
College Station, TX
Ph.D., Oceanography, 1999

Affiliations

Society of Environmental Toxicology and Chemistry (SETAC)

Publication

Dr. Salata has a number of publications and published abstracts. For a complete list, contact ALS|Kelso.

Client Services Manager

2013 – Present

Management of the Client Services Departments: Project Management, Electronic Data Deliverables and Report Generation, and Sample Management. Oversee the client services for approximately $15 million in revenue annually. Personally responsible for approximately $4 million of direct technical project management annually providing technical and regulatory interpretation assistance, as well as project organization of work received by the laboratory.

Previous Experience

ALS Group USA Corp dba ALS Environmental — **Project Manager V '11 –'13**
Kelso, WA

Responsible for technical project management, ensuring overall data quality and compliance with customer requirements. Provide technical support to clients regarding laboratory application to projects. Additionally, acts as a consultant to clients regarding industrial/environmental compliance issues; serving as liaison between clients and regulatory agencies. Responsible for direct technical project management annually providing technical and regulatory interpretation assistance, as well as project organization of work received and reported by the laboratory. Specializes in complex or highly sensitive projects which may involve difficult matrices and analytes..

Columbia Analytical Services, Inc. — **Project Manager V, '03 – '11**
Kelso, WA

Responsibilities include Project Management, including quotation preparation and data reporting, as well as providing technical support to the laboratory as needed. Responsibilities also include oversight of the organic extractions lab, managing resources and providing technical support for all organic preparation work flows

B&B Laboratories — **Project Manager**, '99-'03
College Station, TX

Supervisor/responsible for analysis of TPH (waters, tissues, sediments), organotins (waters, tissues, sediments), Atterberg Limits (sediments), and total organic/inorganic carbon (sediments, waters). Also responsible for report generation on specific projects. Instrumentation operated included GCs with FID and FPD detectors, Combustion TOC, Water TOC, and Dionex Accelerated Solvent Extractor.

Texas A&M University — **Graduate Student**,'91-'99
College Station, TX

While working toward MS in Oceanography, performed organic extractions for pesticides, PCBs, PAHs, and butyltins. While working toward Ph.D. in Oceanography determined stable carbon isotope ratios in sediments, waters, and bacterial phospholipid fatty acids. Other responsibilities included field sample collection, and operation/maintenance of FinniganMAT 252 isotope ratio MS.

Science Applications International — **Analytical Chemist**, '89-'90
San Diego, CA

Performed organic extraction and GC/FID analysis on sediment/rock samples for the Exxon Valdez oil spill.

Analytical Technologies — **GC Chemist**, '87-'89
San Diego, CA

Responsible for analysis of volatile organics using purge and trap and GC/PID/ELCD.

Carl S. Degner

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ALS Environmental

Education

University of Houston, Houston, TX
MS in Environmental Management 1998

University of Houston, Houston, TX
BS in Biochemistry/ Biophysical Science 1984

Kelso QA Manager

2015 – Present

Directing the quality systems and ethics programs for the Kelso, WA laboratory facility. Responsible for ensuring that ALS quality systems and data integrity standards are implemented. Act as liaison with government entities involving quality, technical and operational issues. This includes maintaining accreditations and certifications, and maintaining all necessary documents (QA Manual, SOPs, and QA records). Act as primary point of contact during laboratory audits and provide audit responses and corrective actions. Coordinate performance audits (PE/PT testing) and conduct internal audits. Provide QA input and policy as needed for operations, development initiatives, special projects, planning, and information technology implementation.

Previous Experience

ALS Group USA Corp. — **Technical Manager, SVM Laboratory '11–'14**
Kelso, WA
Responsible for daily operation of Semi-volatiles GC/MS laboratory. This includes scheduling workloads of 3 analyst, data review, reporting and long-range planning for SVM laboratory. Work with PCs on client specific project requirements.

Columbia Analytical Services, Inc. — **Technical Manager, SVM Laboratory '01–'11**
Kelso, WA
Essentially the same as current duties above.

Columbia Analytical Services, Inc. — **Scientist IV, SVM Laboratory '98 – '01**
Kelso, WA
Responsible for all phases of operation of GC/MS systems, utilizing SIM and 8270C methodologies, including preparation of standards, QC verifications, data review, and reporting.

Environ Express Laboratory — **Project Chemist/Principal Organic Scientist '93 – '98**
LaPorte, TX
Responsible for SV Extractions and GC/MS laboratories. Set up, operated, and maintained three HP GC/MS systems and worked with clients on technical issues.

BETZ Analytical Services — **GCMS Supervisor, '91– '93 GCMS Operator: '90–'91**
The Woodlands, TX
Supervised GC/MS Volatiles laboratory and oversaw staff's operation of four GC/MS systems. Served as system manager for HP 1000 utilizing RTE-A software. As operator performed routine sample analysis in Volatiles laboratory.

Harris County Pollution Control — **Instrument Technician, '88 – '90**
Pasadena, TX
Operated and maintained various equipment in instrumentation laboratory, including GC/MS, GC, HPLC, UV-Vis and Fluorescence spectrophotometers. Selected to meet with EPA and Texas Air Control Board at industrial sampling sites.

Harris County Pollution Control — **Chemist, '84 – '88**
Pasadena, TX
Performed wide variety of inorganic analyses utilizing gravimetric, titrimetric, and colorimetric techniques. Brought analytical methods online e.g. TKN, ortho-Phosphate. Performed metals digestions and analyzed samples using Flame AAS and GFAA.

Eileen M. Arnold

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ALS Environmental

Education

Immaculata College,
Immaculata, PA
BA, Chemistry, 1977

Affiliations

American Chemical Society, Member since 1987.

Scientist, Metals Laboratory/Kelso Health and Safety Officer

2011 - Present

Supervisor of the Metals reporting group responsible for ensuring timely, accurate reporting of all metals reports. Responsible for updating instrument specific data, such as MDL and control limits. Analyst for the Inductively Coupled Argon Plasma (ICAP) Emission Spectrometer. This involves digestion, instrumental analysis, and report generation for environmental samples using approved EPA techniques.

Environmental, Health and Safety Officer responsibilities include development and implementation of the Kelso Health and Safety program, including accident investigation and incident review, maintenance of all safety related equipment, review of monthly safety audits, and completion of all Federal and State mandated EH&S reports.

Previous Experience

Columbia Analytical Services, Inc.
Kelso, WA
Scientist IV Metals Laboratory/Kelso Health and Safety Officer, *'94-'11*
Duties as described above.

Columbia Analytical Services, Inc.
Kelso, WA
Project Chemist, '92-'94
Duties included technical project management and customer service. Responsible for meeting the clients' needs of timely and appropriate analyses, and to act as liaison for all client-related activities within Columbia Analytical Services, Inc.

Columbia Analytical Services, Inc.
Kelso, WA
Scientist IV Metals Laboratory, '87-'92
Duties include the operation and maintenance of the Inductively Coupled Argon Plasma (ICAP) Emission Spectrometer. This involves digestion, instrumental analysis, and report generation for environmental samples using approved EPA techniques.

Dow Corning Corporation.
Springfield, OR
Chemist, '86-'87
Responsibilities included ICP and atomic absorption work in silicon manufacturing. Methods development for ICP analysis of minor impurities found in silicon.

Ametek, Inc.
Harleysville, PA
Chemist, '86-'87
Responsibilities included product research and development chemist involved in production of thin-film semiconductors for use as solar cells. Work involved AA and SEM techniques

Janbridge, Inc..
Philadelphia, PA
Chemist, '78-'82
Responsibilities included maintaining electroplating process lines through wet chemical analysis techniques, and performed Quality Assurance testing on printed circuit boards.

Jeffrey A. Coronado

1317 S. 13th Avenue | Kelso, WA 98626 | +1 360 577 7222

ALS Environmental

Education

Western Washington University – Bellingham, WA
BS, Chemistry, 1988

Western Washington University – Bellingham, WA
BA, Business Administration, 1985

Winter Conference on Plasma Spectrochemistry – Tucson, AZ, 2012

LC/ICP-MS Training Course – PerkinElmer, 2008

Field Immunaossay Training Course – EnSys Inc., 1995

Winter Conference on Plasma Spectrochemistry – San Diego, CA, 1994

ICP-MS Training Course – VG-Elemental, 1992

Technical Manager IV, Metals Department Manager

1992 – Present

Management of the Kelso Metals Department with a staff of 22 chemists and technicians, and annual revenues approaching $4 million. Responsible for data quality and timeliness, annual budgeting, revenues, expenses, workload coordination, method development efforts, and resource allocation. 2001 to Present—Project Manager: Responsible for technical project management, ensuring overall data quality and compliance with customer requirements, and providing technical support to clients regarding laboratory application to projects.2008 to Present— Participation in the corporate Information Technology governance team ensuring software development activities are in line with the companies operational objectives.2010 to Present—Participation in multiple LIMS development teams responsible for defining the CAS product. Team leader for defining specifications of the Sample Preparation Module to capture preparation information across all laboratory departments.

Previous Experience

Columbia Analytical Services, Inc. — **Metals Department Manager, '92 – present**
Kelso, WA

Responsibilities included management of all aspects of the metal laboratory operation, including personnel training and evaluation, review of all metals data, and report generation. Also responsible for client service on a number of ongoing CAS accounts. Technical duties include primary analytical responsibility for trace level metals analysis by ICP/MS. Analyses range from routine water and soil analysis, to marine tissues, as well as industrial applications such as ultra-trace QA/QC work for various semiconductor clients. Also responsible for a number of specialized sample preparation techniques including trace metals in seawater by reductive precipitation, and arsenic and selenium speciation by ion-exchange chromatography. Developed methodology for performing mercury analysis at low part per trillion levels by cold vapor atomic fluorescence.

Columbia Analytical Services, Inc. — **Supervisor, GFAA Laboratory, '89 – '92**
Kelso, WA

Responsibilities included supervision of metals analysis by graphite furnace atomic absorption following SW 846 and EPA CLP methodologies. Duties include workload scheduling, data review, instrument maintenance, personnel training and evaluation.

Harvey Jacky

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ALS Environmental

Education

Oregon State University – Corvallis, OR
BS, Zoology, 1988

Oregon State University – Corvallis, OR
BS, General Science, 1988

Linfield College – McMinnville, OR
General Studies, 1981 - 1982

40-Hour Hazmat Certification, PBS Environmental, 1996

Industrial Emergency Response, SFSP Seminar, 1991

Presentations

American Chemical Society, Member since 1988

Biochemical and Physical Factors Involved in the Application and Measurement of a Soil Bioremediation System. Biogeochemistry, Portland State University, 1996

General Chemistry Department Manager

2008 – Present

Oversee the operation of the General Chemistry and Microbiology groups. Responsible for the quality and timeliness of the inorganic laboratories analytical reports, departmental budgets, workload coordination, method development efforts, cost-effectiveness, and resource allocation.

Previous Experience

Columbia Analytical Services, Inc. — **Project Manager III, '99 – '08**
Kelso, WA

Responsible for technical project management, ensuring overall data quality and compliance with customer requirements, and providing technical support to clients regarding laboratory application to projects. Additionally, acts as a consultant to clients regarding industrial/environmental compliance issues; serving as liaison between clients and regulatory agencies.

Coffey Laboratories — **Director of Project Management, '97 – '99**
Portland, OR

Responsible for technical project management. Communicated with clients to determine needs and expectations. Monitored laboratory production and ensured the timely completion of analytical projects. Technical consultant for clients regarding environmental compliance. Supervised and managed other members of the project management team. Served as a member of the senior management team for oversight of general operations, strategic planning, finances, and policy.

Coffey Laboratories — **Project Manager/Chemist, '97 – '99**
Portland, OR

Responsibilities: Served as primary liaison between Coffey Laboratories and major clients. Ensured that work was completed in a timely manner and done to client specifications. Served as technical consultant regarding environmental chemistry, soil remediation, and waste water industrial compliance. Clients included the Oregon Department of Transportation, Hazmat Unit, Portland, Oregon; Raythion Demilitarization Co., Umatilla, Oregon; Hydroblast - Wastewater Evaporator Systems, Vancouver, Washington; and Union Pacific Railroad, Northwest Region, Klamath Falls, Oregon.

Coffey Laboratories — **Technical Sales Representative, '95 – '97**
Portland, OR

Responsible for marketing and sales, including actively prospecting for new potential clients. Additional responsibilities included procurement and preparation of all major project bids; ensuring that client expectations were met; and maintaining customer satisfaction. Served as consultant regarding industrial compliance issues, environmental remediation projects, and hazardous waste management.

Coffey Laboratories — **Senior Chemist/Laboratory Chemical Hygiene Officer, '88 – '95**
Portland, OR

Responsibilities: Performed analytical tests including Anions by Ion Chromatography (EPA 300.0), PAHs by HPLC (EPA 8310), Cyanides (EPA 335), and other inorganic, wet chemistry, and organic analytical tests on a wide variety of sample matrices. Responsible for the initial quality assurance review of work performed, supervised and managed personnel. Developed and implemented Laboratory Chemical Hygiene Plan. Directed personnel in regards to safety issues and hazardous waste management. Served as consultant and teacher regarding analytical methodology, environmental compliance, and industrial hygiene.

Jonathan (Jon) James

1317 S. 13th Avenue | Kelso, WA 98626 | +1 360 577 7222

ALS Environmental

Education

Evergreen State College
Olympia, WA
BA, Chemistry/Biology
1991

Introduction to LC Methods Development & Troubleshooting, *Hewlett-Packard, Tacoma, WA,* **1995.**
HPLC Maintenance Seminar, *Waters, Portland, OR,* **1994.**
GC/HPLC Maintenance Seminar, *Hewlett-Packard, Olympia, WA,* **1993.**
Gas Chromatography Seminar, *Curtis Matheson Scientific, Kelso, WA,* **1992.**
HPLC Seminar, *Hewlett-Packard, Kelso, WA,* **1991.**

VOA/MS, GC/MS and HPLC Department Manager

2009 – Present

Oversee the operation of the Volatiles GC/MS, Semivolatile GC/MS and HPLC laboratories. Responsibilities include organizing and prioritizing workload, training and development of staff, working with PCs on client specific project requirements, departmental budgets, workload coordination, method development efforts and resource allocation. Responsible for the quality and timeliness of analytical reports. Other responsibilities include ensuring compliance with CAS QA protocols and assisting staff with troubleshooting equipment and procedural problems.

Previous Experience

Columbia Analytical Services, Inc.
Kelso, WA
Manager VOA and PHC/HPLC Laboratories, '04– '09

Oversee daily operation of the Volatiles GC/MS and PHC/HPLC laboratories. Responsibilities include organizing and prioritizing workload, initiating process improvements, training and development of staff and working wit PCs on client specific project requirements. Responsible for analytical duties as listed below for Scientist IV. Other responsibilities include ensuring compliance with CAS QA protocols and assisting staff with troubleshooting equipment and procedural problems.

Columbia Analytical Services, Inc.
Kelso, WA
Scientist IV, VOA Laboratory, '99 – '04

Perform sample analysis and data review for EPA methods 524.2, 624 and 8260. Duties also include Project Management.

Columbia Analytical Services, Inc.
Kelso, WA
Project Chemist, Supervisor Pesticides GC Laboratory, '98 – '99

Primary responsibilities included workload scheduling, data review, instrument maintenance and troubleshooting, and personnel training and evaluation. Also responsible for supervision of extraction personnel and instrument analysts.

Columbia Analytical Services, Inc.
Kelso, WA
Analyst, SVOC GC Lab '92 – '98

Primary responsibilities included analysis of samples using GC and HPLC techniques, report generation, data review, preparation of analytical standards, maintenance of instrumentation, Client Services and some Project Management. Routine duties included analysis of soil and water samples for pesticides, PCBs, CLP Pesticides, Explosives and PAHs using EPA methods.

Columbia Analytical Services, Inc.
Kelso, WA
Analyst, Organic Extractions Lab, '91 – '92

. Responsibilities included extraction of soil and water samples for various SVOCs, and TCLP extraction of SVOC and VOC compounds using TCLP equipment. Other duties included performing cleanup procedures, validation studies, MDL studies, and the training of employees in advanced extraction procedures and techniques..

Loren E. Portwood

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ALS Environmental

Technical Manager I, Semivolatile Organics Laboratory

2011 – Present

Responsible for the overall operation and supervision of the Semivolatile Organics Gas chromatograph department. Perform method development.

Previous Experience

ALS Group USA Corp.
Kelso, WA
Technical Manager I, DW Laboratory, '08 – '13

Columbia Analytical Services, Inc.
Kelso, WA

Responsible for management of the Semivolatile Organics Gas chromatograph and drinking water department. Also responsible for implementation and oversight of UCMR2 analyses. Perform method development. Project management of drinking water accounts. Develop SOPs for Drinking Water methods, EPA 600 methods and SW-846 methods. Operation of Varian GC/MS ion trap, Thermo GC/MS ion trap, Agilent GC/ECD, Agilent GC/FPD, Agilent GC/FID.

Columbia Analytical Services, Inc.
Kelso, WA
Technical Manager I, DW Laboratory, '08 – '11

Plan, conduct, and, as lead analyst, supervise analyses using advanced instrumentation such as HPLC with post column derivatization, GC/MS, and GC/ECD. Responsible for data interpretation, quality control and data reporting. Additional responsibilities include SOP generation; handling routine and advanced maintenance and troubleshooting of instrumentation; and assisting in the training of staff department analysts. Assists the department manager and/or other senior scientists in setting up more complex procedures. Serves as senior technical advisor for teams and projects

Columbia Analytical Services, Inc.
Kelso, WA
Lead Analyst DW Laboratory, , '02 – '08

Primary responsibilities include management of the petroleum hydrocarbon team, initiating new methods and process improvements, and staff development and training. Other duties include department wide compliance with CAS quality assurance guidelines, routine system checks, assist and encourage staff in troubleshooting equipment and procedural problems in a manner consistent with company, state and federal guidelines..

Columbia Analytical Services, Inc.
Kelso, WA
Petroleum Hydrocarbons Supervisor, , '98 – '02

Analysis, reporting, and archiving of water, soil, and product samples for semi-volatile petroleum hydrocarbons and miscellaneous FID tests. Methods include EPA methods 8100, 8310, 8315, 8330, 8040, 8015 and various state modifications of 8015 (OR, WA, CA, AK). Additional analyses include solvent scans, alcohols, glycols, and EPA methods 413.2 and 418.1. Other responsibilities include sample preparation and instrument maintenance

Columbia Analytical Services, Inc.
Kelso, WA
Petroleum Hydrocarbons, '93 – '98

SVOC sample preparations for water, soil, and oil to be analyzed in the GC, GC/MS, and PH Departments. These extraction methods included hazardous waste, wastewater, and drinking water procedures. Other responsibilities included extract cleanup via Florisil®, GPC, and Hg.

Treclen Laboratories
Spokane, WA
Bench Chemist, Extractions, '92 – '93

Inorganic water and soil testing and sample preparation by EPA methods.

Education

Whitworth College
Spokane, WA
BS in Chemistry, Emphasis in Biochemistry 1990

HP 5890 GC Maintenance and Troubleshooting, Hewlett Packard, 1993

Capilliary Chromatography Restek, 1993

HP6890 – Fast GC Hewlett Packard, 1996

HP5890-C+GC Advanced Operations Hewlett Packard, 1996

Purge and Trap Theory and Troubleshooting, Full Spectrum Analytics, 2001

Comprehensive HPLC, Restek, 2002

Lester "Les"Kennedy

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ALS Environmental

Education

Lower Columbia College, Longview, WA
Coursework, general Studies, 1988 - 1990

Portland Bible College Portland, OR
Batchelor ofTheology, 2009

Support Services Manager/Sample Management Manager

2010 - Present

Responsible for the operation of the Sample Management, Sample Control, Bottle preparation departments, including sample receiving, courier service, sample control, storage and disposal, bottle preparation and shipping, and general freight receiving. Responsible for employee supervision, personnel evaluations, workload coordination, and adherence to all standard operating procedures within said departments. Additional duties include oversight of quarantined soil importation for laboratory testing. Is the designated Sample Custodian for the laboratory.

Previous Experience

Columbia Analytical Services, Inc.
Kelso, WA
Project Manager '99 -'11
SMO Supervisor, '06 -'11

Responsible for technical project management, ensuring overall data quality and compliance with customer requirements, and serving as liaison to clients and regulatory agencies. Oversight of the daily activities in sample management department including receipt, login, storage, and proper disposal of all samples received in the laboratory.

Columbia Analytical Services, Inc.
Kelso, WA
Supervisor Organic Extractions Laboratory, '97-'99

Responsible for managing work load; directing efficiency; and ensuring that all critical holding times and QC are met each day. This involves GC/MS prep work, including extracting and GPC clean up; and subsequent sample screening of the GC/MS prep work. Additional responsibilities include data processing of GC/MS analytical runs including all steps of the data review and reporting process.

Columbia Analytical Services, Inc.
Kelso, WA
Senior Analyst, GC/MS Laboratory, '96-'97

Primary duties were performing analyses by EPA Method 8270, SIM TCL. SIM PAH, including all steps in the data review and reporting process.

Columbia Analytical Services, Inc.
Kelso, WA
Senior Analyst, Organic Extractions Laboratory, '93-'96

Primary responsibilities include managing workload; directing efficiency; and ensuring that all critical holding times and QC are met each day. This involves GC/MS prep work, including extracting and GPC clean up; and subsequent sample screening of the GC/MS prep work.

Columbia Analytical Services, Inc.
Kelso, WA
Analyst, Organic Extractions Laboratory, '91-'93

Duties primarily as listed above

Jeffery D. Christian

1317 S. 13th Avenue | Kelso, WA 98626 | +1 360 577 7222

ALS Environmental

Education

Evergreen State College – Olympia, WA
BS in Chemistry 1993

Coursework, *Pacific Lutheran University, Tacoma, WA.* 1988-1989.
Coursework, *Tacoma Community College, Tacoma, WA* 1970-1971, 1988-1989.
CERTIFICATION, Chemistry, *L.H. Bates Technical, Tacoma, WA,* 1976-1978.
Coursework, *Central Washington University, Ellensburg, WA.* 1969-1970.
Numerous Training/Educational Activities via Conferences, Professional Seminars, and Factory Training, 1989-2010

Publications

Mr. Christian has a number of publications and presentations. For a list of these publications and presentations, please contact ALS

Director of Operation, Western USA

2011 – Present

Responsible for oversight of operating units In the territory designated Western reporting to the COO. Primary responsibilities include establishment of consistent quality, technical, and client service enhancements across the group, as well as the financial performance of the individual operating units. In addition, a significant role is to represent operations as a member of the management team consisting of the Directors of Operations of other territories, Laboratory Directors for all locations, and senior management of the North America Environmental Division of ALS USA.

Previous Experience

Columbia Analytical Services, Inc.
Kelso, WA
Chief Operating Officer/Vice President – '10 to '11

Responsible for oversight of operating units of Columbia Analytical Services, Inc. with all Laboratory Directors reporting to the COO. Primary responsibilities include establishment of consistent quality, technical, and client service enhancements across the company, as well as the financial performance of the individual operating units. In addition, a significant role is to represent operations as a member of the Senior Management Team (SMT) consisting of the Chief Executive Officer, Chief Financial Officer, Chief Quality Officer, and the Director of Information Technology.

Columbia Analytical Services, Inc.
Kelso, WA
Vice President/Kelso Laboratory Director '93–'10

Responsible for all phases of laboratory operations, including project planning, budgeting, and quality assurance.

Columbia Analytical Services, Inc.
Kelso, WA
Operations Manager, Kelso Laboratory '92–'93

. Responsibilities included directing the daily operation of the Kelso laboratory. Other responsibilities and duties included functioning as a technical consultant to clients, providing assistance in developing and planning analytical schemes to match client objectives, and writing and developing analytical procedures/methods. Also, served as Project Manager for State of Alaska Department of Environmental Conservation contract and Coordinator for EPA Special Analytical Services (SAS) contracts.. Always leave an extra space after this paragraph to separate from the next job.

Columbia Analytical Services, Inc.
Kelso, WA
Project Chemist & Manager, Metals Analysis Lab, '89–'92

Responsible for directing the daily operation of the Metals Laboratory, including the sample preparation, AAS, ICP-OES, and ICP-MS Laboratories

Weyerhaeuser Technology Center,
Federal Way, WA
Scientist '86–'89

Responsibilities included supervising atomic spectroscopy laboratory which included flame and furnace AAS, ICP-OES, and sample preparation capabilities to handle a wide variety of sample types. Interfaced with internal and external clients to provide technical support. Wrote and developed analytical procedures/methods.

Weyerhaeuser Technology Center,
Federal Way, WA
Lead Technician, Metals Lab '81–'86

Responsibilities included primary ICP and AAS analyst for EPA-CLP contract work. Extensive experience in wide variety of environmental and product-related testing.

ITT Rayonier, Olympic Research Division,
Shelton, WA
Research Assistant, '78–'81

Responsibilities included performing water quality tests, product-related analytical tests, corrosion tests operated pilot equipment specific to the pulp and paper ind

APPROVED SIGNATORIES FOR FINAL ANALYTICAL REPORTS

ALS Environmental, Kelso, WA

CHRISTIAN, JEFF
CORONADO, JEFFREY
DEGNER, CARL
GRINDSTAFF, JEFF
HOLMES, HOWARD
JACKY, HARVEY
JAMES, JON
JUELL, AMANDA
KENNEDY, LES
LEAF, CHRIS
MALLOCH, JANET
MIHAI-LAZAR, CARMEN
MOORE, RACHEL
SALATA, GREGORY
SAMY, SHAR
SCHROEDER, COLLEEN

Update: May, 2015 Approved by: Gregory Salata, Client Services Manager

APPENDIX C

ALS Environmental Confidentiality Agreement

Confidentiality Agreement

The Confidentiality Agreement (the "Agreement") is entered into by and between ALS Group (hereinafter referred to as the "Company") and _____ (hereinafter referred to as "Employee").

WHEREAS, employee is presently employed by the Company in a position in which Employee will receive and have access to confidential business information and other secrets of the Company, and shall, to the best of Employee's ability, assist the Company in improving and developing the products and services of the Company; and

WHEREAS, employee is desirous of continuing such employment and receiving such disclosures of confidential business information, and assisting the Company in improving and developing its products and services.

NOW, this Agreement being a condition therefore and ancillary thereto, and in further consideration of the benefits to Employee pursuant to the employment by the Company, the receipt and sufficiency of all such consideration being hereby acknowledged by Employee, it is agreed between the Company and Employee as follows:

1. **Confidential Business Information.** Employee recognizes and agrees that the Company has certain confidential business information, including, but not limited to, compilations of information, customer lists, customer data, records, specifications, and trade secrets, and related business methods and techniques, which confidential business information are used by the Company to obtain a competitive advantage over the Company's competitors who do not know or use this information. Employee further recognizes and agrees that the protection of such confidential business information against unauthorized disclosure and use is of critical importance to the company to maintain its competitive position and Employee therefore agrees that use of, or disclose to any other person or entity, except as authorized by the Company in writing, any of the confidential business information of the Company. Employee also agrees not to disclose to the Company or utilize on the Company's behalf, any of the trade secrets or other confidential information of any of the Employee's former employers.

2. **Return of Confidential Business Information.** Upon termination of his employment for any reason, employee shall promptly deliver to the Company all drawings, manuals, letters, photographs, tapes or video recordings, records of any kind, and all copies thereof, that may be in the possession of, or under the control of, Employee pertaining to the Company's employers.

3. **Assignment of Rights to Company.** Employee agrees to assist the Company in all possible ways in the discovery, perfection, and development of new ideas, inventions, discoveries, devices, and methods in processes, all for the benefit of the Company and as its exclusive property. Employee agrees to and does hereby assign, transfer, and convey to the Company, or at the written direction of the Company and which are made, developed or conceived by Employee, either solely or jointly with others, during Employee's employment with the Company, whether prior or subsequent to the signing of this Agreement, whether made, developed or conceived by Employee during or outside of regular working hours or on or away from the

Company's premises or at Employee's expense, the expense of the Company or some other person or persons. At any time, the Employee shall execute such documents requested by the Company to confirm the rights of the Company in the ideas, inventions, discoveries, and devices, methods and processes referenced in this Section 3.

4. **Reasonableness of Covenants**. Employee specifically acknowledges and agrees as follow: (I) the covenants set forth in this Agreement are reasonable and necessary to protect the goodwill and the operations and business of the Company; (ii) the time duration of the covenants set forth in this Agreement and are reasonable and necessary to protect the goodwill and the operations and business of the Company; (iii) the geographical area limitations of the covenants set forth in this Agreement are reasonable and necessary to protect the goodwill and the operations and business of the Company; (iv) the covenants set forth in this Agreement are not oppressive to Employee and do not impose a greater restraint on Employee than is necessary to protect the goodwill and the operations and business of the Company.

5. **Remedies**. Employee recognizes that irreparable injury or damage will result to the business of the company in the event to the breach of any covenant contained in this Agreement and Employee therefore agrees that in the event of such breach on the part of the Employee, the Company shall be entitled, in addition to any legal or equitable remedies and damages available, to an injunction to restrain the violation thereof by Employee and all other persons action for or on behalf of Employee. Any claim of Employee against the Company shall not prevent the Company from enforcing any provision of this agreement. Further, in the event legal action is necessary to enforce any of Employee's obligations hereunder and the Company prevails in such legal action, the Company shall be entitled to a recovery of its attorney's fees expended in such action.

6. **Reformation**. Whenever possible, each provision of this agreement shall be interpreted in such manner as to be effective and valid under applicable law; provided, however, incase any on or more of the provisions contained in this Agreement shall, for any reason, be held to be invalid, illegal, or unenforceable in any respect, such invalidity, illegality, or unenforceability shall no affect any other provision of this agreement, and this Agreement shall be construed as if such invalid, illegal, or unenforceable provision had never been contained herein. Should a court of competent jurisdiction declare any of the provisions of this Agreement unenforceable due to any restriction of duration, territorial coverage, scene of activity, or otherwise, in lieu of declaring such provisions unenforceable, the parties hereto expressly authorize the court, to the extent permissible by law, to revise or reconstruct such provisions in a manner sufficient to cause them to be enforceable.

7. **Affiliates**. This agreement, and Employee's obligations hereunder, shall apply to any confidential business information, formulas, recipes, patterns, devices, secret inventions, processes, compilations of information, materials, ingredients, customer lists, records, specifications and trade secrets of any affiliate of the Company. For the purpose of this Agreement, the "affiliate" means any person that, directly or indirectly, controls, or controlled by, or is under common control with, another person'; "person" means any individual, corporation, partnership, joint venture, limited liability company, association, joint stock company, trust, unincorporated

organization or any other form of entity; and "control" means the power to direct or cause the direction of the management and policies of a person, directly or indirectly, whether through the ownership of voting securities by contract, or otherwise.

8. **Compelled Disclosure**. In the event that Employee is requested or required (by oral questions, interrogatories, requested for information or documents, subpoenas, civil investigative demand or similar process) to disclose any of the confidential business information of the Company, it is agreed that Employee will provide the Company with immediate notice of such request(s), so that the Company may seek an appropriate protective order or, if appropriate, waive Employee's compliance with this agreement. Employee agreed that, if in the absence of a protective order or the receipt of a waive hereunder, Employee is nonetheless, in the reasonable opinion of Employee's counsel, legally compelled to disclose the confidential business information of the Company or else stand liable for contempt or suffer other censure or penalty, Employee may, after prior notice to the Company, disclose such the confidential business information of the Company to the extent legally required.

9. **Indemnity**. Employee agrees to indemnify and hold harmless the Company, and its directors, officers, employees, agents, and attorneys, from and after the date hereof, against any and all actions, causes of action, claims, suites, proceedings, demands, assessments, demands, settlement, judgment, damages, loses, costs, and legal and other expenses arising out of or resulting from the breach or failure of Employee to Company with any covenant or agreement made herein.

10. **Choice of Law: Waiver of Trial by Jury**. This Agreement shall be construed in accordance with, and governed for all purposes by the laws of the State of Texas and obligations and undertakings of each of the parties to this contract shall be performable at Houston, Harris County. TO THE EXTENT NOT PROHIBITED BY APPLICABLE LAW, THE PARTIES HEREBY KNOWLINGLY, VOLUNTARILY, AND INTENTIONALLY WAIVE ANY RIGHT TO TRIAL BY JURY THAT THE COMPANY OR EMPLOYEE MAY HAVE IN ACTION OR PROCEEDING, IN LAW OR IN EQUITY, IN CONNECTION WITH THIS AGREEMENT, EACH PARTY REPRESENTS AND WARRANTS THAT NEITHER PARTY HAS REPRESENTED, EXPRESSLY, OR OTHERWISE THAT IT WILL NOT, IN THE EVENT OF LITIGATION, SEEK TO ENFORCE THIS RIGHT TO JURY TRIAL WAIVER. EACH PARTY ACKNOWLEDGES THAT THE OTHER PARTY HAS BEEN INCLUDED TO ENTER INTO THIS AGREEMENT BY, AMONG OTHER THINGS, THE PROVISIONS OF THE WAIVER.

11. **Waiver**. No waiver of any provision of this Agreement shall constitute a waiver of any other provision of this agreement, nor such waiver constitute a waiver of any subsequent breach of such provision.

12. **Acknowledgement of Receipt.** Employee acknowledges a receipt of a copy of this Agreement, which has been executed in multiple copies, all executed copies of that shall be deemed originals.

13. **No Promise of Employment.** It is expressly agreed that this Agreement is not a promise of future employment.

14. **Assignment**: **Survival**. This agreement shall not be assignable by Employee. This agreement and the obligations of Employee hereunder, shall survive the termination of Employee's employment with the Company.

15. **Entire Agreement**. This Agreement entered into by the Company and Employee, embodies the entire agreement and understanding between the Company and the Employee relating to the subject matter hereof, and supersedes all prior agreements and understandings relating to the employment and compensation of the Employee and may only be amended by a written agreement signed by all parties hereto.

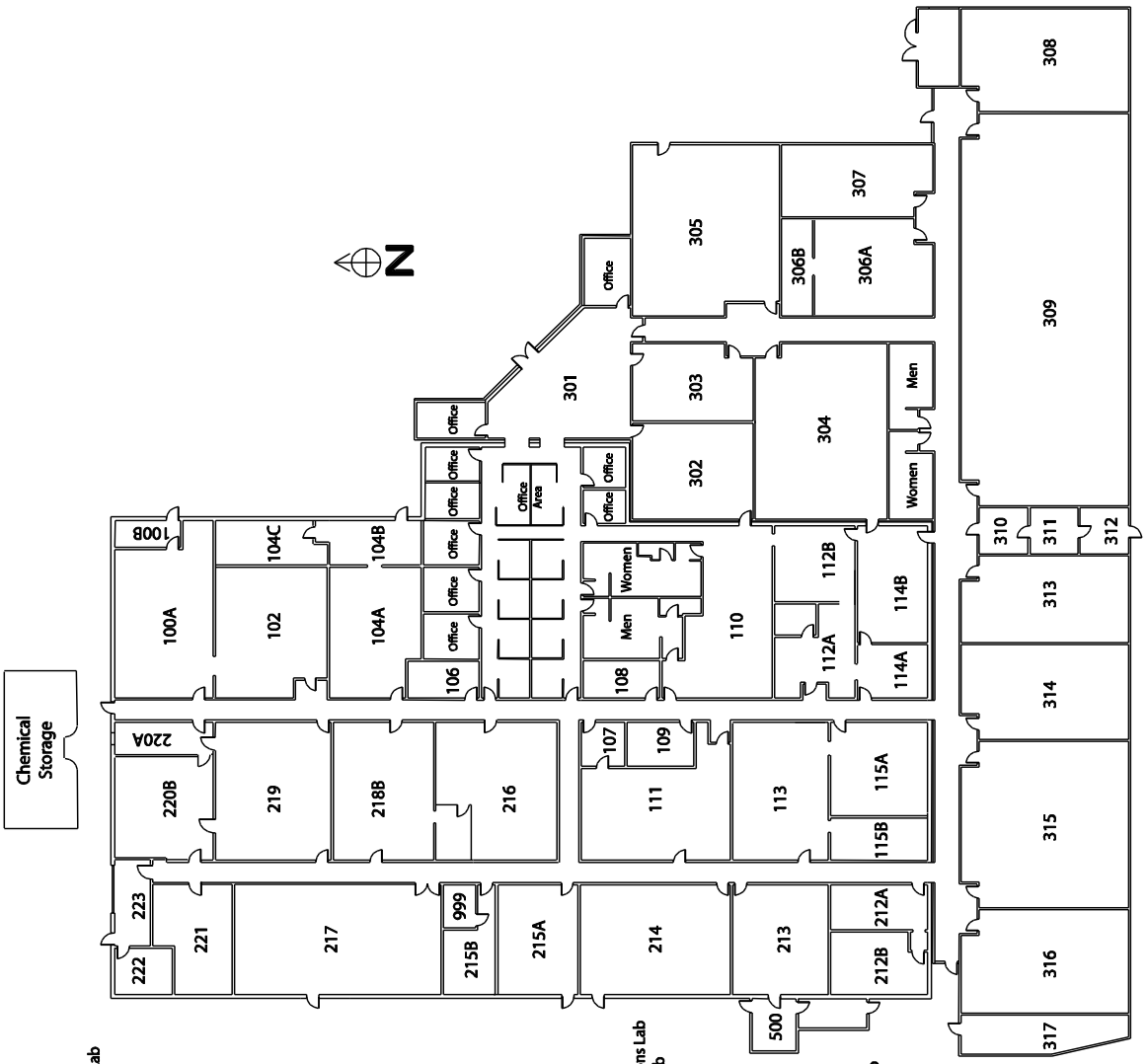
Employee Signature: _____ Date: _____

Employee Printed Name: _____

Witness: _____ Date: _____

Witness Printed Name: _____

APPENDIX D – Laboratory Floor Plan



APPENDIX E – Analytical Equipment

GENERAL CHEMISTRY/WATER CHEMISTRY LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balances (14):			
Precisa,Mettler,OHOUS, Adams models	1990-2011	LM	13
Autoclave - Market Forge Sterilmatic	1988	LM	5
Autoclave – Heidolph Brinkman 3870EP	2010	LM	3
Autotitrator – Thermo Orion 500	2007	LM	3
Calorimeters (2):			
Parr 1241 EA Adiabatic	1987	LM	4
Parr 6300 Isoparabolic	2005	LM	4
Centrifuge - Damon/IEC Model K	1992	LM	13
Colony Counter - Quebec Darkfield	1988	LM	2
Conductivity Meter (1):			
YSI Model 3200	2004	LM	4
Digestion Systems (3):			
COD (2)	1989	LM	4
Kjeldahl, Lachat 46-place (1)	1999	LM	3
Dissolved Oxygen Meter - YSI Model 58 (2)	1988, 1991	LM	4
Distillation apparatus (Midi) - Easy Still (2)	1996, 2000	LM	5
Drying Ovens (12):			
Shel-Lab and VWR models	1990-2010	LM	13
Air Drying Cabinets	2011	LM	-
Flash Point Tester (1):			
Petroleum Systems Services	2005	LM	3
Flow-Injection Analyzers (2):			
Bran-Leubbe	2002	LM	2
Lachat 8500	2007	LM	2
Ion Chromatographs (4)			
Dionex DX-120 with Peaknet Data System	1998	LM	3
Dionex ICS-2500 with Chromchem Data System	2002	LM	3
	2006	LM	3
Dionex ICS-2000 with Chromchem Data System	2009	LM	3
Dionex ICS-1600 with Chromchem Data System			
Meters (ISE and pH) (4)			
Fisher Scientific Accument Model 50	1997	LM	4
Fisher Scientific Accument Model 25	1993	LM	4
Fisher Scientific Accument Model 20	2000	LM	4
Fisher Scientific Accument Model AR25	1992	LM	4

Microscope - Olympus	1988	LM	1
Muffle Furnace- Sybron Thermolyne Model F-A1730	1991	LM	13
Shatter Box (2): GP 1000 SPEX 8530	 1989 2011	LM	5
Sieve Shakers (2): CE Tyler - Portable RX 24 WS Tyler - RX 86	 1990 1991	 LM LM	 5 5
Thomas-Wiley Laboratory Mill, Model 4	1989	LM	5
Total Organic Carbon (TOC) Analyzers (4) Coulemetrics Model 5012 OI 1010 Teledyne Tekmar Fusion 1 Analytik Jena 2500	 1997 2000 2009 2013	 LM LM LM LM	 3 3 3 3
Total Organic Halogen (TOX) Analyzers (2): Mitsubishi TOX-100	2001	LM	2
Turbidimeter - Hach Model 2100N	1996	LM	5
UV-Visible Spectrophotometers (4): SpectraMax 384 Plus Beckman-Coulter DU520 Perkin Elmer Lambda 25 Abrazix	 2009 2005 2008 2011	 LM LM LM LM	 4 4 4 2
Discrete Autoanlayzer –Westco SmartChem AD20-1	2011	LM	2
Vacuum Pumps (3): Welch Duo-Seal Model 1376 Busch R-5 Series Single Stage Chem Star 1402N-01	 1990 1991 2011	LM	13
Water Baths/Incubators (5): Various Fisher Scientific and VWR Models	1986 - 2009	LM	13
Drill Press – Craftsman	2012	-	4
METALS LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance (8) Mettler AE 200 analytical balance Various Mettler, Sartorius, and Ohaus models	1988-2010	MM	12
Atomic Absorption Spectrophotometers (4): Varian SpectrAA Zeeman/220 AA Perkin Elmer AAnalyst 200 Flame AA CETAC Mercury Analyzer M-6100	 2000 2005 2010	 LM MM MM	 2 2 2
Buck AA Spectrophotometer Model 205	2008	LM	2

Atomic Fluorescence Spectrophotometer Brooks-Rand Model III (1)	2005	LM	3
Centrifuge - IEC Model Clinical Centrifuge	1990	LM	12
Drying Oven - VWR Model 1370F	1990	LM	12
Freeze Dryers (1) - Labconco	2006	LM	5
Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES) (2) Thermo Scientific Model iCAP 6500 Thermo Scientific Model iCAP 6500	 2007 2012	 MM MM	 3 3
Inductively Coupled Plasma Mass Spectrometers (ICP-MS) (3): Agilent 7700 Thermo X-Series Nexion Model 300D	 2014 2006 2011	 MM MM MM	 2 2 2
Muffle Furnace (2) - Thermolyne Furnatrol - 53600	1991, 2005	LM	5
Shaker - Burrell Wrist Action Model 75	1990	LM	12
TCLP Extractors (3)	1989, 2002	LM	5
Turbidimeter – Hach			
SEMIVOLATILE ORGANICS SAMPLE PREPARATION LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance (3) Mettler PM480, AG204 OHaus EP613	1999 - 2011	MM	15
Centrifuge – Sorvall GLC-1 (2)	2014	LM	15
Drying Ovens (2) Fisher Model 655G VWR Model 1305U	 1991 1999	 LM LM	 15 15
Evaporators/concentrators Organomation N-Evap (6) Organomation S-Evap (8) Biotage Turbovap (2)	 1990-2010 1990-2010 2013	 LM LM LM	 15 15 15
Extractor Heaters: Lab-Line Multi-Unit for Soxhlet and Continuous Liquid-Liquid Extractions (90)	1987-2007	LM	9
Solids Extractors: Sonic Bath VWR Sonic Horn (4) Soxhtherm Gerhardt (2) OI Analytical (5)	 1994 1994 2000 2008	 LM LM LM LM LM	 6 6 6 6

Extractors, TCLP (8):			
Millipore TCLP Zero Headspace Extractors (20)	1992-2011	LM	2
TCLP 12 position Extractor/Tumbler (2)	1989-2011	LM	2
Gel Permeation Chromatography (GPC) (3)			
J2 Scientific AccuPrep (2)	2005, 2010	LM	4
Gilson (1)	2013	LM	4
Muffle Furnace (2)	2006, 2009	LM	4
Solid Phase Extractors (18) – Horizon SPE-Dex 4790	2003, 2006,2008	LM	4
Microwave Extractor – Mars 6	2014	LM	2
GC SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Gas Chromatographs (18):			
Hewlett-Packard 5890 GC with HP 7673 Autosampler and Dual ECD Detectors	1995	LM	6
Agilent 6890 GC with Agilent 7683 Autosampler and Dual ECD Detectors (6)	2001, 2005, 2007,2011	LM	6
Agilent 6890 GC with Agilent 7683 Autosampler and Dual FPD Detectors	2003	LM	3
Agilent 7890A Dual ECD Detectors Agilent 7683B autosampler (4)	2010 - 2014	LM	6
Hewlett-Packard 5890 GC with HP 7673 Autosampler and FID Detector	1995	LM	3
Agilent 6890 with Dual FID Detectors and Agilent 7873 Autosampler (4)	2001, 2005	LM	6
Agilent 7890A Dual NPD Detectors and Agilent 7683B autosampler	2012	LM	3
Varian Ion trap GC/MS:	2003	LM	2
Varian 3800 GC w/CP8400 autosampler	2006	LM	2
Varian Saturn 2100T mass spectrometer	2003	LM	2
Thremo Ion Trap ITQ-90C GC/MS w/TriPlus autosampler	2008	LM	2
GC/MS SEMIVOLATILE ORGANICS INSTRUMENT LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler AB 104-S	2000	MM	6
Gas Chromatograph: Hewlett-Packard 5890 with HP 7673 autosampler and FID Detector	1994	LM	6

Semivolatile GC/MS Systems (11):			
Agilent 6890/5973 with ATAS Optic2 LVI and HP 7673 Autosampler (2)	1997, 2001	LM	6
Agilent 5890/5970 and HP 7673 Autosampler	1990	LM	6
Agilent 5890/5972 with ATAS Optic2 LVI and HP 7673 Autosampler (2)	1993, 1994	LM	6
Agilent 6890/5973 with ATAS Optic3 LVI and HP 7683 Autosampler	2005	LM	6
Agilent 6890/5973 with Agilent PTV Injector and 7683 Autosampler	2007	LM	6
Agilent7890A/5975C with Agilent 7693 Autosampler (4)	2010 - 2011	LM	6
Semivolatile GC/MS/MS –			
Waters Quattro Micro GC Micromass with Agilent 6890, Agilent PTV Injector, 7683B Autosampler	2008	MM	2
HPLC LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler BB240	1994	MM	6
Drying Oven - Fisher Model 630F	1991	LM	5
Evaporator – Turbo Vap	2009	LM	6
Centrifuge (2)			
Beckman Coulter	2002	LM	6
Eppendorf	2012	LM	6
High-Performance Liquid Chromatographs (3):			
Agilent 1260 Infinity with Diode Array UV Detector	2011	LM	4
High-Performance LC/MS (3)			
Spectrometer - Thermo Electron TSQ Vantage LC/MS/MS and autosampler	2005	MM	2
API 5000 LC/MS/MS and SIL-20AC autosampler	2008	MM	4
AB Sciex 5500 and Schimadzu DGU 20A5	2011	MM	4
Agilent 1100 HPLC -UV/Fluorescence detector	2003	LM	3
VOLATILE ORGANICS LABORATORY			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
Analytical Balance - Mettler PE 160	1989	MM	5
Fisher Vortex Mixer	1989	LM	5

Drying Ovens (1): Boekel 107801	1989	LM	5
Sonic Water Bath - Branson Model 2200	1989	LM	5
Volatile GC/MS Systems (8):			
Agilent 5890/5970	1989	LM	5
Tekmar 3000 Purge and Trap Concentrator	1995	LM	5
Dynatech ARCHON 5100 Autosampler	1996	LM	5
Agilent 6890/5973	2001	LM	4
Tekmar 3100 Purge and Trap Concentrator	2001	LM	4
Encon Centurion Autosampler	2001	LM	4
Agilent 6890/5973	2005	LM	4
Tekmar Velocity Purge and Trap Concentrator	2005	LM	4
Tekmar Aquatech Autosampler	2005	LM	4
Agilent 6890/5973	2007	LM	4
Tekmar 3000 Purge and Trap Concentrator	2007	LM	4
Varian Archon 5100 Autosampler	2007	LM	4
Agilent 7980A/5975C (2)	2010, 2011	LM	4
Teledyne Tekmar-Atomx	2010, 2011	LM	4
Agilent 6890/5973	2013	LM	4
Encon Evolution Purge and Trap Concentrator	2013	LM	4
Encon Centurion Autosampler	2013	LM	4
Agilent 7890/5977A	2014	LM	4
Encon Evolution Purge and Trap Concentrator	2014	LM	4
Encon Centurion Autosampler	2014	LM	4
Agilent 7890 GC with FID Encon Evolution Purge and Trap Concentrator Encon Centurion Autosampler	2013	LM	3

AUTOMATED DATA PROCESSING EQUIPMENT			
Equipment Description	**Year Acquired**	**Manufacturer or Laboratory Maintained (MM/LM)**	**# of Trained Operators**
1 - WAN: LIMS Sample Manager using Oracle 11gR2 Enterprise RDBMS running on Red Hat Enterprise Linux Advanced Server v.6.6 platform connected via DMVPN circuits (100 Mbps)	2013	LM	NA
1 - Network Server for reporting and data acquisition running Windows Server 2008 R2 with a 1.4 TB capacity, 1 - Application server running Windows Server 2008 R2	2012	LM	NA
Approximately 90+ HP (3015, 4000, 4014, 4050, 4200, 4250, 4300), Dell 1720dn, and Lexmark M5155 printers.	2010 - 2015	LM	NA
Approximately 220+ Dell/HP PC workstations running Windows XP/Windows 7 on LAN connected via 100BT/1GigE network	2010 - 2015	LM	NA

Microsoft Office 2013 Professional as the base office application suite for all PC workstations. Some systems using Microsoft Office 2003/2007/2010	1996 - 2014	LM	NA
E-mail via Exchange 2010 with webmail via Outlook Web Access. Microsoft Outlook 2013 is standard email client, with some using Outlook 2010	2011 - 2014	LM	NA
Facsimile Machines - Brother 4750e, Brother 2920, and Brother 1860	2005 - 2008	LM	NA
Copier/Scanners - BizHub 283, BizHub 600, BizHub 601 (2), BizHub 654, BizHUb754e (2), BizHub 951, BizHub 1050.	2005 - 2015	LM	NA
Thruput, MARRS, Stealth, Harold, Blackbird, EDDGE, CASLIMS, & LabCoat reporting software systems.	1998 - 2014	LM	NA
Data processing terminals (79) - Enviroquant, Target, Saturn, MassHunter, Chromeleon	1996 - 2014	LM	NA

APPENDIX F – Containers, Preservation and Holding Times

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Bacterial Tests				
Coliform, Colilert (SM 9223)	W, DW	P, Bottle or Bag	Cool, 4˚C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Coliform, Fecal and Total (SM 9221, 9222D)	W, S, DW	P,G	Cool, 4˚C, 0.008% $Na_2S_2O_3$[d]	6-24 hours[e]
Enterococci (Enterolert)	W	P	Cool, 4˚C, 0.008% $Na_2S_2O_3$[d]	8 hours
Inorganic Tests				
Acidity (SM 2310B)	W	P,G	Cool, 4˚C	14 days[EPA]
Alkalinity (SM 2320B)	W, DW	P,G	Cool, 4˚C	14 days[EPA]
Ammonia (SM 4500 NH_3)	W, DW	P,G	Cool, 4˚C, H_2SO_4 to pH<2	28 days
Biochemical Oxygen Demand(SM 5210B)	W	P,G	Cool, 4˚C	48 hours
Bromate (EPA 300.1)	W, DW	P,G	50mg/L EDA, cool to 4˚C	28 days
Bromide (EPA 300.1)	W, DW	P,G	None Required	28 days
Chemical Oxygen Demand (SM 5220C)	W	P,G	Cool, 4˚C, H_2SO_4 to pH<2	28 days
Chloride (EPA 300.0)	W, DW	P,G	None Required	28 days
Chloride (EPA 9056)	W, S	P,G	Cool, 4˚C	28 days
Chlorine, Total Residual (SM 4500 Cl F)	W, S	P,G	None Required	24 hours
Chlorite (EPA 300.1)	W, DW	P,G	50mg/L EDA, cool to 4˚C	14 days
Chlorophyll-A (SM 11200H)	W	G Amber	Cool, 4˚C	Analyze immediately
Chromium VI (EPA 7196A)	W	P,G	Cool, 4˚C	24 hours
Color (SM 2120B)	W, DW	P,G	Cool, 4˚C	48 hours
Cyanide, Total and Amenable to Chlorination (EPA 335.4, 9010, 9012) (SM 4500 CN E,G)	W, S, DW	P,G	Cool, 4˚C, NaOH to pH>12, plus 0.6 g Ascorbic Acid	14 days
Cyanide, Weak Acid Dissociable (SM 4500 CN I)	W, S	P,G	Cool, 4˚C, NaOH to pH >12	14 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[C]	PRESERVATION	HOLDING TIME
Ferrous Iron (ALS SOP)	W, D	G Amber	Cool, 4˚C	24 hours
Fluoride (EPA 300.0, 9056, SM 4500 F-C)	W, S	P,G	Cool, 4˚C	28 days
Formaldehyde (ASTM D6303)	W	G Amber	Cool, 4˚C	48 hours
Hardness (SM 2340C)	W, DW	P,G	HNO_3 to pH<2	6 months
Hydrogen Ion (pH) (SM 4500H B)	W, DW	P,G	None Required	Analyze immediately
Kjeldahl and Organic Nitrogen (ASTM D3590-89)	W	P,G	Cool, 4˚C, H_2SO_4 to pH<2	28 days
Nitrate (EPA 300.0)	W, DW	P,G	Cool, 4˚C	48 hours
Nitrate (EPA 353.2)	W, S	P,G	Cool, 4˚C, H_2SO_4 to pH<2	48 hours
Nitrate (EPA 9056)	W, S	P,G	Cool, 4˚C	Analyze immediately
Nitrate-Nitrite (EPA 353.2)	W, DW	P,G	Cool, 4˚C, H_2SO_4 to pH<2	28 days
Nitrite (EPA 300.0)	W, DW	P,G	Cool, 4˚C	48 hours
Nitrite (EPA 353.2)	W, S	P,G	Cool, 4˚C, H_2SO_4 to pH<2	48 hours
Nitrite (EPA 9056)	W, S	P,G	Cool, 4˚C	Analyze immediately
Nitrocellulose	S	G	Cool, 4˚C	28 days
Oil and Grease, Hexane Extractable Material (EPA 1664)	W	G, Teflon Lined Cap	Cool, 4˚C, H_2SO_4 or HCL to pH<2	28 days
Organic Carbon, Total (9060 & SM 5310 C)	W	P,G	Cool, 4˚C, H_2SO_4 to pH<2	28 days
Organic Carbon, Total (ASTM-D4129)	S	P,G	Cool, 4˚C	28 days
Organic Halogens, Adsorbable (EPA 1650B)	W	G, Teflon Lined Cap	Cool, 4˚C, HNO_3 to pH<2	6 months
Organic Halogens, Total (EPA 9020)	W	G, Teflon Lined Cap	Cool, 4˚C, H_2SO_4 to pH<2, No headspace	28 days
Orthophosphate (SM 4500 P-E)	W, DW	P,G	Cool, 4˚C	Analyze immediately
Oxygen, Dissolved (Probe) (SM 4500O G)	W, DW	G, Bottle and Top	None Required	Analyze immediately
Oxygen, Dissolved (Winkler)	W, DW	G, Bottle and Top	Fix on Site and Store in Dark	8 hours
Perchlorate (EPA 314.0)	W, DW ,S	P,G	Protect from temp. extremes	28 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[C]	PRESERVATION	HOLDING TIME
Phenolics, Total (EPA 420.1, 9056)	W, S	G Amber	Cool, 4˚C, H_2SO_4 to pH<4	28 days
Phosphorus, Total (EPA 365.3)	W	P,G	Cool, 4˚C, H_2SO_4 to pH<2	28 days
Residue, Filterable (TDS) (SM 2540C)	W	P,G	Cool, 4˚C	7 days
Residue, Nonfilterable (TSS) (SM 2540D)	W	P,G	Cool, 4˚C	7 days
Residue, Settleable (SM 2540F)	W	P,G	Cool, 4˚C	48 hours
Residue, Total (SM 2540B)	W	P,G	Cool, 4˚C	7 days
Residue, Volatile (EPA 160.4)	W	P,G	Cool, 4˚C	7 days
Silica (SM 4500 SiO2 C)	W	P Only	Cool, 4˚C	28 days
Specific Conductance (SM 2510 B)	W, DW	P,G	Cool, 4˚C	28 days
Sulfate (EPA 300.0)	W, DW	P,G	Cool, 4˚C	28 days
Sulfate (EPA 9056)	W, S	P,G	Cool, 4˚C	28 days
Sulfide (9030/934)	W, S	P,G	Cool, 4˚C, Add Zinc Acetate, plus Sodium Hydroxide to pH>9	7 days
Sulfide (SM 4500 S_2 D)	W	P,G	Cool, 4˚C, Add Zinc Acetate, plus Sodium Hydroxide to pH>9	7 days
Sulfide (SM 4500 S_2 F)	W	P,G	Cool, 4˚C, Add Zinc Acetate, plus Sodium Hydroxide to pH>9	7 days
Sulfite (SM 4500 SO_3 B)	W	P,G	None Required	24 hours
Sullfides, Acid Voaltile	S	G	Cool, 4˚C	14 days
Surfactants (MBAS) (SM 5540 C)	W	P,G	Cool, 4˚C	48 hours
Tannin and Lignin (SM 5550B)	W	P,G	Cool, 4˚C	28 days
Turbidity (EPA 180.1)	W, DW	P,G	Cool, 4˚C	48 hours
Metals				
Arsenic Species 1632	W	G	HCL to pH<2, Cool < 4ºC	28 days
Chromium VI (EPA 7195/7191)	W	P,G	Cool, 4˚C	24 hours

DETERMINATION[a]	MATRIX[b]	CONTAINER[C]	PRESERVATION	HOLDING TIME
Mercury (1631E)	W	F	Cool, 4˚C, HCl or H_2SO_4 to pH<2	90 days
Mercury (1631E)	S	F	Freeze < -15ºC	1 Yr
Mercury (7471)	S	P,G	Cool, 4˚C	28 days
Mercury (EPA 245.1, 7470, 7471)	W, DW	P,G	HNO_3 to pH<2	28 days
Metals (200.7, 200.8, 200.9, 6010, 6020)	W, DW	P,G	HNO_3 to pH<2	6 months
Metals (200.7, 200.8, 200.9, 6010, 6020)	S	G, Teflon Lined cap	Cool, 4˚C	6 months
Methyl Mercury 1630	W, S, T	F	HCL to pH<2	6 months
Volatile Organics				
Gasoline Range Organics (8015, NWTPH-Gx)	W	G, Teflon-Lined, Septum Cap	Cool, 4˚C, HCl to pH<2, No headspace	14 days
Gasoline Range Organics (8015, NWTPH-Gx)	S	G, Teflon- Lined Cap	Cool, 4ºC, Minimize Headspace	14 days
Purgeable Halocarbons (624, 8260)	W	G, Teflon-Lined, Septum Cap	No Residual Chlorine Present; HCl to pH<2, Cool, 4˚C, No Headspace	14 days
Purgeable Halocarbons (624, 8260)	W	G, Teflon-Lined, Septum Cap	Residual Chlorine Present; 10% $Na_2S_2O_3$, HCl to pH<2, Cool, 4˚C	14 days
Purgeable Halocarbons (8260)	S	G, Teflon- Lined Cap	Cool, 4˚C, Minimize Headspace	14 days
Purgeable Halocarbons (8260)	S	Method 5035	Terracore/Encore device, Freeze at -20˚C Methanol, Cool, 4C	48 hrs to prepare from device, 14 days after preparing.
Purgeable Halocarbons (8260)	S	Method 5035	Sodium Bisulfate Cool, 4˚C	48 hrs to prepare, 14 days after preparation
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	W	G, Teflon-Lined,Septum Cap, No Headspace	No Residual Chlorine Present: HCl to pH<2, Cool, 4˚C, No Headspace	14 days

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	W	G, Teflon-Lined,Septum Cap, No Headspace	Residual Chlorine Present: 10% $Na_2S_2O_3$,, HCl to pH<2, Cool 4˚C	14 days
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	S	G, Teflon- Lined Cap	Cool, 4˚C, Minimize Headspace	14 days
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	S	Method 5035	Encore, Freeze at -20˚C Methanol, Cool, 4C	48 hr to prepare from Encore, 14 days after preparation.
Purgeable Aromatic Hydrocarbons (including BTEX and MTBE 624, 8260)	S	Method 5035	Sodium Bisulfate, Cool, 4˚C	48 hr to prepare from Encore, 14 days after preparation
Acrolein, Acrylonitrile, Acetonitrile (624, 8260)	W	G, Teflon - Lined Septum Cap	Adjust pH to 4-5, Cool, 4˚C, No headspace	14 days
2-chloroethyl vinyl ether (8260)	W	G, Teflon - Lined Septum Cap	Cool, 4˚C, Minimize Headspace	7 days
Semivolatile Organics				
Nonyl Phenols	W	G, Teflon-Lined Cap	H_2SO_4 to pH<2, Cool, 4˚C	28 days
Organotins (CAS SOP)	W, S	G, Teflon-Lined Cap	Cool, 4˚C	7[f] days until extraction;40 days after extraction
Otto Fuel		G, Teflon-Lined Cap	Cool, 4˚C	7[f] days until extraction;40 days after extraction
Methanol in Process Liquid NCASI 94.03	L	G, Teflon-Lined Cap	Cool, 4˚C	30 days
HAPS – Condensates NCASI 99.01		G, Teflon-Lined Cap	Cool, 4˚C	14/30 days
HAPS – Impinger/Canisters NCASI 99.02			Cool, 4˚C	21 days
Perfluorinated Compounds HPLC/MS/MS	W	P	Cool, 4˚C	14 days until extraction; 40 days after extraction

DETERMINATION[a]	MATRIX[b]	CONTAINER[C]	PRESERVATION	HOLDING TIME
PBDE/PBB – ROHS GC/MS	W, S, T	G	Cool, 4˚C	40 days after extraction
Pharma Personal Care Products 1694	W, S	Amber G, Teflon-Lined Cap	Cool, < 6˚C	7[f] days until extraction; 30 days after extraction
Nitroaromatics and Nitramines 8330B	W, S	G, Teflon-Lined Cap	Cool, 4˚C	S 14, W 7 days until extraction; 40 days after extraction
Nitroaromatics/Nitroamines HPLC/MS/MS	W, S, T	G	Cool, 4˚C Tissues < -10 C	S 14, W 7 days until extraction; 40 days after extraction
Organic acids HPLC/MS/MS	W	G, Teflon-Lined, Septum Cap	H_2SO_4 to pH<2, Cool, 4˚C	14 days
Petroleum Hydrocarbons, Extractable (Diesel-Range Organics) (EPA 8015)	W, S	G, Teflon-Lined Cap	Cool, 4˚C	7[f] days until extraction, 40 days after extraction
Alcohols and Glycols (EPA 8015)	W, S	G, Teflon-Lined Cap	Cool, 4˚C[g]	7[f] days until extraction; 40 days after extraction
Acid Extractable Semivolatile Organics (EPA 625, 8270)	W	G, Teflon-Lined Cap	Cool, 4˚C[g]	7[f] days until extraction; 40 days after extraction
Base/Neutral Extractable Semivolatile Organics (EPA 625, 8270)	W	G, Teflon-Lined Cap	Cool, 4˚C[g]	7[f] days until extraction; 40 days after extraction
Acid Extractable Semivolatile Organics (EPA 8270)	S	G, Teflon-Lined Cap	Cool, 4˚C[g]	14[f] days until extraction; 40 days after extraction
Base/Neutral Extractable Semivolatile Organics (EPA 8270)	S	G, Teflon-Lined Cap	Cool, 4˚C[g]	14[f] days until extraction; 40 days after extraction
Chlorinated Herbicides (EPA 8151)	W, S	G, Teflon-Lined Cap	Cool, 4˚C[g]	7[f] days until extraction; 40 days after extraction
Chlorinated Phenolics (EPA 1653)	W	G, Teflon-Lined Cap	H_2SO_4 to pH<2, Cool, 4˚C[g]	30 days until extraction; 30 days after extraction

DETERMINATION[a]	MATRIX[b]	CONTAINER[C]	PRESERVATION	HOLDING TIME
Polynuclear Aromatic Hydrocarbons (EPA 625, 8270)	W, S	G, Teflon-Lined Cap	Cool, 4˚C, Store in Dark[g]	7[f] days until extraction; 40 days after extraction
Organochlorine Pesticides and PCBs (EPA 608, 8081, 8082, GC/MS/MS)	W, S	G, Teflon-Lined Cap	Cool, 4˚C	7[f] days until extraction; 40 days after extraction
Organophosphorus Pesticides (EPA 8141, GC/MS/MS)	W, S	G, Teflon-Lined Cap	Cool, 4˚C, Store in Dark[g]	7[f] days until extraction; 40 days after extraction
Nitrogen- and Phosphorus-Containing Pesticides (EPA 8141)	W,S	G, Teflon-Lined Cap	Cool, 4˚C[g]	7[f] days until extraction; 40 days after extraction
Drinking Water Organics				
Purgeable Organics (EPA 524.2)	DW	G, Teflon-Lined, Septum cap	Ascorbic Acid, HCl to pH≤2, Cool, 4˚C, No Headspace	14 days
EDB, DBCP, and TCP (EPA 504.1)	W	G, Teflon Lined Cap	Cool, 4˚C, 3 mg $Na_2S_2O_3$, No Headspace	14 days
Chlorinated Herbicides (EPA 515.4)	DW	G, Amber, Teflon-Lined Cap	If Res.Cl, 2mg/40 mL NaS; Cool , <6ºC	14 days until extraction; 21 days after extraction
Chlorinated Pesticides (EPA 508.1, 525.2)	DW	G, Amber, Teflon-Lined Cap	50 mg/L NaS, HCl to pH≤ 2;Cool 4ºC	14 days until extraction; 30 days after extraction
Diquat and Paraquat (EPA 549.2)	DW	G, Amber, Teflon-Lined Cap	100 mg/L $Na_2S_2O_3$, Res.Cl.Cool 4ºC	7 days until extraction; 21 days after extraction
Endothall (EPA 548.1)	DW	G, Amber, Teflon-Lined Cap	Cool, 4˚C	7 days until extraction; 14 days after extraction
Haloacetic Acids (EPA 552.2)	DW	G, Amber, Teflon-Lined Cap	100 mg/L NH_4Cl, Cool, 4˚C	14 days until extraction; 7 days after extraction
Semivolatile Organics (EPA 525.2)	DW	G, Amber, Teflon-Lined Cap	50 mg/L NaS, HCl to pH≤ 2;Cool, 4˚C	14 days until extraction; 30 days after extraction

DETERMINATION[a]	MATRIX[b]	CONTAINER[c]	PRESERVATION	HOLDING TIME
Nitrosoamines (EPA 521)	DW	G, Amber, Teflon-Lined Cap	Dechlorinate at collection[g]	14 days until extraction; 28 days after extraction
Selected Pesticides and Flame Retardants (EPA 527)	DW	G, Amber, Teflon-Lined Cap	See Method, Cool, 4˚C	14 days until extraction; 28 days after extraction
Toxicity Characteristic Leaching Procedure (TCLP)				
Semivolatile Organics (EPA 1311/8270)	HW	G, Teflon - Lined Cap	Sample: Cool, 4˚C, Store in dark[g]	14 days until TCLP extraction
			TCLP extract: Cool, 4˚C, Store in dark[g]	7 days until extraction; 40 days after extraction
Organochlorine Pesticides (EPA 1311/8081)	HW	G, Teflon Lined Cap	Sample: Cool, 4˚C	14 days until TCLP extraction
			TCLP extract: Cool, 4˚C	7 days until extraction;40 days after extraction
Chlorinated Herbicides (EPA 1311/8151)	HW	G, Teflon Lined Cap	Sample: Cool, 4˚C	14 days until TCLP extraction
			TCLP extract: Cool, 4˚C	7 days until extraction;40 days after extraction
Mercury(EPA 1311/7470)	HW	P,G	Sample: Cool, 4°C	28 days until extraction
			TCLP extract: HNO_3 to pH<2	28 days after extraction
Metals, except Mercury (EPA 1311/6010)	HW	P,G	Sample: Cool, 4°C	180 days until extraction;
			TCLP extract: HNO_3 to pH<2	14 days until TCLP extraction
Volatile Organics (EPA 1311/8260)	HW	G, Teflon Lined Cap	Sample: Cool, 4˚C , Minimize Headspace	14 days until TCLP extraction
			Extract: Cool 4°C, HCL to pH,2, No Headspace	14 days after extraction

a For EPA SW-846 methods the method listed generically, without specific revision suffixes
b DW = Drinking Water, W = Water; S = Soil or Sediment; HW = Hazardous Waste
c P = Polyethylene; G = Glass, F- Fluoropolymer
d For chlorinated water samples
e The maximum holding time dependent upon the geographical proximity of sample source to the lab.
f Fourteen days until extraction for soil, sediment, and sludge samples.
g If the water sample contains residual chlorine, 10% sodium thiosulfate is used to dechlorinate.

APPENDIX G – Standard Operating Procedures

Corporate General and Quality Assurance SOPs

SOP TITLE	SOP ID	Revision
Laboratory Ethics and Data Integrity	CE-GEN001	2.00
(proprietary– client specific)	CE-GEN002	1.00
Records Management Policy	CE-GEN003	1.00
Preventive Action	CE-GEN004	1.00
Document Control	CE-GEN005	1.00
Data Recall	CE-GEN006	0.00
Procurement and Control of Laboratory Services and Supplies	CE-GEN007	0.00
Method Development	CE-GEN008	0.00
Establishing Standard Operating Procedures	CE-GEN009	0.00
Handling Customer Feedback	CE-GEN010	0.00
Assigning and TSR to a Project	CE-GEN011	0.00
Policy for the Use of Accreditation Organization Names, Symbols, and Logos	CE-GEN012	0.00
(proprietary – client specific)	CE-GEN013	0.00
(proprietary– client specific)	CE-GEN014	0.00
Internal Audits	CE-QA001	1.00
Manual Integration Policy	CE-QA002	1.00
Training Policy	CE-QA003	1.00
Qualification of Subcontract Laboratories	CE-QA004	2.00
Laboratory Management Review	CE-QA005	1.00
Proficiency Testing Sample Analysis	CE-QA006	1.00
Making Entries onto Analytical Records	CE-QA007	1.00
Nonconformance and Corrective Action	CE-QA008	1.00
Control Limits	CE-QA009	1.00
Estimation of Uncertainty of Analytical Measurements	CE-QA010	0.00
Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation	CE-QA011	0.00
Quality of Reagents and Standards	CE-QA012	0.00

LABORATORY SOPs

SOP TITLE	SOP ID	Revision
DATA ARCHIVING	ADM-ARCH	6
DOCUMENTING LABORATORY BALANCE AND TEMPERATURE CHECKS	ADM-BAL	6
SAMPLE BATCHES	ADM-BATCH	10
CONTROL CHARTING QUALITY CONTROL DATA	ADM-CHRT	3
DEPARTMENT OF DEFENSE PROJECTS LABORATORY PRACTICES AND PROJECT MANAGEMENT	ADM-DOD	6
DEPARTMENT OF DEFENSE PROJECTS LABORATORY PRACTICES AND PROJECT MANAGEMENT – QSM 5.0	ADM-DOD5	0
LABORATORY DATA REVIEW PROCESS	ADM-DREV	8
CONTINGENCY PLAN FOR LABORATORY EQUIPMENT FAILURE	ADM-ECP	3
METHOD VALIDATION DOCUMENTATION	ADM-MDLC	4
MANUAL INTEGRATION OF CHROMATOGRAPHIC PEAKS	ADM-MI	0
PROJECT MANAGEMENT	ADM-PCM	12
DATA REPORTING AND REPORT GENERATION	ADM-RG	9
REAGENT AND STANDARDS LOGIN AND TRACKING	ADM-RLT	5
SUPPORT EQUIPMENT MONITORING AND CALIBRATION	ADM-SEMC	13
SOFTWARE QUALITY ASSURANCE AND DATA SECURITY	ADM-SWQADATA	0
ALS KELSO TRAINING PROCEDURE	ADM-TRAIN	2
CHECKING VOLUMETRIC LABWARE	ADM-VOLWARE	4
SOP FOR WISCONSIN PROJECTS LABORATORY PRACTICES AND PROJECT MANAGEMENT, WI ADMINISTRATIVE CODE, CHAPTER NR 149	ADM-WISC	1
COLIFORM, FECAL	BIO-9221FC	9
COLIFORM, TOTAL	BIO-9221TC	6
COLIFORM, TOTAL (MEMBRANE FILTER PROCEDURE)	BIO-9222B	0
COLIFORM, FECAL (MEMBRANE FILTER PROCEDURE)	BIO-9222D	4
COLILERT® , COLILERT-18®, & COLISURE®	BIO-9223	9
ENTEROLERT	BIO-ENT	2
HEPTEROTROPHIC PLATE COUNT	BIO-HPC	7
MICROBIOLOGY QUALITY ASSURANCE AND QUALITY CONTROL	BIO-QAQC	16
SHEEN SCREEN/OIL DEGRADING MICROORGANISMS	BIO-SHEEN	3

SEPARATORY FUNNEL LIQUID-LIQUID EXTRACTION	EXT-3510	11
CONTINUOUS LIQUID - LIQUID EXTRACTION	EXT-3520	16
SOLID PHASE EXTRACTION	EXT-3535	6
SOXHLET EXTRACTION	EXT-3540	11
AUTOMATED SOXHLET EXTRACTION	EXT-3541	10
ULTRASONIC EXTRACTION	EXT-3550	10
WASTE DILUTION EXTRACTION	EXT-3580	6
SILICA GEL CLEANUP	EXT-3630	5
GEL PERMEATION CHROMATOGRAPHY	EXT-3640A	8
REMOVAL OF SULFUR USING COPPER	EXT-3660	7
REMOVAL OF SULFUR USING MERCURY	EXT-3660M	3
SULFURIC ACID CLEANUP	EXT-3665	6
CARBON CLEANUP	EXT-CARCU	4
DIAZOMETHANE PREPARATION	EXT-DIAZ	6
FLORISIL CLEANUP	EXT-FLOR	6
ORGANIC EXTRACTIONS GLASSWARE CLEANING	EXT-GC	7
PERCENT LIPIDS IN TISSUE	EXT-LIPID	5
EXTRACTION METHOD FOR ORGANOTINS IN SEDIMENTS, WATER, AND TISSUE	EXT-OSWT	8
PREPARATION OF REAGENTS AND BLANK MATRICES USED IN SEMIVOLATILE ORGANICS ANALYSIS	EXT-REAG	3
ADDITION OF SPIKES AND SURROGATES	EXT-SAS	10
MEASURING SAMPLE WEIGHTS AND VOLUMES FOR ORGANIC ANALYSIS	EXT-WVOL	3
FACILITY AND LABORATORY CLEANING	FAC-CLEAN	2
OPERATION AND MAINTENANCE OF LABORATORY REAGENT WATER SYSTEMS	FAC-WATER	2
FLASHPOINT DETERMINATION - SETAFLASH	GEN-1020	7
COLOR	GEN-110.2	7
TOTAL SOLIDS	GEN-160.3	14
SOLIDS, TOTAL VOLATILE AND PERCENT ASH IN SOIL AND SOLID SAMPLES	GEN-160.4	7
SETTEABLE SOLIDS	GEN-160.5	5
HALIDES, ADSORBABLE ORGANIC (AOX)	GEN-1650	4

GRAVIMETRIC DETERMINATION OF HEXANE EXTRACTABLE MATERIAL (1664)	GEN-1664	9
ALKALINITY TOTAL	GEN-2320	9
HARDNESS, TOTAL	GEN-2340	8
DETERMINATION OF INORGANIC ANIONS IN DRINKING WATER BY ION CHROMATOGRAPHY	GEN-300.1	8
ACIDITY	GEN-305.2	4
PERCHLORATE BY ION CHROMATOGRAPHY	GEN-314.0	14
CHLORIDE (TITRIMETRIC, MERCURIC NITRATE)	GEN-325.3	5
CHLORINE, TOTAL/FREE RESIDUAL	GEN-330.4	3
TOTAL RESIDUAL CHLORINE - METHOD 330.5	GEN-330.5	2
AMMONIA BY FLOW INJECTION ANALYSIS	GEN-350.1	10
NITRATE/NITRITE, NITRITE BY FLOW INJECTION ANALYSIS	GEN-353.2	9
PHOSPHORUS DETERMINATION USING COLORMETRIC PROCEDURE	GEN-365.3	12
PHENOLICS, TOTAL	GEN-420.1	15
AMMONIA AS NITROGEN BY ION SPECIFIC ELECTRODE	GEN-4500 NH3 E	7
DISSOLVED SILICA	GEN-4500 SIO2C	3
SILICA DETERMINATION USING SMARTCHEM METHOD	GEN-4500 SiO2E	2
NITRITE BY COLORIMETRIC PROCEDURE	GEN-4500NO2 B	3
ORTHOPHOSPHATE DETERMINATION USING COLORIMETRIC PROCEDURE	GEN-4500-P-E	2
SULFIDE, METHYLENE BLUE	GEN-4500S2D	3
SULFIDE, TITRIMETRIC (IODINE)	GEN-4500S2F	3
HALOGENS TOTAL AS CHLORIDE BY BOMB COMBUSTION	GEN-5050	3
BIOCHEMICAL OXYGEN DEMAND	GEN-5210B	6
HALIDES, ADSORBABLE ORGANIC (AOX) - SM 5320B	GEN-5320B	3
AQUATIC HUMIC SUBSTANCES	GEN-5510B	1
DETERMINATION OF METHYLENE BLUE ACTIVE SUBSTANCES (MBAS)	GEN-5540C	7
TANNIN AND LIGNIN	GEN-5550	6
HALIDES, TOTAL ORGANIC (TOX)	GEN-9020	9
HALIDES, EXTRACTABLE ORGANIC (EOX)	GEN-9020M	4
TOTAL SULFIDES BY METHYLENE BLUE DETERMINATION	GEN-9030	10

TOTAL HALIDES BY OXIDATIVE COMBUSTION AND MICROCOULOMETRY	GEN-9076	2
TOTAL CARBON IN SOIL	GEN-ASTM	9
AUTOFLUFF	GEN-AUTOFLU	2
SULFIDES, ACIDS VOLATILE	GEN-AVS	7
HEAT OF COMBUSTION	GEN-BTU	5
CHLOROPHYLL-a BY COLORIMETRY	GEN-CHLOR	3
TOTAL CYANIDES AND CYANIDES AMENABLE TO CHLORINATION	GEN-CN	19
CYANIDE, WEAK ACID DISSOCIABLE	GEN-CNWAD	2
CHEMICAL OXYGEN DEMAND	GEN-COD	9
CONDUCTIVITY IN WATER AND WASTES	GEN-COND	10
CORROSIVITY TOWARDS STEEL	GEN-CORR	2
HEXAVALENT CHROMIUM - COLORIMETRIC	GEN-CR6	12
STANDARD TEST METHODS FOR DETERMINING SEDIMENT CONCENTRATION IN WATER SAMPLES	GEN-D3977	0
CARBONATE (CO3) BY EVOLUTION AND COLUMETRIC TITRATION	GEN-D513-82M	1
SULFIDE, SOLUBLE DETERMINATION OF SOLUBLE SULFIDE IN SEDIMENT	GEN-DIS.S2	3
BULK DENSITY OF SOLID WASTE FRACTIONS	GEN-E1109	1
FDA EXTRACTABLES	GEN-FDAEX	2
FERROUS IRON IN WATER	GEN-FeII	4
FLUORIDE BY ION SELECTIVE ELECTRODE	GEN-FISE	9
FORMALDEHYDE COLORIMETRIC DETERMINATION	GEN-FORM	3
HYDROGEN PEROXIDE BY PERMANGANATE TITRATION	GEN-H2O2	2
HYDROGEN HALIDES BY ION CHROMATOGTRAPHY (METHOD 26)	GEN-HA26	3
HYDAZINE IN WATER USING COLORIMETRIC PROCEDURE	GEN-HYD	2
TOTAL SULFUR FOR ION CHROMATOGRAPHY	GEN-ICS	2
ION CHROMATOGRAPHY	GEN-IONC	17
COLOR, NCASI	GEN-NCAS	3
NITROCELLULOSE IN SOIL	GEN-NCEL	1
OXYGEN CONSUMPTION RATE	GEN-O2RATE	1
CARBON, TOTAL ORGANIC DETERMINATION (WALKELY BLACK METHOD)	GEN-OSU	3

Ph IN SOIL AND SOLIDS	GEN-Phs	13
Ph IN WATER	GEN-Phw	13
PARTICLE SIZE DETERMINATION - ASTM PROCEDURE	GEN-PSASTM	2
PARTICLE SIZE DETERMINATION	GEN-PSP	8
SULFIDES, REACTIVE	GEN-RS	5
TOTAL SULFIDE BY PSEP	GEN-S2PS	2
SULFITE	GEN-SO3	3
SPECIFIC GRAVITY	GEN-SPGRAV	1
SUBSAMPLING AND COMPOSITING OF SAMPLES	GEN-SUBS	6
SOLIDS, TOTAL DISSOLVED (TDS)	GEN-TDS	11
THIOCYANATE	GEN-THIOCN	2
NITROGEN, TOTAL AND SOLUBLE KJELDAHL	GEN-TKN	14
TOTAL NITROGEN AND TOTAL PHOSPHORUS BY ALKALINE PERSULFATE DIGESTION NCASI METHOD TNTP-W10900	GEN-TNTP	1
TOTAL ORGANIC CARBON IN WATER	GEN-TOC	14
SOLIDS, TOTAL SUSPENDED (TSS)	GEN-TSS	11
TURBIDITY MEASUREMENT	GEN-TURB	6
GLASSWASHING FOR INORGANIC ANALYSES	GEN-WASH	4
PHARMACEUTICALS, PERSONAL CARE PRODUCTS AND ENDOCRINE DISRUPTING COMPOUNDS BY HPLC/TANDEM MASS SPECTROMETRY (HPLC/MS/MS)	LCP-1694	5
DETERMINATION OF SELECTED PERFLUORINATED ALKYL ACIDS IN DRINKING WATER BY SOLID PHASE EXTRACTION AND TANDEM (LC/MS/MS)	LCP-537	2
DETERMINATION OF HORMONES IN DRINKING WATER BY SOLID PHASE EXTRACTION AND LIQUID CHROMATOGRAPHY ELECTROSPRAY IONIZATION	LCP-539	2
PERCHLORATE IN WATER, SOILS, AND SOLID WASTE USING LIQUID CHROMATOGRAPHY TANDEM MASS SPECTROMETRY (LC/MS/MS)	LCP-6850	0
ALDEHYDES BY HPLC	LCP-8315	7
Quantitative Determination of Carbamate Pesticides in Solid Matrices by High Performance Liquid Chromatography/Tandam Mass Spectrometry (HPLC/MS/MS)	LCP-8321(S)	1
Determination of Carbamates in Water by EPA 8321 Using LC Tandem Mass Spectrometry	LCP-8321W	2
NITROAROMATICS AND NITRAMINES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY(HPLC)	LCP-8330B	4
Acrylamide by High Performance Liquid Chromatography/tandem mass spectrometry (HPLC/ms/ms)..	LCP-ACRYL	2
Dioctyl sulfosuccinate by High Performance Liquid Chromatography/tandem mass spectrometry (HPLC/ms/ms)..	LCP-DOS	5
QUANTITATION OF NITROAROMATICS AND NITRAMINES IN WATER, SOIL, AND TISSUE BY LIQUID CHROMATOGRAPHY AND TANDEM MASS SPECTROMETRY (LC-	LCP-LCMS4	2
NITROGUANIDINE BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY	LCP-NITG	7

QUANTITATION OF NITROPHENOLS IN SOILS BY LIQUID CHROMATOGRAPHYAND TANDEM MASS SPECTROMETRY (LC-MS/MS)	LCP-NITRO	3
ORGANIC ACIDS IN AQUEOUS MATRICES BY HPLC	LCP-OALC	5
QUANTITATIVE DETERMINATION OF OPTICAL BRIGHTENER 220 By High Performance Liquid Chromatography (HPLC)	LCP-OPBr	1
OXYANIONS IN WATER USING LIQUID CHROMATOGRAPHY TANDEM MASS SPECTROMETRY (LC/MS/MS)	LCP-OXY	0
PERFLUORINATED COMPOUNDS BY HPLC/MS/MS	LCP-PFC	4
DETERMINATION OF PHTHALATES IN FOOD BY LIQUID CHROMATOGRAPHY TANDEM MASS SPECTROMETRY (LC/MSMS)	LCP-PHT	1
PICRIC ACID AND PICRAMIC ACID BY HPLC	LCP-PICRIC	3
METHYL MERCURY IN SOIL AND SEDIMENT BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630S	3
METHYL MERCURY IN TISSUE BY ALCOHOLIC POTASSIUM HYDROXIDE DIGESTION, ETHYLATION, PURGE AND TRAP, AND COLD VAPOR ATOMIC FLUORESCENCE	MET-1630T	2
METHYL MERCURY IN WATER BY ATOMIC FLUORESCENCE SPECTROMETRY	MET-1630W	3
MERCURY IN WATER BY OXIDATION, PURGE&TRAP, AND COLD VAPOR ATOMIC FLUORES. SPECTROMETRY	MET-1631	13
DETERMINATION OF ARSENIC SPECIES BY HYDRIDE GENERATION CRYOGENIC TRAPPING GAS CHROMATOGRAPHY ATOMIC ABSORPTION SPECTROPHOTOMETRY	MET-1632	3
MERCURY IN WATER	MET-245.1	14
METALS DIGESTION	MET-3010A	12
METALS DIGESTION	MET-3020A	15
METALS DIGESTION	MET-3050B	14
CLOSED VESSEL OIL DIGESTION	MET-3051M	3
CLOSED VESSEL DIGESTION OF SILICEOUS AND ORGANICALLY BASED MATRICIES	MET-3052M	1
DETERMINATION OF METALS & TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MS (METHOD 6020)	MET-6020	16
ARSENIC BY BOROHYDRIDE REDUCTION ATOMIC ABSORPTION	MET-7062	4
METALS DIGESTION FOR HEXAVALENT CHROMIUM	MET-7195	9
MERCURY IN LIQUID WASTE	MET-7470A	16
MERCURY IN SOLID OR SEMISOLID WASTE	MET-7471	17
SELENIUM BY BOROHYDRIDE REDUCTION ATOMIC ABSORPTION	MET-7742	4
BIOACCESSIBILITY OF METALS IN SOIL AND SOLID WASTE	MET-BIOACC	1
METALS DIGESTION OF AQUEOUS SAMPLES	MET-DIG	15
SAMPLE FILTRATION FOR METALS ANALYSIS	MET-FILT	4
METALS LABORATORY GLASSWARE CLEANING	MET-GC	5
DETERMINATION OF TRACE METALS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY (GFAA)	MET-GFAA	21

DETERMINATION OF METALS AND TRACE ELEMENTS BY ICP/AES	MET-ICP	25
DETERMINATION OF METALS & TRACE ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MS (METHOD 200.8)	MET-ICPMS	16
TRACE METALS IN WATER BY PRECONCENTRATION USING REDUCTIVE PRECIPITATION FOLLOWED BY ICP-MS	MET-RPMS	7
METALS AND SEMIVOLATILES SPLP EXTRACTION (EPA METHOD 1312)	MET-SPLP	1
WASTE EXTRACTION TEST (WET) PROCEDURE (STLC) for NONVOLATILE and SEMIVOLATILE PARAMETERS	MET-STLC	2
METALS AND SEMIVOLATILES TCLP EXTRACTION (EPA METHOD 1311)	MET-TCLP	9
SAMPLE PREPARATION OF BIOLOGICAL TISSUES FOR METALS ANALYSIS BY GFAA, ICP-OES, AND ICP-MS	MET-TDIG	4
TISSUE SAMPLE PREPARATION	MET-TISP	9
ANALYSIS OF WATER AND SOLID SAMPLES FOR ALIPHATIC HYDROCARBONS	PET-ALIPHAT	2
GASOLINE RANGE ORGANICS BY GAS CHROMATOGRAPHY	PET-GRO	10
ANALYSIS OF WATER, SOLIDS AND SOLUBLE WASTE SAMPLES FOR SEMI-VOLATILE FUEL HYDROCARBONS	PET-SVF	14
ANALYSIS OF WATER AND SOLIDS SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS	PET-TPH	2
ANALYSIS OF SOLID AND AQUEOUS SAMPLES FOR STATE OF WISCONSIN DIESEL RANGE ORGANICS	PHC-WIDRO	5
BOTTLE ORDER PREPARATION AND SHIPPING	SMO-BORD	16
SAMPLE DISPOSAL	SMO-DISP	12
FOREIGN SOILS HANDLING TREATMENT	SMO-FSHT	11
SAMPLE RECEIVING	SMO-GEN	31
SAMPLE TRACKING AND INTERNAL CHAIN OF CUSTODY	SMO-SCOC	15
ORGANOCHLORINE PESTICIDES AND PCBs (METHOD 608)	SOC-608	8
1,2-DIBROMOETHANE (EDB) AND 1,2-DIBROMO-3-CHLORO-PROPANE (DBCP) IN AQUEOUS SAMPLES BY MICROEXTRACTION AND GAS CHROMATOGRAPHY	SOC-8011	0
1,2-DIBROMOETHANE (EDB) AND 1,2-DIBROMO-3-CHLORO-PROPANE (DBCP) IN SOLIDS BY MICROEXTRACTION AND GAS CHROMATOGRAPHY	SOC-8011S	0
GLYCOLS	SOC-8015	11
ORGANOCHLORINE PESTICIDES BY GAS CHROMATOGRAPHY: CAPILLARY COLUMN TECHNIQUE	SOC-8081	18
PCBS AS AROCLORS	SOC-8082Ar	16
CONGENER-SPECIFIC DETERMINATION OF PCBS BY GC/ECD	SOC-8082Co	13
DETERMINATION OF NITROGEN OR PHOSPHORUS CONTAINING PESTICIDES	SOC-8141	13
CHLORINATED HERBICIDES	SOC-8151	16
CHLORINATED PHENOLS METHOD 8151 MODIFIED	SOC-8151M	11
METHANOL IN PROCESS LIQUIDS AND STATIONARY SOURCE EMISSIONS	SOC-9403	8

HAZARDOUS AIR POLLUTANTS (HAPS) IN PULP AND PAPER INDUSTRY CONDENSATES	SOC-9901	5
HAPS AND OTHER COMPOUNDS IN IMPINGER/CANISTER SAMPLES FROM WOOD PRODUCTS FACILITIES	SOC-9902	4
ALCOHOLS	SOC-ALC	2
BUTYLTINS	SOC-BUTYL	13
CALIBRATION OF INSTRUMENTS FOR ORGANICS CHROMATOGRAPHIC ANALYSES	SOC-CAL	9
CONFIRMATION PROCEDURE FOR GC AND HPLC ANALYSES	SOC-CONF	6
DETERMINATION OF OTTO FUEL II IN WATER	SOC-OTTO	2
PREPARATION OF POLYETHYLENE (PE) PASSIVE SAMPLERS WITH PERFORMANCE REFERENCE COMPOUNDS (PRC) LOADING	SOC-PE/PRC	0
SEMI-VOLATILE ORGANICS SCREENING	SOC-SCR	5
1,2-DIBROMOETHANE, 1,2-DIBROMO-3-CHLOROPROPANE, AND 1,2,3-TCP BY GC	SVD-504	10
ORGANOCHLORINE PESTICIDES AND PCBS IN DRINKING WATER	SVD-508_1	8
CHLORINATED HEBICIDES IN DRINKING WATER	SVD-515.4	10
N-NITROSAMINES BY GC/MS/MS	SVD-521	6
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS (METHOD 525.2)	SVD-525	9
ENDOTHALL IN DRINKING WATER BY GC/MS	SVD-548	10
DIQUAT AND PARAQUAT BY HPLC	SVD-549	8
HALOACETIC ACIDS IN DRINKING WATER	SVD-552	8
CHLORINATED PHENOLICS BY IN-SITU ACETYLATION AND GC/MS	SVM-1653A	10
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS	SVM-625	8
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS - METHOD 8270D	SVM-8270D	4
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS - LOW LEVEL PROCEDURE	SVM-8270L	9
POLYNUCLEAR AROMATIC HYDROCARBONS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY SIM	SVM-8270P	9
Quantifying and Reporting Alkylated Homologs of Polycyclic Aromatic Hydrocarbons for Gulf Oil Spill Analyses	SVM-8270PQAH	0
SEMIVOLATILE ORGANIC COMPOUNDS BY GC/MS SELECTED ION MONITORING	SVM-8270S	7
QUANTITATIVE GEOCHEMICAL BIOMARKERS BY GC/MS SELECTIVE ION MONITORING	SVM-BIO	1
OCTAMETHYLCYCLOTETRASILOXANE (D4) IN AQUEOUS SAMPLES BY GC/MS	SVM-D4AQ	0
OCTAMETHYLCYCLOTETRASILOXANE (D4) IN SEDIMENTS AND BIOSOLIDS BY GC/MS	SVM-D4SO	0
OCTAMETHYLCYCLOTETRASILOXANE (D4) IN BIOLOGICAL MATRICES BY GC/MS	SVM-D4TI	0
NONYLPHENOLS ISOMERS AND NONYLPHENOL ETHOXYLATES	SVM-NONYL	5

ORGANOPHOSPHOROUS PESTICIDES BY GC/MS/MS	SVM-OPPMS2	2
CHLORINATED PESTICIDES BY GC/MS/MS	SVM-PESTMS2	4
POLYBROMINATED DIPHENYL ETHERS (PBDEs) AND POLYBROMINATED BIPHENYLS (PBBs) BY GC/MS	SVM-ROHS	2
DIMP	SVM-SIM	0
1,2,3-TRICHLOROPROPANE BY ISOTOPE DILUTION-GC/MS SIM	SVM-TCP	0
PURGE AND TRAP FOR AQUEOUS SAMPLES	VOC-5030	9
PURGE AND TRAP/EXTRACTION FOR VOC IN SOIL AND WASTE SAMPLES , CLOSED SYSTEM	VOC-5035	10
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-524.2	16
VOLATILE ORGANIC COMPOUNDS IN WATER BY GC/MS SIM	VOC-524.2SIM	0
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-624	13
VOLATILE ORGANIC COMPOUNDS BY GC/MS	VOC-8260	18
VOLATILE ORGANIC COMPOUNDS BY GC/MS SELECTIVE ION MONITORING	VOC-8260S	3
VOA STORAGE BLANKS	VOC-BLAN	10
SAMPLE SCREENING FOR VOLATILE ORGANIC COMPOUNDS IN SOIL, WATER AND MISC. MATRICES	VOC-BVOC	8
ZERO HEADSPACE EXTRACTION (EPA METHOD 1311)	VOC-ZHE	8

APPENDIX H – Data Qualifiers

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable. See case narrative.
J	The result is an estimated value.
E	The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
M	The duplicate injection precision was not met.
N	The Matrix Spike sample recovery is not within control limits. See case narrative.
S	The reported value was determined by the Method of Standard Additions (MSA).
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
W	The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
A	A tentatively identified compound, a suspected aldol-condensation product.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
C	The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
D	The reported result is from a dilution.
E	The result is an estimated value.
J	The result is an estimated value.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

F	The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
H	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
O	The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
Z	The chromatographic fingerprint does not resemble a petroleum product.

APPENDIX I – Controlled and Normative Documents

Internal QA Documents	Location
Quality Assurance Manual	Q:\QA Manual\QAM.rXX.DOC
ALS-Kelso Certifications/Accreditations	Cert_kel.xls (QA Dept.)
MDL/LOD/LOQ Tracking Spreadsheet	MDL_LIST.(*date*).xls
Technical Training Summary Database	TrainDat.mdb
Approved Signatories List	QAM App A
Personnel resumes/qualifications	HR Department
Personnel Job Descriptions	HR Department
ALS – Kelso Data Quality Objectives	Kelso DQO 20XX.rX.xls
Master Logbook of Laboratory Logbooks	QA Masterlog-001
Standard Operating Procedures and Spreadsheet	1_ Kelso SOP.xls
Proficiency Testing Schedule and Tracking Spreadsheet	PT_Schedule.xls
External Normative Documents	**Location**
USEPA Manual for the Certification of Laboratories Analyzing Drinking Water, 5th Edition, EPA 815-B-97-001 (January 2005	QA Department
USEPA 40 CFR Part 136, Guidelines for Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and EPA Method Update Rule 2007 and 2012.	QA Department and online access
USEPA 40 CFR Part 141, National Primary Drinking Water Regulations and EPA Method Update Rule 2007.	QA Department and online access
National Environmental Laboratory Accreditation Program (NELAP), 2003 Quality Standards.	QA Department
TNI: TNI Standard – Environmental Laboratory Sector, Volume 1, Management and Technical Requirements for Laboratories Performing Environmental Analysis, EL-V1-2009.	QA Department
Quality Standards. American National Standard General requirements for the competence of testing and calibration laboratories, ANSI/ISO/IEC 17025:2005(E)	QA Department
DoD Quality Systems Manual for Environmental Laboratories, Versions 4.2 and 5.0	QA Department and online access
Analytical Methods (see References section)	Laboratory Departments and Online access

APPENDIX J – Laboratory Accreditations

The list of accreditations, certifications, licenses, and permits existing at the time of this QA Manual revision is given below, followed by the entire primary NELAP and DOD ELAP accreditations (un-numbered attachments). Current accreditation information is available at any time by contacting the laboratory or viewing the ALS Global website www.alsglobal.com.

Program	Number
National Programs	
DoD ELAP	L14-51-R2
ISO 17025	L14-50
State Programs	
Alaska DEC UST	UST-040
Arizona DHS	AZ0339
Arkansas - DEQ	88-0637
California DHS	2795
Florida DOH	E87412
Hawaii DOH	-
Louisiana DEQ	3016
Maine DHS	WA01276
Michigan DEQ	9949
Minnesota DOH	053-999-457
Montana DPHHS	CERT0047
Nevada DEP	WA012762015-3
New Jersey DEP	WA005
North Carolina DWQ	605
Oklahoma DEQ	9801
Oregon - DOH (primary NELAP)	WA100010
South Carolina DHEC	61002
Texas CEQ	T104704427-14-7
Utah	WA012762015-4
Washington DOE	C544
Wisconsin DNR	998386840
Wyoming (EPA Region8)	-
Miscellaneous	
Foreign Soil Permit	USDA
Plant Import Permit	USDA
Controlled Substances Permit	US DEA
Controlled Substances Permit	WA DOH

Oregon

Environmental Laboratory Accreditation Program

Department of Agriculture, Laboratory Division
Department of Environmental Quality, Laboratory Division
Oregon Health Authority, Public Health Division

NELAP Recognized

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

As of 02/11/2015 ***this list supercedes all previous lists for this certificate number.***
Customers. Please verify the current accreditation standing with ORELAP.

MATRIX : Biological Tissue

Reference	Code	Description
ALS Kelso LCP-PFC 4	**60001505**	**ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS**

Analyte Code	*Analyte*
6911	Perfluorobutane Sulfonate (PFBS)
9562	Perfluorodecane Sulfonate (PFDS)
6905	Perfluorodecanoic acid (PFDA)
6903	Perfluorododecanoic (PFDDA)
6908	Perfluoroheptanoic acid (PFHA)
6910	Perfluorohexane Sulfonate (PFHS)
6913	Perfluorohexanoic acid (PFHXA)
6906	Perfluorononanoic acid (PFNA)
6912	Perfluorooctanoic acid
6909	Perfluorooctanoic Sulfonate (PFOS)
6914	Perfluoropentanoic acid (PFPEA)
6904	Perfluoroundecanoic acid (PFUDA)

CAS SOC-Butyl	**60035009**	**Butyltin by GC/Flame Photometric Detector**

Analyte Code	*Analyte*
1201	Butyltin trichloride
1202	Dibutyltin dichloride
1209	Tetrabutyltin
1203	Tributyltin chloride

EPA 1631E	**10237204**	**Mercury in Water by Oxidation, Purge & Trap, and Cold Vapor Atomic Fluorescence**

Analyte Code	*Analyte*
1095	Mercury

EPA 1632A	**10123407**	**Arsenic in Water by Gaseous Hydride Atomic Absorption**

Analyte Code	*Analyte*
1010	Arsenic
1012	Arsenite (As+3)
6138	Dimethylarsinic acid (DMA)
1207	Monomethylarsonic acid (MMA)

EPA 3540C	**10140202**	**Soxhlet Extraction**

Analyte Code	*Analyte*
8031	Extraction/Preparation

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

ALS Environmental, Kelso

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EPA 3541 **10140406** **Automated Soxhlet Extraction**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3630C **10146802** **Silica gel cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3640A **10147203** **Gel Preparation Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 365.3 **10070607** **Phosphorous - Colorimetric, two reagent.**

Analyte Code	*Analyte*
1908	Total Phosphate

EPA 3660B **10148400** **Sulfur cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3665A **10148808** **Sulfuric Acid / permanganate Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 5035A **10284807** **Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 6010C **10155803** **ICP - AES**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1175	Tin
1185	Vanadium
1190	Zinc

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

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EPA 6020A **10156408** **Inductively Coupled Plasma-Mass Spectrometry**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1165	Thallium
1185	Vanadium
1190	Zinc

EPA 7196A **10162400** **Chromium Hexavalent colorimetric**

Analyte Code	*Analyte*
1045	Chromium VI

EPA 7471B **10166402** **Mercury by Cold Vapor Atomic Absorption**

Analyte Code	*Analyte*
1095	Mercury

EPA 7742 **10169207** **Selenium by Borohydride Reduction and Atomic Absorption**

Analyte Code	*Analyte*
1140	Selenium

EPA 8081B **10178800** **Organochlorine Pesticides by GC/ECD**

Analyte Code	*Analyte*
8580	2,4'-DDD
8585	2,4'-DDE
8590	2,4'-DDT
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7005	Alachlor
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7300	Chlorpyrifos
7925	cis-Nonachlor
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin

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Analyte Code	*Analyte*
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
7725	Isodrin
7810	Methoxychlor
7870	Mirex
3890	Oxychlordane
8250	Toxaphene (Chlorinated camphene)

EPA 8082A **10179201** **Polychlorinated Biphenyls (PCBs) by GC/ECD**

Analyte Code	*Analyte*
9095	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)
9090	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)
9103	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)
9065	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)
9020	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)
9112	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)
9116	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)
9114	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)
9120	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)
9133	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)
9134	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)
9075	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)
9025	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)
9139	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)
9080	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)
9030	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)
9151	2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)
8975	2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)
9155	2,2',3,4',5-Pentachlorobiphenyl (BZ-90)
9154	2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)
9035	2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)
9166	2,2',3,5',6-Pentachlorobiphenyl (BZ-95)
8945	2,2',3,5'-Tetrachlorobiphenyl (BZ-44)
9040	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)
9174	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)
9175	2,2',4,4',5-Pentachlorobiphenyl (BZ-99)
8980	2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)
8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)
8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)
8930	2,2',5-Trichlorobiphenyl (BZ-18)
9085	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)
9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)
9045	2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)
9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)
8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)
8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)
9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)
9055	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)
9218	2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)
9005	2,3,4,4',5-Pentachlorobiphenyl (BZ-114)
8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)
9000	2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)
9220	2,3',4,4',6-Pentachlorobiphenyl (BZ-119)
9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)

ALS Environmental, Kelso

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Kelso WA 98626

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Analyte Code	*Analyte*
8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)
9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)
9239	2,3',4'-Trichlorobiphenyl (BZ-33)
8920	2,3-Dichlorobiphenyl (BZ-5)
9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)
9252	2,4,4'-Trichlorobiphenyl (BZ-28)
8940	2,4',5-Trichlorobiphenyl (BZ-31)
8915	2-Chlorobiphenyl (BZ-1)
9060	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)
9015	3,3',4,4',5-Pentachlorobiphenyl (BZ-126)
8965	3,3',4,4'-Tetrachlorobiphenyl (BZ-77)
8970	3,4,4',5-Tetrachlorobiphenyl (BZ-81)
9266	3,4,4'-Trichlorobiphenyl (BZ-37)
8880	Aroclor-1016 (PCB-1016)
8885	Aroclor-1221 (PCB-1221)
8890	Aroclor-1232 (PCB-1232)
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
8912	Aroclor-1262 (PCB-1262)
8913	Aroclor-1268 (PCB-1268)
9105	Decachlorobiphenyl (BZ-209)

EPA 8270D **10186002** **Semivolatile Organic compounds by GC/MS**

Analyte Code	*Analyte*
5660	4-Bromophenyl phenyl ether (BDE-3)
5562	Azobenzene
5570	Benzaldehyde
5640	Biphenyl
6545	n-Nitrosodi-n-propylamine

EPA 8270D SIM **10242509** **Semivolatile Organic compounds by GC/MS Selective Ion Monitoring**

Analyte Code	*Analyte*
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
6221	1,2-Diphenylhydrazine
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
6380	1-Methylnaphthalene
9501	1-Methylphenanthrene
6852	2,3,5-Trimethylnaphthalene
6835	2,4,5-Trichlorophenol
6840	2,4,6-Trichlorophenol
6000	2,4-Dichlorophenol
6130	2,4-Dimethylphenol
6175	2,4-Dinitrophenol
6185	2,4-Dinitrotoluene (2,4-DNT)
6188	2,6-Dimethylnaphthalene
6190	2,6-Dinitrotoluene (2,6-DNT)
5795	2-Chloronaphthalene
5800	2-Chlorophenol
6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)
6385	2-Methylnaphthalene
6400	2-Methylphenol (o-Cresol)
6460	2-Nitroaniline
6490	2-Nitrophenol
6412	3 & 4 Methylphenol
5660	4-Bromophenyl phenyl ether (BDE-3)

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Analyte Code	*Analyte*
5700	4-Chloro-3-methylphenol
5825	4-Chlorophenyl phenylether
6410	4-Methylphenol (p-Cresol)
6470	4-Nitroaniline
6500	4-Nitrophenol
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5630	Benzyl alcohol
5640	Biphenyl
5760	bis(2-Chloroethoxy)methane
5765	bis(2-Chloroethyl) ether
5780	bis(2-Chloroisopropyl) ether
5670	Butyl benzyl phthalate
5680	Carbazole
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
6265	Fluoranthene
6270	Fluorene
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
4840	Hexachloroethane
6315	Indeno(1,2,3-cd) pyrene
6320	Isophorone
5005	Naphthalene
5015	Nitrobenzene
6525	n-Nitrosodiethylamine
6545	n-Nitrosodi-n-propylamine
6535	n-Nitrosodiphenylamine
6605	Pentachlorophenol
6608	Perylene
6615	Phenanthrene
6625	Phenol
6665	Pyrene

EPA 8330B **10308006** **Nitroaromatics, Nitramines and Nitrate Esters by High Performance Liquid Chromatography (HPLC)**

Analyte Code	*Analyte*
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
6160	1,3-Dinitrobenzene (1,3-DNB)
9651	2,4,6-Trinitrotoluene (2,4,6-TNT)
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
9303	2-Amino-4,6-dinitrotoluene (2-am-dnt)
9507	2-Nitrotoluene
6150	3,5-Dinitroaniline
9510	3-Nitrotoluene
9306	4-Amino-2,6-dinitrotoluene (4-am-dnt)

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
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Analyte Code	*Analyte*
9513	4-Nitrotoluene
6415	Methyl-2,4,6-trinitrophenylnitramine (tetryl)
5015	Nitrobenzene
6485	Nitroglycerin
9522	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
9558	Pentaerythritoltetranitrate
9432	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)

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MATRIX : Drinking Water

Reference	Code	Description
EPA 180.1	**10011402**	**Turbidity - Nephelometric**

Analyte Code	*Analyte*
2055	Turbidity

EPA 200.7 4.4	**10013806**	**ICP - metals**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1055	Copper
1760	Hardness (calc.)
1070	Iron
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1990	Silica as SiO2
1150	Silver
1155	Sodium
1185	Vanadium
1190	Zinc

EPA 200.8 5.4	**10014605**	**Metals by ICP-MS**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1055	Copper
1075	Lead
1090	Manganese
1105	Nickel
1140	Selenium
1150	Silver
1165	Thallium

EPA 245.1 3	**10036609**	**Mercury by Cold Vapor Atomic Absorption**

Analyte Code	*Analyte*
1095	Mercury

EPA 300.0 2.1	**10053200**	**Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	*Analyte*
1575	Chloride
1730	Fluoride

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Analyte Code	*Analyte*
1810	Nitrate as N
1820	Nitrate-nitrite
1840	Nitrite as N
2000	Sulfate

EPA 300.1 **10053608** **Ion chromatography - anions.**

Analyte Code	*Analyte*
1535	Bromate
1540	Bromide
1570	Chlorate
1595	Chlorite

EPA 314.0 **10055400** **Perchlorate in Drinking Water by Ion Chromatography**

Analyte Code	*Analyte*
1895	Perchlorate

EPA 335.4 **10061208** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	*Analyte*
1645	Total cyanide

EPA 353.2 2 **10067604** **Nitrate/Nitrite Nitrogen - Automated, Cadmium**

Analyte Code	*Analyte*
1810	Nitrate as N
1840	Nitrite as N
1825	Total nitrate+nitrite

EPA 504.1 **10082607** **EDB/DBCP/TCP micro-extraction, GC/ECD**

Analyte Code	*Analyte*
5180	1,2,3-Trichloropropane
4570	1,2-Dibromo-3-chloropropane (DBCP)
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)

EPA 508.1 2 **10086405** **Chlorinated Pesticides, Herbicides, and Organohalides, liquid/solid extraction by GC/ECD**

Analyte Code	*Analyte*
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide

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Analyte Code	*Analyte*
7810	Methoxychlor
8870	PCBs
8250	Toxaphene (Chlorinated camphene)

EPA 515.4 1 **10088503** **Chlorinated acids Liquid/Solid and GC/ECD**

Analyte Code	*Analyte*
8655	2,4,5-T
8545	2,4-D
8560	2,4-DB
8600	3,5-Dichlorobenzoic acid
6500	4-Nitrophenol
8505	Acifluorfen
8530	Bentazon
8540	Chloramben
8555	Dalapon
8570	DCPA di acid degradate
8595	Dicamba
8605	Dichloroprop (Dichlorprop)
8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)
6605	Pentachlorophenol
8645	Picloram
8650	Silvex (2,4,5-TP)

EPA 524.2 4.1 **10088809** **Volatile Organic Compounds GC/MS Capillary Column**

Analyte Code	*Analyte*
5105	1,1,1,2-Tetrachloroethane
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
4670	1,1-Dichloropropene
5150	1,2,3-Trichlorobenzene
5180	1,2,3-Trichloropropane
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4570	1,2-Dibromo-3-chloropropane (DBCP)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
5215	1,3,5-Trimethylbenzene
4615	1,3-Dichlorobenzene
4660	1,3-Dichloropropane
4620	1,4-Dichlorobenzene
4665	2,2-Dichloropropane
4535	2-Chlorotoluene
4540	4-Chlorotoluene
4910	4-Isopropyltoluene (p-Cymene)
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane
4395	Bromodichloromethane
4397	Bromoethane (Ethyl Bromide)
4400	Bromoform
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform

ORELAP Fields of Accreditation

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Analyte Code	*Analyte*
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4595	Dibromomethane (Methylene bromide)
4625	Dichlorodifluoromethane (Freon-12)
4765	Ethylbenzene
4835	Hexachlorobutadiene
4900	Isopropylbenzene
5240	m+p-xylene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4435	n-Butylbenzene
5090	n-Propylbenzene
5250	o-Xylene
4440	sec-Butylbenzene
5100	Styrene
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)
5140	Toluene
5205	Total trihalomethanes
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5235	Vinyl chloride
5260	Xylene (total)

EPA 525.2 2 **10090003** **Semi-Volatile by SPE extraction and GC/MS**

Analyte Code	*Analyte*
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
4310	Acetochlor
7005	Alachlor
7065	Atrazine
5580	Benzo(a)pyrene
6062	bis(2-Ethylhexyl)adipate
7160	Butachlor
5670	Butyl benzyl phthalate
8550	Dacthal (DCPA)
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
7555	EPTC (Eptam, s-ethyl-dipropyl thio carbamate)
6275	Hexachlorobenzene
6285	Hexachlorocyclopentadiene
6320	Isophorone
7835	Metolachlor
7845	Metribuzin
7875	Molinate
8045	Propachlor (Ramrod)
8125	Simazine
8180	Terbacil

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EPA 548.1 1 **10092805** **Endothall by Ion Exchange, Methylation and GC/MS**

Analyte Code	*Analyte*
7525	Endothall

EPA 549.2 **10093206** **Diquat/Paraquat, Liquid/Solid Extraction and HPLC/UV**

Analyte Code	*Analyte*
9390	Diquat
9528	Paraquat

EPA 552.2 1 **10095804** **Haloacetic Acid/Dalapon, Liquid/Liquid Extraction, Derivitization and GC/ECD**

Analyte Code	*Analyte*
9312	Bromoacetic acid
9315	Bromochloroacetic acid
9336	Chloroacetic acid
9357	Dibromoacetic acid
9360	Dichloroacetic acid
9414	Total haloacetic acids
9642	Trichloroacetic acid

SM 2120 B 20th ED **20224004** **Color by Visual Comparison**

Analyte Code	*Analyte*
1605	Color

SM 2320 B 20th ED **20045209** **Alkalinity by Titration**

Analyte Code	*Analyte*
1505	Alkalinity as CaCO3

SM 2340 B 20th ED **20046202** **Hardness by calculation**

Analyte Code	*Analyte*
1750	Hardness

SM 2510 B 20th ED **20048208** **Conductivity by Probe**

Analyte Code	*Analyte*
1610	Conductivity

SM 2540 C 20th ED **20050004** **Total Dissolved Solids**

Analyte Code	*Analyte*
1955	Residue-filterable (TDS)

SM 4500-Cl F 20th ED **20080506** **Residual Chlorine by DPD Ferrous Titration**

Analyte Code	*Analyte*
1945	Residual free chlorine

SM 4500-F¯ C 20th ED **20102005** **Fluoride by Ion Selective Electrode**

Analyte Code	*Analyte*
1730	Fluoride

SM 4500-H+ B 20th ED **20104807** **pH by Probe**

Analyte Code	*Analyte*

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Analyte Code	*Analyte*
1900	pH

SM 4500-P E 20th ED **20123802** **Phosphorus by Ascorbic Acid Reduction**

Analyte Code	*Analyte*
1870	Orthophosphate as P

SM 5310 C 20th ED **20138403** **Total Organic Carbon by Persulfate-Ultraviolet Oxidation Method**

Analyte Code	*Analyte*
2040	Total organic carbon

SM 9215 B (PCA) 20th ED **20181208** **Heterotrophic Plate Count Pour Plate (plate count agar): Heterotrophic Bacteria**

Analyte Code	*Analyte*
2555	Heterotrophic plate count

SM 9223 B (Colilert-18® Multiple-tube) 20th ED **20229407** **Chromogenic/Fluorogenic Quantitative: Total Coliform and E. coli**

Analyte Code	*Analyte*
2530	Fecal coliforms

SM 9223 B (Colilert®) 20th ED **20212208** **Chromogenic/Fluorogenic Qualitative (Colilert®): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

SM 9223 B (Colilert®-18) 20th ED **20214204** **Chromogenic/Fluorogenic Qualitative (Colilert®-18): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

SM 9223 B (Colilert®-18) 21st ED **20214408** **Chromogenic/Fluorogenic Qualitative (Colilert®-18): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

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MATRIX : Non-Potable Water

Reference	Code	Description
ALS Kelso LCP-Acryl 1	**60001712**	**ALS Kelso - Acrylamide by HPLC/MS/MS**

Analyte Code	*Analyte*
4330	Acrylamide

ALS Kelso LCP-PFC 4	**60001505**	**ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS**

Analyte Code	*Analyte*
6911	Perfluorobutane Sulfonate (PFBS)
9562	Perfluorodecane Sulfonate (PFDS)
6905	Perfluorodecanoic acid (PFDA)
6903	Perfluorododecanoic (PFDDA)
6908	Perfluoroheptanoic acid (PFHA)
6910	Perfluorohexane Sulfonate (PFHS)
6913	Perfluorohexanoic acid (PFHXA)
6906	Perfluorononanoic acid (PFNA)
6912	Perfluorooctanoic acid
6909	Perfluorooctanoic Sulfonate (PFOS)
6914	Perfluoropentanoic acid (PFPEA)
6904	Perfluoroundecanoic acid (PFUDA)

ASTM D1426-08B	**30007397**	**Ammonia by Titration**

Analyte Code	*Analyte*
1515	Ammonia as N

ASTM D1426-98B	**30023406**	**Ammonia by Titration**

Analyte Code	*Analyte*
1515	Ammonia as N

ASTM D3590-02(06)A	**30016819**	**Total Kjeldahl Nitrogen in Water**

Analyte Code	*Analyte*
1795	Kjeldahl nitrogen - total

ASTM D3590-89B	**30016809**	**Total Kjeldahl Nitrogen in Water**

Analyte Code	*Analyte*
1795	Kjeldahl nitrogen - total

ASTM D4129 05	**30018907**	**Total and Organic Carbon in Water by High Temperature Oxidation and by Coulometric Detection**

Analyte Code	*Analyte*
2040	Total organic carbon

CAS PestMS2 (1699 modified) 2	**60035101**	**Chlorinated Pesticides by GC/MS/MS**

Analyte Code	*Analyte*
8580	2,4'-DDD
8585	2,4'-DDE
8590	2,4'-DDT
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)

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Analyte Code	*Analyte*
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7300	Chlorpyrifos
7925	cis-Nonachlor
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
6275	Hexachlorobenzene
7725	Isodrin
7810	Methoxychlor
7870	Mirex
5553	Octachlorostyrene
3890	Oxychlordane
7910	trans-Nanochlor

CAS SOC-Butyl **60035009** **Butyltin by GC/Flame Photometric Detector**

Analyte Code	*Analyte*
1201	Butyltin trichloride
1202	Dibutyltin dichloride
1209	Tetrabutyltin
1203	Tributyltin chloride

Enterolert® **60030208** **Chromogenic/Fluorogenic Quantitative (Enterolert®): Enterococci**

Analyte Code	*Analyte*
2520	Enterococci

EPA 1020A **10117007** **Ignitability Setaflash Closed-cup Method**

Analyte Code	*Analyte*
1780	Ignitability

EPA 160.4 **10256801** **Total Volatile Solids, ignition @ 550 C.**

Analyte Code	*Analyte*
4075	Vol. residue, density, water & solids content of coatings

EPA 1630 **10122608** **Methyl Mercury by Purge & Trap Cold Vapor Atomic Fluorescence Spectrometry**

Analyte Code	*Analyte*
1205	Methyl Mercury

EPA 1631E **10237204** **Mercury in Water by Oxidation, Purge & Trap, and Cold Vapor Atomic Fluorescence**

Analyte Code	*Analyte*
1095	Mercury

EPA 1632A **10123407** **Arsenic in Water by Gaseous Hydride Atomic Absorption**

Analyte Code	*Analyte*

ORELAP Fields of Accreditation

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Analyte Code	*Analyte*
1010	Arsenic
1012	Arsenite (As+3)
6138	Dimethylarsinic acid (DMA)
1207	Monomethylarsonic acid (MMA)

EPA 1650C **10125005** **Adsorbable Organic Halides by Adsorption and Coulometric Titration**

Analyte Code	*Analyte*
4345	Adsorbable organic halogens (AOX)

EPA 1653A **10125403** **Chlorinated Phenolics by "In Situ" Acetylation and GC/MS**

Analyte Code	*Analyte*
6735	2,3,4,6-Tetrachlorophenol
6835	2,4,5-Trichlorophenol
6840	2,4,6-Trichlorophenol
6805	3,4,5-Trichlorocatechol
6815	3,4,5-Trichloroguaiacol
6810	3,4,6-Trichlorocatechol
6820	3,4,6-Trichloroguaiacol
6825	4,5,6-Trichloroguaiacol
6605	Pentachlorophenol
6720	Tetrachlorocatechol
6725	Tetrachloroguaiacol
6875	Trichlorosyringol

EPA 1664A (HEM) **10127807** **N-Hexane Extractable Material (Oil and Grease) by Extraction and Gravimetry**

Analyte Code	*Analyte*
1803	n-Hexane Extractable Material (O&G)
1860	Oil & Grease

EPA 1694 1.0 **10132908** **Pharmaceuticals and Personal Care Products by HPLC/MS/MS**

Analyte Code	*Analyte*
6769	17a-estradiol
6771	17a-ethynylestradiol
6773	17ß-estradiol
4307	Acetominophen
7052	Androstenedione
7065	Atrazine
9301	Bisphenol A
5675	Caffeine
7194	Carbamazepine
7375	DEET
7086	Diazepam
7087	Diclofenac
6075	Diethylstilbestrol
7253	Estriol
7254	Estrone
7257	Fluoxetine
7258	Gemfibrozil
7219	Hydrocodone
7259	Ibuprofen
7719	Iopromide
7313	Meprobamate
7316	Methadone
7269	Naproxen
7317	Oxybenzone
7318	Pentoxifylline

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Analyte Code	*Analyte*
7284	Progesterone
9585	Salicylic acid
7297	Sulfamethoxazole
7301	Testosterone
7304	Triclosan
7307	Trimethoprim

EPA 180.1 **10011402** **Turbidity - Nephelometric**

Analyte Code	*Analyte*
2055	Turbidity

EPA 200.7 4.4 **10013806** **ICP - metals**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1055	Copper
1760	Hardness (calc.)
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1990	Silica as SiO2
1150	Silver
1155	Sodium
1160	Strontium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 200.8 5.4 **10014605** **Metals by ICP-MS**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel

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Analyte Code	*Analyte*
1140	Selenium
1150	Silver
1165	Thallium
3035	Uranium
1185	Vanadium
1190	Zinc

EPA 200.9 2.2 **10015404** **Metals by Graphite Atomic Absorption**

Analyte Code	*Analyte*
1010	Arsenic
1040	Chromium
1075	Lead
1140	Selenium
1165	Thallium

EPA 245.1 3 **10036609** **Mercury by Cold Vapor Atomic Absorption**

Analyte Code	*Analyte*
1095	Mercury

EPA 300.0 2.1 **10053200** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	*Analyte*
1540	Bromide
1575	Chloride
1730	Fluoride
1810	Nitrate as N
1820	Nitrate-nitrite
1840	Nitrite as N
2000	Sulfate

EPA 3005A **10133207** **Acid Digestion of waters for Total Recoverable or Dissolved Metals**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3010A **10133605** **Acid Digestion of Aqueous samples and Extracts for Total Metals**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3020A **10134404** **Acid Digestion of Aqueous samples and Extracts for Total Metals for Analysis by GFAA**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 314.0 **10055400** **Perchlorate in Drinking Water by Ion Chromatography**

Analyte Code	*Analyte*
1895	Perchlorate

EPA 330.4 **10059004** **Residual Chlorine - DPD-FAS Titration**

Analyte Code	*Analyte*
1940	Total residual chlorine

EPA 335.4 **10061208** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	*Analyte*

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Analyte Code	*Analyte*
1645	Total cyanide

EPA 3510C **10138202** **Separatory Funnel Liquid-liquid extraction**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3520C **10139001** **Continuous Liquid-liquid extraction**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 353.2 2 **10067604** **Nitrate/Nitrite Nitrogen - Automated, Cadmium**

Analyte Code	*Analyte*
1810	Nitrate as N
1820	Nitrate-nitrite
1840	Nitrite as N
1825	Total nitrate+nitrite

EPA 3535A **10139409** **Solid-Phase Extraction (SPE)**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3610B **10144602** **Alumina Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3620C **10146006** **Florisil Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3630C **10146802** **Silica gel cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3640A **10147203** **Gel Preparation Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 365.3 **10070607** **Phosphorous - Colorimetric, two reagent.**

Analyte Code	*Analyte*
1870	Orthophosphate as P
1908	Total Phosphate

EPA 3660B **10148400** **Sulfur cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3665A **10148808** **Sulfuric Acid / permanganate Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

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EPA 420.1 **10079206** **Phenolics - Spectrophotometric, manual.**

Analyte Code	*Analyte*
1905	Total phenolics

EPA 5030B **10153409** **Purge and trap for aqueous samples**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 6010C **10155803** **ICP - AES**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel
1125	Potassium
1140	Selenium
1150	Silver
1155	Sodium
1160	Strontium
1165	Thallium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 6020A **10156408** **Inductively Coupled Plasma-Mass Spectrometry**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1160	Strontium

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Analyte Code	*Analyte*
1165	Thallium
3035	Uranium
1185	Vanadium
1190	Zinc

EPA 608 **10103603** **Organochlorine Pesticides & PCBs by GC/ECD**

Analyte Code	*Analyte*
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
8880	Aroclor-1016 (PCB-1016)
8885	Aroclor-1221 (PCB-1221)
8890	Aroclor-1232 (PCB-1232)
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7685	Heptachlor
7690	Heptachlor epoxide
7810	Methoxychlor
8250	Toxaphene (Chlorinated camphene)

EPA 624 **10107207** **Volatile Organic Compounds by purge and trap GC/MS**

Analyte Code	*Analyte*
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4500	2-Chloroethyl vinyl ether
4995	4-Methyl-2-pentanone (MIBK)
4325	Acrolein (Propenal)
4340	Acrylonitrile
4375	Benzene
4395	Bromodichloromethane
4400	Bromoform
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform

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Analyte Code	*Analyte*
4680	cis-1,3-Dichloropropene
4625	Dichlorodifluoromethane (Freon-12)
4765	Ethylbenzene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
4975	Methylene chloride (Dichloromethane)
5100	Styrene
5115	Tetrachloroethylene (Perchloroethylene)
5140	Toluene
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5235	Vinyl chloride
5260	Xylene (total)

EPA 625 **10300002** **Base/Neutrals and Acids by GC/MS**

Analyte Code	*Analyte*
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
6221	1,2-Diphenylhydrazine
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
6840	2,4,6-Trichlorophenol
6000	2,4-Dichlorophenol
6130	2,4-Dimethylphenol
6175	2,4-Dinitrophenol
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
5795	2-Chloronaphthalene
5800	2-Chlorophenol
6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)
6490	2-Nitrophenol
5945	3,3'-Dichlorobenzidine
5660	4-Bromophenyl phenyl ether
5700	4-Chloro-3-methylphenol
5825	4-Chlorophenyl phenylether
6500	4-Nitrophenol
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5595	Benzidine
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5590	Benzo(g,h,i)perylene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5760	bis(2-Chloroethoxy)methane
5765	bis(2-Chloroethyl) ether
5780	bis(2-Chloroisopropyl) ether
5670	Butyl benzyl phthalate
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
6265	Fluoranthene
6270	Fluorene

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Analyte Code	Analyte
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
6285	Hexachlorocyclopentadiene
4840	Hexachloroethane
6315	Indeno(1,2,3-cd) pyrene
6320	Isophorone
5005	Naphthalene
5015	Nitrobenzene
6530	n-Nitrosodimethylamine
6545	n-Nitrosodi-n-propylamine
6535	n-Nitrosodiphenylamine
6605	Pentachlorophenol
6615	Phenanthrene
6625	Phenol
6665	Pyrene

EPA 6850 **10304606** **Perchlorate in Water, Soils and Solid Wastes Using High Performance Liquid Chromatography/Electrospray Ionization/Mass Spectrometry**

Analyte Code	Analyte
1895	Perchlorate

EPA 7010 **10157809** **Metals by Graphite Furnace Atomic Absorption**

Analyte Code	Analyte
1010	Arsenic
1040	Chromium
1075	Lead
1140	Selenium
1165	Thallium

EPA 7062 **10159407** **Antimony and Arsenic by Borohydride Reduction and Atomic Absorption**

Analyte Code	Analyte
1010	Arsenic

EPA 7195 **10162002** **Chromium, Hexavalent (Coprecipitation) by Graphite Furnace Atomic Absorption**

Analyte Code	Analyte
1045	Chromium VI

EPA 7196A **10162400** **Chromium Hexavalent colorimetric**

Analyte Code	Analyte
1045	Chromium VI

EPA 7470A **10165807** **Mercury in Liquid Waste by Cold Vapor Atomic Absorption**

Analyte Code	Analyte
1095	Mercury

EPA 7742 **10169207** **Selenium by Borohydride Reduction and Atomic Absorption**

Analyte Code	Analyte
1140	Selenium

EPA 8015C **10173805** **Non-halogenated organics using GC/FID**

Analyte Code	Analyte
9369	Diesel range organics (DRO)
4785	Ethylene glycol

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Analyte Code	*Analyte*
9408	Gasoline range organics (GRO)

EPA 8081B **10178800** **Organochlorine Pesticides by GC/ECD**

Analyte Code	*Analyte*
8580	2,4'-DDD
8585	2,4'-DDE
8590	2,4'-DDT
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7005	Alachlor
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7300	Chlorpyrifos
7925	cis-Nonachlor
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
4840	Hexachloroethane
7725	Isodrin
7810	Methoxychlor
7870	Mirex
3890	Oxychlordane
8250	Toxaphene (Chlorinated camphene)
7910	trans-Nanochlor

EPA 8082A **10179201** **Polychlorinated Biphenyls (PCBs) by GC/ECD**

Analyte Code	*Analyte*
9095	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)
9090	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)
9103	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)
9065	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)
9020	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)
9112	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)
9116	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)
9114	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)
9120	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)
9133	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)
9134	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)
9075	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)
9025	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)
9139	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)
9080	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)
9030	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)
9151	2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)

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Analyte Code	*Analyte*
8975	2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)
9155	2,2',3,4',5-Pentachlorobiphenyl (BZ-90)
9154	2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)
9035	2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)
9166	2,2',3,5',6-Pentachlorobiphenyl (BZ-95)
8945	2,2',3,5'-Tetrachlorobiphenyl (BZ-44)
9040	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)
9174	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)
9175	2,2',4,4',5-Pentachlorobiphenyl (BZ-99)
8980	2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)
8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)
8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)
8930	2,2',5-Trichlorobiphenyl (BZ-18)
9085	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)
9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)
9045	2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)
9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)
8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)
8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)
9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)
9055	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)
9217	2,3,4,4',5,6-Hexachlorobiphenyl (BZ-166)
9218	2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)
9005	2,3,4,4',5-Pentachlorobiphenyl (BZ-114)
8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)
9000	2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)
9220	2,3',4,4',6-Pentachlorobiphenyl (BZ-119)
9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)
8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)
9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)
9239	2,3',4'-Trichlorobiphenyl (BZ-33)
8920	2,3-Dichlorobiphenyl (BZ-5)
9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)
9252	2,4,4'-Trichlorobiphenyl (BZ-28)
8940	2,4',5-Trichlorobiphenyl (BZ-31)
9256	2,4'-Dichlorobiphenyl (BZ-8)
8915	2-Chlorobiphenyl (BZ-1)
9060	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)
9015	3,3',4,4',5-Pentachlorobiphenyl (BZ-126)
8965	3,3',4,4'-Tetrachlorobiphenyl (BZ-77)
8970	3,4,4',5-Tetrachlorobiphenyl (BZ-81)
9266	3,4,4'-Trichlorobiphenyl (BZ-37)
8880	Aroclor-1016 (PCB-1016)
8885	Aroclor-1221 (PCB-1221)
8890	Aroclor-1232 (PCB-1232)
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
8912	Aroclor-1262 (PCB-1262)
8913	Aroclor-1268 (PCB-1268)
9105	Decachlorobiphenyl (BZ-209)

EPA 8141B **10182204** **Organophosphorous Pesticides by GC/NPD**

Analyte Code	*Analyte*
7075	Azinphos-methyl (Guthion)
7125	Bolstar (Sulprofos)
7300	Chlorpyrifos
7315	Coumaphos
7395	Demeton-o

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

ALS Environmental, Kelso

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Analyte Code	*Analyte*
7385	Demeton-s
7410	Diazinon
8610	Dichlorovos (DDVP, Dichlorvos)
7475	Dimethoate
8625	Disulfoton
7550	EPN
7570	Ethoprop
7600	Fensulfothion
7605	Fenthion
7770	Malathion
7785	Merphos
7825	Methyl parathion (Parathion, methyl)
7850	Mevinphos
7955	Parathion, ethyl
7985	Phorate
8110	Ronnel
8155	Sulfotepp
8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer
8245	Tokuthion (Prothiophos)
8275	Trichloronate

EPA 8151A **10183207** **Chlorinated Herbicides by GC/ECD**

Analyte Code	*Analyte*
8655	2,4,5-T
8545	2,4-D
8560	2,4-DB
8555	Dalapon
8595	Dicamba
8605	Dichloroprop (Dichlorprop)
8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)
7775	MCPA
7780	MCPP
8650	Silvex (2,4,5-TP)

EPA 8260C **10307003** **Volatile Organics: GC/MS (capillary column)**

Analyte Code	*Analyte*
5105	1,1,1,2-Tetrachloroethane
5185	1,1,1-Trichloro-2,2,2-trifluoroethane
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
5165	1,1,2-Trichloroethane
5167	1,1,2-Trichlorofluoroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
4670	1,1-Dichloropropene
5150	1,2,3-Trichlorobenzene
5180	1,2,3-Trichloropropane
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4570	1,2-Dibromo-3-chloropropane (DBCP)
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
6800	1,3,5-Trichlorobenzene
5215	1,3,5-Trimethylbenzene
4615	1,3-Dichlorobenzene
4660	1,3-Dichloropropane

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Analyte Code	*Analyte*
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
4510	1-Chlorohexane
4665	2,2-Dichloropropane
4410	2-Butanone (Methyl ethyl ketone, MEK)
4500	2-Chloroethyl vinyl ether
4535	2-Chlorotoluene
4860	2-Hexanone
5020	2-Nitropropane
4536	4-Bromofluorobenzene
4540	4-Chlorotoluene
4910	4-Isopropyltoluene (p-Cymene)
4995	4-Methyl-2-pentanone (MIBK)
4305	Acetamide
4315	Acetone
4320	Acetonitrile
4325	Acrolein (Propenal)
4330	Acrylamide
4340	Acrylonitrile
4355	Allyl chloride (3-Chloropropene)
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4525	Chloroprene (2-Chloro-1,3-butadiene)
4705	cis & trans-1,2-Dichloroethene
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4595	Dibromomethane (Methylene bromide)
4625	Dichlorodifluoromethane (Freon-12)
4725	Diethyl ether
4755	Ethyl acetate
4810	Ethyl methacrylate
4765	Ethylbenzene
4835	Hexachlorobutadiene
4870	Iodomethane (Methyl iodide)
4875	Isobutyl alcohol (2-Methyl-1-propanol)
4900	Isopropylbenzene
5240	m+p-xylene
4925	Methacrylonitrile
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5245	m-Xylene
5005	Naphthalene
4435	n-Butylbenzene
5090	n-Propylbenzene
5250	o-Xylene
4440	sec-Butylbenzene
5100	Styrene
4370	T-amylmethylether (TAME)
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)

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Analyte Code	*Analyte*
5140	Toluene
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
4605	trans-1,4-Dichloro-2-butene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5225	Vinyl acetate
5235	Vinyl chloride
5260	Xylene (total)

EPA 8270D **10186002** **Semivolatile Organic compounds by GC/MS**

Analyte Code	*Analyte*
6715	1,2,4,5-Tetrachlorobenzene
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
6221	1,2-Diphenylhydrazine
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
6420	1,4-Naphthoquinone
6630	1,4-Phenylenediamine
5790	1-Chloronaphthalene
6380	1-Methylnaphthalene
6425	1-Naphthylamine
6735	2,3,4,6-Tetrachlorophenol
6835	2,4,5-Trichlorophenol
6795	2,4,6-Trichloroaniline
6840	2,4,6-Trichlorophenol
6000	2,4-Dichlorophenol
6130	2,4-Dimethylphenol
6175	2,4-Dinitrophenol
6185	2,4-Dinitrotoluene (2,4-DNT)
5992	2,5-Dichlorophenol
6005	2,6-Dichlorophenol
6190	2,6-Dinitrotoluene (2,6-DNT)
5735	2-Chloroaniline
5795	2-Chloronaphthalene
5800	2-Chlorophenol
6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)
5145	2-Methylaniline (o-Toluidine)
6385	2-Methylnaphthalene
6400	2-Methylphenol (o-Cresol)
6430	2-Naphthylamine
6460	2-Nitroaniline
6490	2-Nitrophenol
5050	2-Picoline (2-Methylpyridine)
6412	3 & 4 Methylphenol
5945	3,3'-Dichlorobenzidine
6120	3,3'-Dimethylbenzidine
6355	3-Methylcholanthrene
6405	3-Methylphenol (m-Cresol)
6465	3-Nitroaniline
5540	4-Aminobiphenyl
5660	4-Bromophenyl phenyl ether (BDE-3)
5700	4-Chloro-3-methylphenol
5745	4-Chloroaniline
5825	4-Chlorophenyl phenylether
6410	4-Methylphenol (p-Cresol)
6470	4-Nitroaniline
6500	4-Nitrophenol

ORELAP Fields of Accreditation

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Certificate: WA100010 - 010

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Analyte Code	*Analyte*
6125	a-a-Dimethylphenethylamine
5500	Acenaphthene
5505	Acenaphthylene
5510	Acetophenone
5545	Aniline
5555	Anthracene
5560	Aramite
7065	Atrazine
5562	Azobenzene
5570	Benzaldehyde
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5610	Benzoic acid
5630	Benzyl alcohol
5640	Biphenyl
5760	bis(2-Chloroethoxy)methane
5765	bis(2-Chloroethyl) ether
5780	bis(2-Chloroisopropyl) ether
5670	Butyl benzyl phthalate
7180	Caprolactam
5680	Carbazole
7260	Chlorobenzilate
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
7405	Diallate
7410	Diazinon
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
6070	Diethyl phthalate
7475	Dimethoate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
7580	Famphur
6265	Fluoranthene
6270	Fluorene
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
6285	Hexachlorocyclopentadiene
4840	Hexachloroethane
6290	Hexachlorophene
6315	Indeno(1,2,3-cd) pyrene
7725	Isodrin
6320	Isophorone
7740	Kepone
6345	Methapyrilene
7825	Methyl parathion (Parathion, methyl)
5005	Naphthalene
5015	Nitrobenzene
6525	n-Nitrosodiethylamine
6530	n-Nitrosodimethylamine
6545	n-Nitrosodi-n-propylamine
6535	n-Nitrosodiphenylamine
6555	n-Nitrosomorpholine
6560	n-Nitrosopiperidine
6565	n-Nitrosopyrrolidine

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Analyte Code	*Analyte*
7955	Parathion, ethyl
6590	Pentachlorobenzene
6600	Pentachloronitrobenzene
6605	Pentachlorophenol
6608	Perylene
6615	Phenanthrene
6625	Phenol
6650	Pronamide (Kerb)
6665	Pyrene
5095	Pyridine
6685	Safrole
8235	Thionazin (Zinophos)

EPA 8270D SIM **10242509** **Semivolatile Organic compounds by GC/MS Selective Ion Monitoring**

Analyte Code	*Analyte*
4735	1,4-Dioxane (1,4- Diethyleneoxide)
6380	1-Methylnaphthalene
9501	1-Methylphenanthrene
6852	2,3,5-Trimethylnaphthalene
6188	2,6-Dimethylnaphthalene
6385	2-Methylnaphthalene
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5640	Biphenyl
5670	Butyl benzyl phthalate
5680	Carbazole
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
5910	Dibenzothiophene
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
6265	Fluoranthene
6270	Fluorene
6315	Indeno(1,2,3-cd) pyrene
5005	Naphthalene
6605	Pentachlorophenol
6608	Perylene
6615	Phenanthrene
6665	Pyrene

EPA 8315A **10188008** **Determination of Carbonyl Compounds by HPLC/UV-VIS**

Analyte Code	*Analyte*
4815	Formaldehyde

EPA 8321B **10189205** **Solvent Extractable non-volatile compounds by HPLC/TS/MS**

Analyte Code	*Analyte*

ORELAP Fields of Accreditation

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Analyte Code	*Analyte*
7010	Aldicarb (Temik)
7040	Aminocarb
7080	Barban
7130	Bromacil
7195	Carbaryl (Sevin)
7205	Carbofuran (Furaden)
7275	Chloropropham
7505	Diuron
7610	Fenuron
7630	Fluometuron
7765	Linuron (Lorox)
7800	Methiocarb (Mesurol)
7805	Methomyl (Lannate)
7855	Mexacarbate
7885	Monuron
7915	Neburon
7940	Oxamyl
8075	Propham
8080	Propoxur (Baygon)
8120	Siduron

EPA 8330B **10308006** **Nitroaromatics, Nitramines and Nitrate Esters by High Performance Liquid Chromatography (HPLC)**

Analyte Code	*Analyte*
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
6160	1,3-Dinitrobenzene (1,3-DNB)
9651	2,4,6-Trinitrotoluene (2,4,6-TNT)
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
9303	2-Amino-4,6-dinitrotoluene (2-am-dnt)
9507	2-Nitrotoluene
6150	3,5-Dinitroaniline
9510	3-Nitrotoluene
9306	4-Amino-2,6-dinitrotoluene (4-am-dnt)
9513	4-Nitrotoluene
6415	Methyl-2,4,6-trinitrophenylnitramine (tetryl)
5015	Nitrobenzene
6485	Nitroglycerin
9522	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
9558	Pentaerythritoltetranitrate
9432	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)

EPA 9012B **10243206** **Total and Amenable Cyanide (automated colorimetric with off-line distillation)**

Analyte Code	*Analyte*
1510	Amenable cyanide
1645	Total cyanide

EPA 9020B **10194408** **Total Organic Halides**

Analyte Code	*Analyte*
2045	Total organic halides (TOX)

EPA 9040C **10244403** **pH Electrometric Measurement**

Analyte Code	*Analyte*
1900	pH

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EPA 9060A	**10244801**	**Total Organic Carbon**

Analyte Code	*Analyte*
2040	Total organic carbon

NCASI 94.03 0	**60031507**	**Methanol in Process Liquids and Wastewaters**

Analyte Code	*Analyte*
4930	Methanol

NCASI 99.01	**60002804**	**Selected HAPS in Condensates by GC/FID**

Analyte Code	*Analyte*
4930	Methanol

NWTPH-Dx	**90018409**	**Oregon DEQ TPH Diesel Range**

Analyte Code	*Analyte*
9369	Diesel range organics (DRO)
9506	Residual Range Organics (RRO)

NWTPH-Gx	**90018603**	**Oregon DEQ TPH Gasoline Range Organics by GC/FID-PID Purge & Trap**

Analyte Code	*Analyte*
9408	Gasoline range organics (GRO)

NWTPH-HCID	**90013200**	**Oregon DEQ Total Petroleum Hydrocarbon ID**

Analyte Code	*Analyte*
2050	Total Petroleum Hydrocarbons (TPH)

SM 2120 B 20th ED	**20224004**	**Color by Visual Comparison**

Analyte Code	*Analyte*
1605	Color

SM 2310 B 20th ED	**20044206**	**Acidity by Titration**

Analyte Code	*Analyte*
1500	Acidity, as CaCO3

SM 2320 B 20th ED	**20045209**	**Alkalinity by Titration**

Analyte Code	*Analyte*
1505	Alkalinity as CaCO3

SM 2340 B 20th ED	**20046202**	**Hardness by calculation**

Analyte Code	*Analyte*
1750	Hardness

SM 2340 C 20th ED	**20047205**	**Hardness by EDTA Titration**

Analyte Code	*Analyte*
1750	Hardness

SM 2510 B-97 online	**20048606**	**Conductivity by Probe**

Analyte Code	*Analyte*
1610	Conductivity

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SM 2540 B 20th ED	**20049007**	**Total Solids**

Analyte Code	*Analyte*
1950	Residue-total

SM 2540 C 20th ED	**20050004**	**Total Dissolved Solids**

Analyte Code	*Analyte*
1955	Residue-filterable (TDS)

SM 2540 D 20th ED	**20050800**	**Total Suspended Solids**

Analyte Code	*Analyte*
1960	Residue-nonfilterable (TSS)

SM 2540 D-2011	**20051212**	**Total Suspended Solids Dried at 103 - 105 C**

Analyte Code	*Analyte*
1960	Residue-nonfilterable (TSS)

SM 2540 D-97 online	**20051201**	**Total Suspended Solids Dried at 103 - 105C**

Analyte Code	*Analyte*
1960	Residue-nonfilterable (TSS)

SM 2540 F 20th ED	**20051803**	**Settleable Solids**

Analyte Code	*Analyte*
1965	Residue-settleable

SM 4500-Cl C 20th ED	**20078802**	**Chlorine by Iodometric Method II**

Analyte Code	*Analyte*
1575	Chloride

SM 4500-Cl F 20th ED	**20080506**	**Residual Chlorine by DPD Ferrous Titration**

Analyte Code	*Analyte*
1945	Residual free chlorine

SM 4500-CN E 20th ED	**20092404**	**Cyanide by Colorimetric Determination**

Analyte Code	*Analyte*
1635	Cyanide
1645	Total cyanide

SM 4500-CN G 20th ED	**20093203**	**Cyanide Amenable to Chlorination after Distillation**

Analyte Code	*Analyte*
1510	Amenable cyanide

SM 4500-CN^- E-97 online	**20096406**	**Cyanide by Colorimetric Method**

Analyte Code	*Analyte*
1635	Cyanide

SM 4500-F^- C 20th ED	**20102005**	**Fluoride by Ion Selective Electrode**

Analyte Code	*Analyte*
1730	Fluoride

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SM 4500-H+ B 20th ED	**20104807**	**pH by Probe**

Analyte Code	*Analyte*
1900	pH

SM 4500-NH3 E 20th ED	**20109802**	**Ammonia by Selective Ion Probe**

Analyte Code	*Analyte*
1515	Ammonia as N

SM 4500-NH3 G 20th ED	**20111006**	**Ammonia by Automated Phenate**

Analyte Code	*Analyte*
1515	Ammonia as N

SM 4500-O G 20th ED	**20121204**	**Dissolved Oxygen by Membrane Electrode Method**

Analyte Code	*Analyte*
1880	Oxygen, dissolved

SM 4500-S2 F-2011	**20126663**	**Sulfide by Iodometric Method**

Analyte Code	*Analyte*
2005	Sulfide

SM 4500-$S2^{-}$ D 20th ED	**20125400**	**Sulfide by Methylene Blue Method**

Analyte Code	*Analyte*
2005	Sulfide

SM 4500-$S2^{-}$ D-97 online	**20125808**	**Sulfide by Methylene Blue Method**

Analyte Code	*Analyte*
2005	Sulfide

SM 4500-$S2^{-}$ F 20th ED	**20126209**	**Sulfide by Iodometric Titration**

Analyte Code	*Analyte*
2005	Sulfide

SM 4500-$SO3^{-}$ B 20th ED	**20130205**	**Sulfite by Iodometric Method**

Analyte Code	*Analyte*
2015	Sulfite-SO3

SM 5210 B 20th ED	**20134809**	**Biochemical Oxygen Demand, 5-Day (BOD5)**

Analyte Code	*Analyte*
1530	Biochemical oxygen demand

SM 5220 C 20th ED	**20135608**	**Chemical Oxygen Demand by Closed Reflux and Titration**

Analyte Code	*Analyte*
1565	Chemical oxygen demand

SM 5310 C 20th ED	**20138403**	**Total Organic Carbon by Persulfate-Ultraviolet Oxidation Method**

Analyte Code	*Analyte*
2040	Total organic carbon

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SM 5540 C 20th ED	**20144609**	**Surfactants as MBAS**

Analyte Code	*Analyte*
2025	Surfactants - MBAS

SM 5550 B 20th ED	**20145306**	**Tannin and Lignin**

Analyte Code	*Analyte*
9597	Tannin & Lignin

SM 9215 B (PCA) 20th ED	**20181208**	**Heterotrophic Plate Count Pour Plate (plate count agar): Heterotrophic Bacteria**

Analyte Code	*Analyte*
2555	Heterotrophic plate count

SM 9221 B (LTB) + C MPN 20th ED	**20186805**	**Multiple Tube Fermentation Quantitative (LTB): Total Coliform**

Analyte Code	*Analyte*
2500	Total coliforms

SM 9221 E (EC) 20th ED	**20226806**	**Multiple Tube Fermentation Quantitative (EC): Fecal Coliform**

Analyte Code	*Analyte*
2530	Fecal coliforms

SM 9222 D (m-FC) 20th ED	**20209603**	**Membrane Filtration Quantitative (m-FC): Fecal Coliform**

Analyte Code	*Analyte*
2530	Fecal coliforms

SM 9223 B (Colilert®) 20th ED	**20212208**	**Chromogenic/Fluorogenic Qualitative (Colilert®): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

SM 9223 B (Colilert®-18 Quanti-Tray®) 20th ED	**20213201**	**Chromogenic/Fluorogenic Quantitative (Colilert®-18): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

SM 9223 B (Colilert®-18) 20th ED	**20214204**	**Chromogenic/Fluorogenic Qualitative (Colilert®-18): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

SM 9223 B (Colilert®-18) 21st ED	**20214408**	**Chromogenic/Fluorogenic Qualitative (Colilert®-18): Total Coliform and E. coli**

Analyte Code	*Analyte*
2525	Escherichia coli
2500	Total coliforms

WI(95) DRO	**90019457**	**Wisconsin DNR - Modified Method for Determination of Diesel Range Organics by GC-FID**

Analyte Code	*Analyte*
9369	Diesel range organics (DRO)

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

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WI(95) GRO **90019468** **Wisconsin DNR - Modified Method for Determining Gasoline Range Organics GC-FID**

Analyte Code	*Analyte*
9408	Gasoline range organics (GRO)

ORELAP Fields of Accreditation

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MATRIX : Solids

Reference	Code	Description
ALS Kelso LCP-Acryl 1	**60001712**	**ALS Kelso - Acrylamide by HPLC/MS/MS**

Analyte Code	*Analyte*
4330	Acrylamide

ALS Kelso LCP-PFC 4	**60001505**	**ALS Kelso - Perfluorinated Compounds by HPLC-MS-MS**

Analyte Code	*Analyte*
6911	Perfluorobutane Sulfonate (PFBS)
9562	Perfluorodecane Sulfonate (PFDS)
6905	Perfluorodecanoic acid (PFDA)
6903	Perfluorododecanoic (PFDDA)
6908	Perfluoroheptanoic acid (PFHA)
6910	Perfluorohexane Sulfonate (PFHS)
6913	Perfluorohexanoic acid (PFHXA)
6906	Perfluorononanoic acid (PFNA)
6912	Perfluorooctanoic acid
6909	Perfluorooctanoic Sulfonate (PFOS)
6914	Perfluoropentanoic acid (PFPEA)
6904	Perfluoroundecanoic acid (PFUDA)

ASTM D1426-08B	**30007397**	**Ammonia by Titration**

Analyte Code	*Analyte*
1515	Ammonia as N

ASTM D3590-02(06)A	**30016819**	**Total Kjeldahl Nitrogen in Water**

Analyte Code	*Analyte*
1795	Kjeldahl nitrogen - total

ASTM D4129 05	**30018907**	**Total and Organic Carbon in Water by High Temperature Oxidation and by Coulometric Detection**

Analyte Code	*Analyte*
2040	Total organic carbon

ASTM D422-63	**30030854**	**Partical Size Distribution (Grain sizing)**

Analyte Code	*Analyte*
6118	Distribution of particle sizes

CAS PestMS2 (1699 modified) 2	**60035101**	**Chlorinated Pesticides by GC/MS/MS**

Analyte Code	*Analyte*
8580	2,4'-DDD
8585	2,4'-DDE
8590	2,4'-DDT
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7300	Chlorpyrifos
7925	cis-Nonachlor
7105	delta-BHC

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Analyte Code	*Analyte*
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
6275	Hexachlorobenzene
7725	Isodrin
7810	Methoxychlor
7870	Mirex
5553	Octachlorostyrene
3890	Oxychlordane
7910	trans-Nanochlor

CAS SOC-Butyl **60035009** **Butyltin by GC/Flame Photometric Detector**

Analyte Code	*Analyte*
1201	Butyltin trichloride
1202	Dibutyltin dichloride
1209	Tetrabutyltin
1203	Tributyltin chloride

EPA 1020A **10117007** **Ignitability Setaflash Closed-cup Method**

Analyte Code	*Analyte*
1780	Ignitability

EPA 1110A **10235208** **Corrosivity Toward Steel**

Analyte Code	*Analyte*
1615	Corrosivity

EPA 1311 **10118806** **Toxicity Characteristic Leaching Procedure**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 1312 **10119003** **Synthetic Precipitation Leaching Procedure**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 160.3 **10009800** **Total Solids, dried @ 103-105 C.**

Analyte Code	*Analyte*
1950	Residue-total

EPA 1630 **10122608** **Methyl Mercury by Purge & Trap Cold Vapor Atomic Fluorescence Spectrometry**

Analyte Code	*Analyte*
1205	Methyl Mercury

EPA 1631E **10237204** **Mercury in Water by Oxidation, Purge & Trap, and Cold Vapor Atomic Fluorescence**

Analyte Code	*Analyte*

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Analyte Code	*Analyte*
1095	Mercury

EPA 1664A (HEM) **10127807** **N-Hexane Extractable Material (Oil and Grease) by Extraction and Gravimetry**

Analyte Code	*Analyte*
1803	n-Hexane Extractable Material (O&G)
1860	Oil & Grease

EPA 300.0 2.1 **10053200** **Methods for the Determination of Inorganic Substances in Environmental Samples**

Analyte Code	*Analyte*
1575	Chloride
1730	Fluoride
2000	Sulfate

EPA 3050B **10135601** **Acid Digestion of Sediments, Sludges, and soils**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 314.0 **10055400** **Perchlorate in Drinking Water by Ion Chromatography**

Analyte Code	*Analyte*
1895	Perchlorate

EPA 350.1 2 **10063602** **Ammonia Nitrogen - Colorimetric, Auto Phenate**

Analyte Code	*Analyte*
1515	Ammonia as N

EPA 353.2 2 **10067604** **Nitrate/Nitrite Nitrogen - Automated, Cadmium**

Analyte Code	*Analyte*
1810	Nitrate as N
1840	Nitrite as N
1825	Total nitrate+nitrite

EPA 3540C **10140202** **Soxhlet Extraction**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3541 **10140406** **Automated Soxhlet Extraction**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3550C **10142004** **Ultrasonic Extraction**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3580A **10143007** **Waste Dilution**

Analyte Code	*Analyte*
8031	Extraction/Preparation

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EPA 3620C **10146006** **Florisil Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3630C **10146802** **Silica gel cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3640A **10147203** **Gel Preparation Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 365.3 **10070607** **Phosphorous - Colorimetric, two reagent.**

Analyte Code	*Analyte*
1870	Orthophosphate as P
1908	Total Phosphate

EPA 3660B **10148400** **Sulfur cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 3665A **10148808** **Sulfuric Acid / permanganate Cleanup**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 5030B **10153409** **Purge and trap for aqueous samples**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 5035A **10284807** **Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 6010C **10155803** **ICP - AES**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1025	Boron
1030	Cadmium
1035	Calcium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1085	Magnesium
1090	Manganese
1100	Molybdenum
1105	Nickel

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Analyte Code	*Analyte*
1125	Potassium
1140	Selenium
1150	Silver
1155	Sodium
1160	Strontium
1165	Thallium
1175	Tin
1180	Titanium
1185	Vanadium
1190	Zinc

EPA 6020A **10156408** **Inductively Coupled Plasma-Mass Spectrometry**

Analyte Code	*Analyte*
1000	Aluminum
1005	Antimony
1010	Arsenic
1015	Barium
1020	Beryllium
1030	Cadmium
1040	Chromium
1050	Cobalt
1055	Copper
1070	Iron
1075	Lead
1090	Manganese
1100	Molybdenum
1105	Nickel
1140	Selenium
1150	Silver
1160	Strontium
1165	Thallium
1185	Vanadium
1190	Zinc

EPA 6850 **10304606** **Perchlorate in Water, Soils and Solid Wastes Using High Performance Liquid Chromatography/Electrospray Ionization/Mass Spectrometry**

Analyte Code	*Analyte*
1895	Perchlorate

EPA 7062 **10159407** **Antimony and Arsenic by Borohydride Reduction and Atomic Absorption**

Analyte Code	*Analyte*
1010	Arsenic

EPA 7196A **10162400** **Chromium Hexavalent colorimetric**

Analyte Code	*Analyte*
1045	Chromium VI

EPA 7471B **10166402** **Mercury by Cold Vapor Atomic Absorption**

Analyte Code	*Analyte*
1095	Mercury

EPA 7742 **10169207** **Selenium by Borohydride Reduction and Atomic Absorption**

Analyte Code	*Analyte*
1140	Selenium

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EPA 8015C **10173805** **Non-halogenated organics using GC/FID**

Analyte Code	*Analyte*
9369	Diesel range organics (DRO)
4785	Ethylene glycol
9408	Gasoline range organics (GRO)

EPA 8081B **10178800** **Organochlorine Pesticides by GC/ECD**

Analyte Code	*Analyte*
8580	2,4'-DDD
8585	2,4'-DDE
8590	2,4'-DDT
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7005	Alachlor
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
7115	beta-BHC (beta-Hexachlorocyclohexane)
7250	Chlordane (tech.)
7300	Chlorpyrifos
7925	cis-Nonachlor
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
4840	Hexachloroethane
7725	Isodrin
7810	Methoxychlor
7870	Mirex
3890	Oxychlordane
8250	Toxaphene (Chlorinated camphene)
7910	trans-Nanochlor

EPA 8082A **10179201** **Polychlorinated Biphenyls (PCBs) by GC/ECD**

Analyte Code	*Analyte*
9095	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)
9090	2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)
9103	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)
9065	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)
9020	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)
9112	2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)
9116	2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)
9114	2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)
9120	2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)
9133	2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)
9134	2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)
9075	2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)

ORELAP Fields of Accreditation

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Analyte Code	*Analyte*
9025	2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)
9139	2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)
9080	2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)
9030	2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)
9151	2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)
8975	2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)
9155	2,2',3,4',5-Pentachlorobiphenyl (BZ-90)
9154	2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)
9035	2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)
9166	2,2',3,5',6-Pentachlorobiphenyl (BZ-95)
8945	2,2',3,5'-Tetrachlorobiphenyl (BZ-44)
9040	2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)
9174	2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)
9175	2,2',4,4',5-Pentachlorobiphenyl (BZ-99)
8980	2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)
8950	2,2',4,5'-Tetrachlorobiphenyl (BZ-49)
8955	2,2',5,5'-Tetrachlorobiphenyl (BZ-52)
8930	2,2',5-Trichlorobiphenyl (BZ-18)
9085	2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)
9050	2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)
9193	2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)
8985	2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)
8990	2,3,3',4',6-Pentachlorobiphenyl (BZ-110)
9207	2,3,3',4'-Tetrachlorobiphenyl (BZ-56)
9055	2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)
9218	2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)
9005	2,3,4,4',5-Pentachlorobiphenyl (BZ-114)
8995	2,3',4,4',5-Pentachlorobiphenyl (BZ-118)
9000	2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)
9220	2,3',4,4',6-Pentachlorobiphenyl (BZ-119)
9221	2,3,4,4'-Tetrachlorobiphenyl (BZ-60)
8960	2,3',4,4'-Tetrachlorobiphenyl (BZ-66)
9230	2,3',4',5-Tetrachlorobiphenyl (BZ-70)
9239	2,3',4'-Trichlorobiphenyl (BZ-33)
8920	2,3-Dichlorobiphenyl (BZ-5)
9250	2,4,4',5-Tetrachlorobiphenyl (BZ-74)
9252	2,4,4'-Trichlorobiphenyl (BZ-28)
8940	2,4',5-Trichlorobiphenyl (BZ-31)
9256	2,4'-Dichlorobiphenyl (BZ-8)
8915	2-Chlorobiphenyl (BZ-1)
9060	3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)
9015	3,3',4,4',5-Pentachlorobiphenyl (BZ-126)
8965	3,3',4,4'-Tetrachlorobiphenyl (BZ-77)
8970	3,4,4',5-Tetrachlorobiphenyl (BZ-81)
9266	3,4,4'-Trichlorobiphenyl (BZ-37)
8880	Aroclor-1016 (PCB-1016)
8885	Aroclor-1221 (PCB-1221)
8890	Aroclor-1232 (PCB-1232)
8895	Aroclor-1242 (PCB-1242)
8900	Aroclor-1248 (PCB-1248)
8905	Aroclor-1254 (PCB-1254)
8910	Aroclor-1260 (PCB-1260)
8912	Aroclor-1262 (PCB-1262)
8913	Aroclor-1268 (PCB-1268)
9105	Decachlorobiphenyl (BZ-209)

EPA 8141B **10182204** **Organophosphorous Pesticides by GC/NPD**

Analyte Code	*Analyte*
7075	Azinphos-methyl (Guthion)
7125	Bolstar (Sulprofos)

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Analyte Code	*Analyte*
7300	Chlorpyrifos
7315	Coumaphos
7395	Demeton-o
7385	Demeton-s
7410	Diazinon
8610	Dichlorovos (DDVP, Dichlorvos)
7475	Dimethoate
8625	Disulfoton
7550	EPN
7570	Ethoprop
7600	Fensulfothion
7605	Fenthion
7770	Malathion
7785	Merphos
7825	Methyl parathion (Parathion, methyl)
7850	Mevinphos
7955	Parathion, ethyl
7985	Phorate
8110	Ronnel
8155	Sulfotepp
8200	Tetrachlorvinphos (Stirophos, Gardona) Z-isomer
8245	Tokuthion (Prothiophos)
8275	Trichloronate

EPA 8151A **10183207** **Chlorinated Herbicides by GC/ECD**

Analyte Code	*Analyte*
8655	2,4,5-T
8545	2,4-D
8560	2,4-DB
8555	Dalapon
8595	Dicamba
8605	Dichloroprop (Dichlorprop)
8620	Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)
7775	MCPA
7780	MCPP
8650	Silvex (2,4,5-TP)

EPA 8260C **10307003** **Volatile Organics: GC/MS (capillary column)**

Analyte Code	*Analyte*
5105	1,1,1,2-Tetrachloroethane
5185	1,1,1-Trichloro-2,2,2-trifluoroethane
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
5165	1,1,2-Trichloroethane
5167	1,1,2-Trichlorofluoroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
4670	1,1-Dichloropropene
5150	1,2,3-Trichlorobenzene
5180	1,2,3-Trichloropropane
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4570	1,2-Dibromo-3-chloropropane (DBCP)
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
6800	1,3,5-Trichlorobenzene

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Analyte Code	*Analyte*
5215	1,3,5-Trimethylbenzene
4615	1,3-Dichlorobenzene
4660	1,3-Dichloropropane
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
4510	1-Chlorohexane
4665	2,2-Dichloropropane
4410	2-Butanone (Methyl ethyl ketone, MEK)
4500	2-Chloroethyl vinyl ether
4535	2-Chlorotoluene
4860	2-Hexanone
5020	2-Nitropropane
4536	4-Bromofluorobenzene
4540	4-Chlorotoluene
4910	4-Isopropyltoluene (p-Cymene)
4995	4-Methyl-2-pentanone (MIBK)
4305	Acetamide
4315	Acetone
4320	Acetonitrile
4325	Acrolein (Propenal)
4330	Acrylamide
4340	Acrylonitrile
4355	Allyl chloride (3-Chloropropene)
4375	Benzene
4385	Bromobenzene
4390	Bromochloromethane
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4525	Chloroprene (2-Chloro-1,3-butadiene)
4705	cis & trans-1,2-Dichloroethene
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4595	Dibromomethane (Methylene bromide)
4625	Dichlorodifluoromethane (Freon-12)
4725	Diethyl ether
4755	Ethyl acetate
4810	Ethyl methacrylate
4765	Ethylbenzene
4835	Hexachlorobutadiene
4870	Iodomethane (Methyl iodide)
4875	Isobutyl alcohol (2-Methyl-1-propanol)
4900	Isopropylbenzene
5240	m+p-xylene
4925	Methacrylonitrile
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5245	m-Xylene
5005	Naphthalene
4435	n-Butylbenzene
5090	n-Propylbenzene
5250	o-Xylene
4440	sec-Butylbenzene
5100	Styrene

ALS Environmental, Kelso

1317 South 13th Ave.
Kelso WA 98626

Issue Date: 02/11/2015 ***Expiration Date:*** 02/10/2016

As of 02/11/2015 ***this list supercedes all previous lists for this certificate number. Customers. Please verify the current accreditation standing with ORELAP.***

Analyte Code	*Analyte*
4370	T-amylmethylether (TAME)
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)
5140	Toluene
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
4605	trans-1,4-Dichloro-2-butene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5225	Vinyl acetate
5235	Vinyl chloride
5260	Xylene (total)

EPA 8270D **10186002** **Semivolatile Organic compounds by GC/MS**

Analyte Code	*Analyte*
6715	1,2,4,5-Tetrachlorobenzene
5155	1,2,4-Trichlorobenzene
4610	1,2-Dichlorobenzene
6221	1,2-Diphenylhydrazine
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
6420	1,4-Naphthoquinone
6630	1,4-Phenylenediamine
5790	1-Chloronaphthalene
6380	1-Methylnaphthalene
6425	1-Naphthylamine
6735	2,3,4,6-Tetrachlorophenol
6835	2,4,5-Trichlorophenol
6795	2,4,6-Trichloroaniline
6840	2,4,6-Trichlorophenol
6000	2,4-Dichlorophenol
6130	2,4-Dimethylphenol
6175	2,4-Dinitrophenol
6185	2,4-Dinitrotoluene (2,4-DNT)
5992	2,5-Dichlorophenol
6005	2,6-Dichlorophenol
6190	2,6-Dinitrotoluene (2,6-DNT)
5735	2-Chloroaniline
5795	2-Chloronaphthalene
5800	2-Chlorophenol
6360	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)
5145	2-Methylaniline (o-Toluidine)
6385	2-Methylnaphthalene
6400	2-Methylphenol (o-Cresol)
6430	2-Naphthylamine
6460	2-Nitroaniline
6490	2-Nitrophenol
5050	2-Picoline (2-Methylpyridine)
6412	3 & 4 Methylphenol
5945	3,3'-Dichlorobenzidine
6120	3,3'-Dimethylbenzidine
6355	3-Methylcholanthrene
6405	3-Methylphenol (m-Cresol)
6465	3-Nitroaniline
5540	4-Aminobiphenyl
5660	4-Bromophenyl phenyl ether (BDE-3)
5700	4-Chloro-3-methylphenol
5745	4-Chloroaniline
5825	4-Chlorophenyl phenylether

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

ALS Environmental, Kelso

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Kelso WA 98626

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Analyte Code	*Analyte*
6410	4-Methylphenol (p-Cresol)
6470	4-Nitroaniline
6500	4-Nitrophenol
6125	a-a-Dimethylphenethylamine
5500	Acenaphthene
5505	Acenaphthylene
5510	Acetophenone
5545	Aniline
5555	Anthracene
5560	Aramite
7065	Atrazine
5562	Azobenzene
5570	Benzaldehyde
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5610	Benzoic acid
5630	Benzyl alcohol
5640	Biphenyl
5760	bis(2-Chloroethoxy)methane
5765	bis(2-Chloroethyl) ether
5780	bis(2-Chloroisopropyl) ether
5670	Butyl benzyl phthalate
7180	Caprolactam
5680	Carbazole
7260	Chlorobenzilate
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
7405	Diallate
7410	Diazinon
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
6070	Diethyl phthalate
7475	Dimethoate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
7580	Famphur
6265	Fluoranthene
6270	Fluorene
6275	Hexachlorobenzene
4835	Hexachlorobutadiene
6285	Hexachlorocyclopentadiene
4840	Hexachloroethane
6290	Hexachlorophene
6315	Indeno(1,2,3-cd) pyrene
7725	Isodrin
6320	Isophorone
7740	Kepone
6345	Methapyrilene
7825	Methyl parathion (Parathion, methyl)
5005	Naphthalene
5015	Nitrobenzene
6525	n-Nitrosodiethylamine
6530	n-Nitrosodimethylamine
6545	n-Nitrosodi-n-propylamine
6535	n-Nitrosodiphenylamine

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Analyte Code	*Analyte*
6555	n-Nitrosomorpholine
6560	n-Nitrosopiperidine
6565	n-Nitrosopyrrolidine
7955	Parathion, ethyl
6590	Pentachlorobenzene
6600	Pentachloronitrobenzene
6605	Pentachlorophenol
6608	Perylene
6615	Phenanthrene
6625	Phenol
6650	Pronamide (Kerb)
6665	Pyrene
5095	Pyridine
6685	Safrole
8235	Thionazin (Zinophos)

EPA 8270D SIM **10242509** **Semivolatile Organic compounds by GC/MS Selective Ion Monitoring**

Analyte Code	*Analyte*
4735	1,4-Dioxane (1,4- Diethyleneoxide)
6380	1-Methylnaphthalene
6852	2,3,5-Trimethylnaphthalene
6188	2,6-Dimethylnaphthalene
6385	2-Methylnaphthalene
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5605	Benzo(e)pyrene
5590	Benzo(g,h,i)perylene
9309	Benzo(j)fluoranthene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5640	Biphenyl
5670	Butyl benzyl phthalate
5680	Carbazole
5855	Chrysene
6065	Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)
5895	Dibenz(a,h) anthracene
5905	Dibenzofuran
5910	Dibenzothiophene
6070	Diethyl phthalate
6135	Dimethyl phthalate
5925	Di-n-butyl phthalate
6200	Di-n-octyl phthalate
6265	Fluoranthene
6270	Fluorene
6315	Indeno(1,2,3-cd) pyrene
5005	Naphthalene
6545	n-Nitrosodi-n-propylamine
6605	Pentachlorophenol
6608	Perylene
6615	Phenanthrene
6665	Pyrene

EPA 8321B **10189205** **Solvent Extractable non-volatile compounds by HPLC/TS/MS**

Analyte Code	*Analyte*
7710	3-Hydroxycarbofuran
7010	Aldicarb (Temik)

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

ALS Environmental, Kelso

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Analyte Code	*Analyte*
7015	Aldicarb sulfone
7020	Aldicarb sulfoxide
7195	Carbaryl (Sevin)
7205	Carbofuran (Furaden)
7800	Methiocarb (Mesurol)
7805	Methomyl (Lannate)
7940	Oxamyl
8080	Propoxur (Baygon)

EPA 8330B **10308006** **Nitroaromatics, Nitramines and Nitrate Esters by High Performance Liquid Chromatography (HPLC)**

Analyte Code	*Analyte*
6885	1,3,5-Trinitrobenzene (1,3,5-TNB)
6160	1,3-Dinitrobenzene (1,3-DNB)
9651	2,4,6-Trinitrotoluene (2,4,6-TNT)
6185	2,4-Dinitrotoluene (2,4-DNT)
6190	2,6-Dinitrotoluene (2,6-DNT)
9303	2-Amino-4,6-dinitrotoluene (2-am-dnt)
9507	2-Nitrotoluene
6150	3,5-Dinitroaniline
9510	3-Nitrotoluene
9306	4-Amino-2,6-dinitrotoluene (4-am-dnt)
9513	4-Nitrotoluene
6415	Methyl-2,4,6-trinitrophenylnitramine (tetryl)
5015	Nitrobenzene
6485	Nitroglycerin
9522	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
9558	Pentaerythritoltetranitrate
9432	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)

EPA 9012B **10243206** **Total and Amenable Cyanide (automated colorimetric with off-line distillation)**

Analyte Code	*Analyte*
1510	Amenable cyanide
1645	Total cyanide

EPA 9013A **10308802** **Cyanide Extraction Procedure for Solids and Oils**

Analyte Code	*Analyte*
8031	Extraction/Preparation

EPA 9020B **10194408** **Total Organic Halides**

Analyte Code	*Analyte*
2045	Total organic halides (TOX)

EPA 9030B **10195605** **Acid-Soluble and Acid-Insoluble sulfides: Distillation**

Analyte Code	*Analyte*
2005	Sulfide

EPA 9034 **10196006** **Titrimetric Procedure for Acid-Soluble and Acid-Insoluble Sulfides**

Analyte Code	*Analyte*
2005	Sulfide

EPA 9045D **10244607** **Soil and Waste pH**

Analyte Code	*Analyte*
1900	pH

ORELAP Fields of Accreditation

ORELAP ID: WA100010
EPA CODE: WA01276
Certificate: WA100010 - 010

ALS Environmental, Kelso

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Kelso WA 98626

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Customers. Please verify the current accreditation standing with ORELAP.

EPA 9056A **10199607** **Determination of Inorganic Anions by Ion Chromatography**

Analyte Code	*Analyte*
1575	Chloride
1730	Fluoride
1805	Nitrate
1835	Nitrite
2000	Sulfate

EPA 9071A **10201408** **Oil and Grease Extraction Method for sludge and sediment samples**

Analyte Code	*Analyte*
1860	Oil & Grease

NWTPH-Dx **90018409** **Oregon DEQ TPH Diesel Range**

Analyte Code	*Analyte*
9369	Diesel range organics (DRO)
9506	Residual Range Organics (RRO)

NWTPH-Gx **90018603** **Oregon DEQ TPH Gasoline Range Organics by GC/FID-PID Purge & Trap**

Analyte Code	*Analyte*
9408	Gasoline range organics (GRO)

NWTPH-HCID **90013200** **Oregon DEQ Total Petroleum Hydrocarbon ID**

Analyte Code	*Analyte*
2050	Total Petroleum Hydrocarbons (TPH)

PLUMB 1981 **60006259** **Extraction/Preparation**

Analyte Code	*Analyte*
6118	Distribution of particle sizes
8031	Extraction/Preparation

WI(95) DRO **90019457** **Wisconsin DNR - Modified Method for Determination of Diesel Range Organics by GC-FID**

Analyte Code	*Analyte*
9369	Diesel range organics (DRO)

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the DoD Quality Systems Manual for Environmental Laboratories Version 5.0 July 2013 and is accredited is accordance with the:

United States Department of Defense
Environmental Laboratory Accreditation Program
(DoD-ELAP)

This accreditation demonstrates technical competence for the defined scope:

Environmental Testing

(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Tracy Szerszen
President/Operations Manager

Initial Accreditation Date:	*Issue Date:*	*Revision Date:*
July 19, 2011	March 13, 2014	February 25, 2015
Expiration Date:	*Accreditation No.:*	*Certificate No.:*
March 13, 2016	65188	L14-51-R2

Perry Johnson Laboratory Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626

Lee Wolf Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 1631E	CVAFS	Mercury (Low level)
Aqueous	EPA 1664A	Gravimetry	Hexane Extractable Material (HEM)
Aqueous	EPA 1664A	Gravimetry	Total Petroleum Hydrocarbons (TPH)
Aqueous	EPA 180.1	Nephelometer	Turbidity
Aqueous	EPA 2340B	Calculation by 6010	Hardness as $CaCO_{3)}$
Aqueous	EPA 245.1	CVAA	Mercury
Aqueous	EPA 300.0	IC	Bromide
Aqueous	EPA 300.0	IC	Chloride
Aqueous	EPA 300.0	IC	Fluoride
Aqueous	EPA 300.0	IC	Nitrate + Nitrite as N
Aqueous	EPA 300.0	IC	Nitrate as N
Aqueous	EPA 300.0	IC	Nitrite as N
Aqueous	EPA 300.0	IC	Sulfate
Aqueous	EPA 353.2	Automated Colorimetry	Nitrate + Nitrite as N
Aqueous	EPA 1632	HG-CT-GC-AAS	Arsenic (III)
Aqueous	EPA 1632	HG-CT-GC-AAS	Arsenic (V)
Aqueous	EPA 1632	HG-CT-GC-AAS	Total Inorganic Arsenic
Aqueous	EPA 7196A	Colorimetry	Chromium VI
Aqueous	EPA 7470A	CVAA	Mercury
Aqueous	EPA 8260C SIM	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous	EPA 8260C SIM	GC-MS	1,1,2-Trichloroethane
Aqueous	EPA 8260C SIM	GC-MS	1,1-Dichloroethene
Aqueous	EPA 8260C SIM	GC-MS	1,2-Dibromoethane
Aqueous	EPA 8260C SIM	GC-MS	1,2-Dichloroethane
Aqueous	EPA 8260C SIM	GC-MS	1,3 Butadine
Aqueous	EPA 8260C SIM	GC-MS	1,4-Dichlorobenzene
Aqueous	EPA 8260C SIM	GC-MS	Bromodichloromethane
Aqueous	EPA 8260C SIM	GC-MS	Carbon Tetrachloride
Aqueous	EPA 8260C SIM	GC-MS	Chlorodibromomethane
Aqueous	EPA 8260C SIM	GC-MS	Chloroform
Aqueous	EPA 8260C SIM	GC-MS	Chloromethane
Aqueous	EPA 8260C SIM	GC-MS	cis-1,2-Dichloroethene
Aqueous	EPA 8260C SIM	GC-MS	Dichloromethane (Methylene Chloride)
Aqueous	EPA 8260C SIM	GC-MS	Tetrachloroethene
Aqueous	EPA 8260C SIM	GC-MS	trans-1,2-Dichloroethene

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626

Lee Wolf Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 8260C SIM	GC-MS	Trichloroethene
Aqueous	EPA 8260C SIM	GC-MS	Vinyl chloride
Aqueous	EPA 9020B	Microcoulometric-titration detector	Total Organic Halides (TOX)
Aqueous	EPA 9040C	pH Meter	pH
Aqueous	EPA 9060A	TOC Meter	Total Organic Carbons (TOC)
Aqueous	SM 10200 H	Colorimetry	Chlorophyll-A
Aqueous	SM 2130B	Nephelometer	Turbidity
Aqueous	SM 2320B	Titrimetry	Total Alkalinity (as $CaCO_3$)
Aqueous	SM 2510B	Conductivity Meter	Specific Conductance
Aqueous	SM 2540B	Balance	Solids, Total
Aqueous	SM 2540C	Balance	Solids, Total Dissolved
Aqueous	SM 2540D	Balance	Solids, Total Suspended
Aqueous	SM 4500-CN- G	Colorimetry	Cyanide, Amenable
Aqueous	SM 4500-P-E	Colorimetry	ortho-phosphorous
Aqueous	SM 4500-S2 D	Distillation Unit	Sulfide
Aqueous	SM 4500-CN E	Colorimetry	Total Cyanide
Aqueous	SM4500-NH3 G	Colorimetry	Ammonia
Aqueous	SM5220C	Titrimetry	Chemical Oxygen Demand (COD)
Aqueous	SM5310C	TOC Meter	Total Organic Carbons (TOC)
Aqueous	SOP-LCP-PFC	HPLC/MS/MS	Perfluor-n butanoic acid (PFBA)
Aqueous	SOP-LCP-PFC	HPLC/MS/MS	Perfluor-n octanesulfonate (PFOS)
Aqueous	SOP-LCP-PFC	HPLC/MS/MS	Perfluor-n octanoic acid (PFOA)
Drinking Water	EPA 504.1	GC-ECD	1,2-Dibromo-3-chloropropane (DBCP)
Drinking Water	EPA 504.1	GC-ECD	1,2-Dibromoethane (EDB)
Drinking Water	EPA 524.2	GC-MS	1,1,1,2-Tetrachloroethane
Drinking Water	EPA 524.2	GC-MS	1,1,1-Trichloroethane
Drinking Water	EPA 524.2	GC-MS	1,1,2,2-Tetrachloroethane
Drinking Water	EPA 524.2	GC-MS	1,1-Dichloroethane
Drinking Water	EPA 524.2	GC-MS	1,1-Dichloroethene
Drinking Water	EPA 524.2	GC-MS	1,1-Dichloropropene
Drinking Water	EPA 524.2	GC-MS	1,2,3-Trichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,2,3-Trichloropropane
Drinking Water	EPA 524.2	GC-MS	1,2,4-Trichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,2,4-Trimethylbenzene

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso
1317 South 13th Avenue, Kelso, WA 98626
Lee Wolf Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Drinking Water	EPA 524.2	GC-MS	1,2-Dibromoethane (EDB)
Drinking Water	EPA 524.2	GC-MS	1,2-Dichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,2-Dichloroethane
Drinking Water	EPA 524.2	GC-MS	1,2-Dichloropropane
Drinking Water	EPA 524.2	GC-MS	1,3,5-Trimethylbenzene
Drinking Water	EPA 524.2	GC-MS	1,3-Dichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,3-Dichloropropane
Drinking Water	EPA 524.2	GC-MS	1,4-Dichlorobenzene
Drinking Water	EPA 524.2	GC-MS	2,2-Dichloropropane
Drinking Water	EPA 524.2	GC-MS	2-Chlorotoluene
Drinking Water	EPA 524.2	GC-MS	4-Chlorotoluene
Drinking Water	EPA 524.2	GC-MS	4-Isopropyltoluene
Drinking Water	EPA 524.2	GC-MS	Benzene
Drinking Water	EPA 524.2	GC-MS	Bromobenzene
Drinking Water	EPA 524.2	GC-MS	Bromochloromethane
Drinking Water	EPA 524.2	GC-MS	Bromodichloromethane
Drinking Water	EPA 524.2	GC-MS	Bromoform
Drinking Water	EPA 524.2	GC-MS	Bromomethane
Drinking Water	EPA 524.2	GC-MS	Carbon Tetrachloride
Drinking Water	EPA 524.2	GC-MS	Chlorobenzene
Drinking Water	EPA 524.2	GC-MS	Chlorodibromomethane
Drinking Water	EPA 524.2	GC-MS	Chloroethane
Drinking Water	EPA 524.2	GC-MS	Chloroform
Drinking Water	EPA 524.2	GC-MS	Chloromethane
Drinking Water	EPA 524.2	GC-MS	cis-1,2-Dichloroethene
Drinking Water	EPA 524.2	GC-MS	cis-1,3-Dichloropropene
Drinking Water	EPA 524.2	GC-MS	Dibromomethane
Drinking Water	EPA 524.2	GC-MS	Dichlorodifluoromethane
Drinking Water	EPA 524.2	GC-MS	Dichloromethane (Methylene Chloride)
Drinking Water	EPA 524.2	GC-MS	Ethylbenzene
Drinking Water	EPA 524.2	GC-MS	Hexachlorobutadiene
Drinking Water	EPA 524.2	GC-MS	Isopropylbenzene
Drinking Water	EPA 524.2	GC-MS	m+p-Xylene
Drinking Water	EPA 524.2	GC-MS	Naphthalene
Drinking Water	EPA 524.2	GC-MS	n-Butylbenzene

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626

Lee Wolf Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Drinking Water	EPA 524.2	GC-MS	n-Propylbenzene
Drinking Water	EPA 524.2	GC-MS	o-Xylene
Drinking Water	EPA 524.2	GC-MS	sec-Butylbenzene
Drinking Water	EPA 524.2	GC-MS	Styrene
Drinking Water	EPA 524.2	GC-MS	tert-butylbenzene
Drinking Water	EPA 524.2	GC-MS	Tetrachloroethene
Drinking Water	EPA 524.2	GC-MS	Toluene
Drinking Water	EPA 524.2	GC-MS	trans-1,2-Dichloroethene
Drinking Water	EPA 524.2	GC-MS	trans-1,3-Dichloropropene
Drinking Water	EPA 524.2	GC-MS	Trichloroethene
Drinking Water	EPA 524.2	GC-MS	Trichlorofluoromethane (Freon 11)
Drinking Water	EPA 524.2	GC-MS	Vinyl chloride
Drinking Water	EPA 524.2	GC-MS	Xylenes, total
Solid	ASTM D4129-92M, Lloyd Kahn	TOC Meter	Total Organic Carbons (TOC)
Solid	EPA 160.3M	Gravimetry	Solids, Total
Solid	EPA 1631E	CVFAS	Mercury (low level)
Solid	EPA 7471A, B	CVAA	Mercury
Solid	EPA 9045D	pH Meter	pH
Solid	EPA 9056A	IC	Nitrate as N
Solid	EPA 9056A	IC	Nitrite as N
Solid	EPA 9071B	Gravimetry	Hexane Extractable Material (HEM)
Solid	GEN-AVS	Colorimetry	Acid Volatile Sulfides
Solid	GEN-NCEL	Colorimetry	Nitrocellulose
Solid	LCP-LCMS4	HPLC/MS/MS	1,3,5-Trinitrobenzene
Solid	LCP-LCMS4	HPLC/MS/MS	1,3-Dinitrobenzene
Solid	LCP-LCMS4	HPLC/MS/MS	2,4,6-Trinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	2,4-Dinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	2,6-Dinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	2-Amino-4,6-dinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	3,5-Dinitroaniline
Solid	LCP-LCMS4	HPLC/MS/MS	4-Amino-2,6-dinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Solid	LCP-LCMS4	HPLC/MS/MS	Pentaerythritoltetranitrate
Solid	LCP-LCMS4	HPLC/MS/MS	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)
Solid	LCP-LCMS4	HPLC/MS/MS	Tetryl (methyl-2,4,6-trinitrophenylnitramine)

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ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso
1317 South 13th Avenue, Kelso, WA 98626
Lee Wolf Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Solid	LCP-Nitro	HPLC/MS/MS	2,4-Dinitrophenol
Solid	LCP-Nitro	HPLC/MS/MS	Picramic Acid
Solid	LCP-Nitro	HPLC/MS/MS	Picric Acid
Solid	PSEP	Gravimetry	Particle Size
Solid	SOP-GEN-AVS	Colorimetry	Acid Volatile Sulfides
Tissue	EPA 1631E	CVAFS	Mercury (low level)
Tissue	EPA 1632	HG-CT-GC-AAS	Arsenic (III)
Tissue	EPA 1632	HG-CT-GC-AAS	Arsenic (V)
Tissue	EPA 1632	HG-CT-GC-AAS	Total Inorganic Arsenic
Tissue	EPA 6010B, C/200.7	ICP	Aluminum
Tissue	EPA 6010B, C/200.7	ICP	Antimony
Tissue	EPA 6010B, C/200.7	ICP	Arsenic
Tissue	EPA 6010B, C/200.7	ICP	Barium
Tissue	EPA 6010B, C/200.7	ICP	Beryllium
Tissue	EPA 6010B, C/200.7	ICP	Boron
Tissue	EPA 6010B, C/200.7	ICP	Cadmium
Tissue	EPA 6010B, C/200.7	ICP	Calcium
Tissue	EPA 6010B, C/200.7	ICP	Chromium, total
Tissue	EPA 6010B, C/200.7	ICP	Cobalt
Tissue	EPA 6010B, C/200.7	ICP	Copper
Tissue	EPA 6010B, C/200.7	ICP	Iron
Tissue	EPA 6010B, C/200.7	ICP	Lead
Tissue	EPA 6010B, C/200.7	ICP	Magnesium
Tissue	EPA 6010B, C/200.7	ICP	Manganese
Tissue	EPA 6010B, C/200.7	ICP	Molybdenum
Tissue	EPA 6010B, C/200.7	ICP	Nickel
Tissue	EPA 6010B, C/200.7	ICP	Potassium
Tissue	EPA 6010B, C/200.7	ICP	Selenium
Tissue	EPA 6010B, C/200.7	ICP	Silver
Tissue	EPA 6010B, C/200.7	ICP	Sodium
Tissue	EPA 6010B, C/200.7	ICP	Strontium
Tissue	EPA 6010B, C/200.7	ICP	Thallium
Tissue	EPA 6010B, C/200.7	ICP	Tin
Tissue	EPA 6010B, C/200.7	ICP	Titanium
Tissue	EPA 6010B, C/200.7	ICP	Vanadium

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Tissue	EPA 6010B, C/200.7	ICP	Zinc
Tissue	EPA 6020A/200.8	ICP-MS	Aluminum
Tissue	EPA 6020A/200.8	ICP-MS	Antimony
Tissue	EPA 6020A/200.8	ICP-MS	Arsenic
Tissue	EPA 6020A/200.8	ICP-MS	Barium
Tissue	EPA 6020A/200.8	ICP-MS	Beryllium
Tissue	EPA 6020A/200.8	ICP-MS	Boron
Tissue	EPA 6020A/200.8	ICP-MS	Cadmium
Tissue	EPA 6020A/200.8	ICP-MS	Chromium, total
Tissue	EPA 6020A/200.8	ICP-MS	Cobalt
Tissue	EPA 6020A/200.8	ICP-MS	Copper
Tissue	EPA 6020A/200.8	ICP-MS	Iron
Tissue	EPA 6020A/200.8	ICP-MS	Lead
Tissue	EPA 6020A/200.8	ICP-MS	Manganese
Tissue	EPA 6020A/200.8	ICP-MS	Molybdenum
Tissue	EPA 6020A/200.8	ICP-MS	Nickel
Tissue	EPA 6020A/200.8	ICP-MS	Selenium
Tissue	EPA 6020A/200.8	ICP-MS	Silver
Tissue	EPA 6020A/200.8	ICP-MS	Strontium
Tissue	EPA 6020A/200.8	ICP-MS	Thallium
Tissue	EPA 6020A/200.8	ICP-MS	Tin
Tissue	EPA 6020A/200.8	ICP-MS	Titanium
Tissue	EPA 6020A/200.8	ICP-MS	Vanadium
Tissue	EPA 6020A/200.8	ICP-MS	Zinc
Tissue	EPA 7471A, B	CVAA	Mercury
Tissue	EPA 7742	AA, Borohydride Reduction; GFAA	Selenium
Tissue	EPA 8081A, B	GC-ECD	Aldrin
Tissue	EPA 8081A, B	GC-ECD	Alpha-BHC
Tissue	EPA 8081A, B	GC-ECD	DDD (4,4)
Tissue	EPA 8081A, B	GC-ECD	DDE (4,4)
Tissue	EPA 8081A, B	GC-ECD	DDT (4,4)
Tissue	EPA 8081A, B	GC-ECD	delta-BHC
Tissue	EPA 8081A, B	GC-ECD	Dieldrin
Tissue	EPA 8081A, B	GC-ECD	Endosulfan I
Tissue	EPA 8081A, B	GC-ECD	Endosulfan II

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Tissue	EPA 8081A, B	GC-ECD	Endosulfan sulfate
Tissue	EPA 8081A, B	GC-ECD	Endrin
Tissue	EPA 8081A, B	GC-ECD	Endrin aldehyde
Tissue	EPA 8081A, B	GC-ECD	Endrin ketone
Tissue	EPA 8081A, B	GC-ECD	gamma-BHC
Tissue	EPA 8081A, B	GC-ECD	gamma-Chlordane
Tissue	EPA 8081A, B	GC-ECD	Heptachlor
Tissue	EPA 8081A, B	GC-ECD	Heptachlor Epoxide (beta)
Tissue	EPA 8081A, B	GC-ECD	Methoxychlor
Tissue	EPA 8081A, B	GC-ECD	Toxaphene (total)
Tissue	EPA 8081B	GC-ECD	2,4-DDD
Tissue	EPA 8081B	GC-ECD	2,4-DDE
Tissue	EPA 8081B	GC-ECD	2,4-DDT
Tissue	EPA 8081B	GC-ECD	Chlorpyrifos
Tissue	EPA 8081B	GC-ECD	cis-Nonachlor
Tissue	EPA 8081B	GC-ECD	Hexachlorobenzene
Tissue	EPA 8081B	GC-ECD	Hexachloroethane
Tissue	EPA 8081B	GC-ECD	Hexchlorobutadiene
Tissue	EPA 8081B	GC-ECD	Isodrin
Tissue	EPA 8081B	GC-ECD	Mirex
Tissue	EPA 8081B	GC-ECD	Oxychlordane
Tissue	EPA 8081B	GC-ECD	trans-Nonachlor
Tissue	EPA 8082A	GC-ECD	2,2',3,3',4,4',5,5',6,6' Decachlorobiphenyl (PCB 209)
Tissue	EPA 8082A	GC-ECD	2,2’,3,3’,4,4’,5,5’,6-Nonachlorobiphenyl (PCB 206)
Tissue	EPA 8082A	GC-ECD	2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl (PCB 195)
Tissue	EPA 8082A	GC-ECD	2,2’,3,3’,4,4’,5-Heptachlorobiphenyl (PCB 170)
Tissue	EPA 8082A	GC-ECD	2,2’,3,3’,4,4’-Hexachlorobiphenyl (PCB 128)
Tissue	EPA 8082A	GC-ECD	2,2’,3,4,4’,5,5’-Heptachlorobiphenyl (PCB 180)
Tissue	EPA 8082A	GC-ECD	2,2’,3,4,4’,5’,6-Heptachlorobiphenyl (PCB 183)
Tissue	EPA 8082A	GC-ECD	2,2’,3,4,4’,5’-Hexachlorobiphenyl (PCB 138)
Tissue	EPA 8082A	GC-ECD	2,2’,3,4,4’,6,6’-Heptachlorobiphenyl (PCB 184)
Tissue	EPA 8082A	GC-ECD	2,2’,3,4,5’-Pentachlorobiphenyl (PCB 87)
Tissue	EPA 8082A	GC-ECD	2,2’,3,4’,5,5’,6-Heptachlorobiphenyl (PCB 187)
Tissue	EPA 8082A	GC-ECD	2,2’,3,4’,5-Pentachlorobiphenyl (PCB 90)
Tissue	EPA 8082A	GC-ECD	2,2’,3,5’-Tetrachlorobiphenyl (PCB 44)
Tissue	EPA 8082A	GC-ECD	2,2’,4,4’,5,5’-Hexachlorobiphenyl (PCB 153)

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Tissue	EPA 8082A	GC-ECD	2,2',4,5,5'-Pentachlorobiphenyl (PCB 101)
Tissue	EPA 8082A	GC-ECD	2,2',5,6'-Tetrachlorbiphenyl (PCB 53)
Tissue	EPA 8082A	GC-ECD	2,2',5-Trichlorobiphenyl (PCB 18)
Tissue	EPA 8082A	GC-ECD	2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189)
Tissue	EPA 8082A	GC-ECD	2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)
Tissue	EPA 8082A	GC-ECD	2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)
Tissue	EPA 8082A	GC-ECD	2,3,3',4,4',6-Hexachlorobiphenyl (PCB 158)
Tissue	EPA 8082A	GC-ECD	2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)
Tissue	EPA 8082A	GC-ECD	2,3,4,4',5-Pentachlorobiphenyl (PCB 114)
Tissue	EPA 8082A	GC-ECD	2,3,4,4'-Tetrachlorobiphenyl (PCB 60)
Tissue	EPA 8082A	GC-ECD	2,3',4,4',5,5' Hexachlorobiphenyl (PCB 167)
Tissue	EPA 8082A	GC-ECD	2,3',4,4',5',6-Hexachlorobiphenyl (PCB 168)
Tissue	EPA 8082A	GC-ECD	2,3',4,4',5-Pentachlorobiphenyl (PCB 118)
Tissue	EPA 8082A	GC-ECD	2,3',4,4',5-Pentachlorobiphenyl (PCB 123)
Tissue	EPA 8082A	GC-ECD	2,3',4,4'-Tetrachlorobiphenyl (PCB 66)
Tissue	EPA 8082A	GC-ECD	2,4,4'-Trichlorobiphenyl (PCB 28)
Tissue	EPA 8082A	GC-ECD	2,4'-Dichlorobiphenyl (PCB 8)
Tissue	EPA 8082A	GC-ECD	3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)
Tissue	EPA 8082A	GC-ECD	3,3',4,4',5-Pentachlorobiphenyl (PCB 126)
Tissue	EPA 8082A	GC-ECD	3,3',4,4'-Tetrachlorobiphenyl (PCB 77)
Tissue	EPA 8082A	GC-ECD	3,4,4',5-Tetrachlorobiphenyl (PCB 81)
Tissue	EPA 8082A	GC-ECD	Aroclor 1016
Tissue	EPA 8082A	GC-ECD	Aroclor 1221
Tissue	EPA 8082A	GC-ECD	Aroclor 1232
Tissue	EPA 8082A	GC-ECD	Aroclor 1242
Tissue	EPA 8082A	GC-ECD	Aroclor 1248
Tissue	EPA 8082A	GC-ECD	Aroclor 1254
Tissue	EPA 8082A	GC-ECD	Aroclor 1260
Tissue	EPA 8082A	GC-ECD	Aroclor 1262
Tissue	EPA 8082A	GC-ECD	Aroclor 1268
Tissue	EPA 8270 SIM	GC-MS	PBDE 100
Tissue	EPA 8270 SIM	GC-MS	PBDE 128
Tissue	EPA 8270 SIM	GC-MS	PBDE 138
Tissue	EPA 8270 SIM	GC-MS	PBDE 153
Tissue	EPA 8270 SIM	GC-MS	PBDE 154
Tissue	EPA 8270 SIM	GC-MS	PBDE 17

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Tissue	EPA 8270 SIM	GC-MS	PBDE 183
Tissue	EPA 8270 SIM	GC-MS	PBDE 190
Tissue	EPA 8270 SIM	GC-MS	PBDE 203
Tissue	EPA 8270 SIM	GC-MS	PBDE 206
Tissue	EPA 8270 SIM	GC-MS	PBDE 209
Tissue	EPA 8270 SIM	GC-MS	PBDE 28
Tissue	EPA 8270 SIM	GC-MS	PBDE 47
Tissue	EPA 8270 SIM	GC-MS	PBDE 66
Tissue	EPA 8270 SIM	GC-MS	PBDE 71
Tissue	EPA 8270 SIM	GC-MS	PBDE 85
Tissue	EPA 8270 SIM	GC-MS	PBDE 99
Tissue	EPA 8270 SIM PAH	GC-MS	2-Methylnaphthalene
Tissue	EPA 8270 SIM PAH	GC-MS	Acenaphthene
Tissue	EPA 8270 SIM PAH	GC-MS	Acenaphthylene
Tissue	EPA 8270 SIM PAH	GC-MS	Anthracene
Tissue	EPA 8270 SIM PAH	GC-MS	Benzo(a)anthracene
Tissue	EPA 8270 SIM PAH	GC-MS	Benzo(a)pyrene
Tissue	EPA 8270 SIM PAH	GC-MS	Benzo(b)fluoranthene
Tissue	EPA 8270 SIM PAH	GC-MS	Benzo(g,h,i)perylene
Tissue	EPA 8270 SIM PAH	GC-MS	Benzo(k)fluoranthene
Tissue	EPA 8270 SIM PAH	GC-MS	Chrysene
Tissue	EPA 8270 SIM PAH	GC-MS	Dibenzo(a,h)anthracene
Tissue	EPA 8270 SIM PAH	GC-MS	Fluoranthene
Tissue	EPA 8270 SIM PAH	GC-MS	Fluorene
Tissue	EPA 8270 SIM PAH	GC-MS	Indeno(1,2,3, cd)pyrene
Tissue	EPA 8270 SIM PAH	GC-MS	Naphthalene
Tissue	EPA 8270 SIM PAH	GC-MS	Phenanthrene
Tissue	EPA 8270 SIM PAH	GC-MS	Pyrene
Tissue	EPA 8270D SIM	GC-MS	1,2,4,5-Tetrachlorobenzene
Tissue	EPA 8270D SIM	GC-MS	1,2,4-Trichlorobenzene
Tissue	EPA 8270D SIM	GC-MS	1,2-Dichlorobenzene
Tissue	EPA 8270D SIM	GC-MS	1,3-Dichlorobenzene
Tissue	EPA 8270D SIM	GC-MS	1,4-Dichlorobenzene
Tissue	EPA 8270D SIM	GC-MS	2,3,4,6-Tetrachlorophenol
Tissue	EPA 8270D SIM	GC-MS	2,4,5-Trichlorophenol
Tissue	EPA 8270D SIM	GC-MS	2,4,6-Trichlorophenol

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Tissue	EPA 8270D SIM	GC-MS	2,4-Dichlorophenol
Tissue	EPA 8270D SIM	GC-MS	2,4-Dimethylphenol
Tissue	EPA 8270D SIM	GC-MS	2,4-Dinitrophenol
Tissue	EPA 8270D SIM	GC-MS	2,4-Dinitrotoluene
Tissue	EPA 8270D SIM	GC-MS	2,6-Dichlorophenol
Tissue	EPA 8270D SIM	GC-MS	2,6-Dinitrotoluene
Tissue	EPA 8270D SIM	GC-MS	2-Chloronaphthalene
Tissue	EPA 8270D SIM	GC-MS	2-Chlorophenol
Tissue	EPA 8270D SIM	GC-MS	2-Methyl-4,6-Dinitrophenol
Tissue	EPA 8270D SIM	GC-MS	2-Methylnaphthalene
Tissue	EPA 8270D SIM	GC-MS	2-Methylphenol
Tissue	EPA 8270D SIM	GC-MS	2-Nitroaniline
Tissue	EPA 8270D SIM	GC-MS	2-Nitrophenol
Tissue	EPA 8270D SIM	GC-MS	3,3-Dichlorobenzidine
Tissue	EPA 8270D SIM	GC-MS	3-Nitroaniline
Tissue	EPA 8270D SIM	GC-MS	4-Bromophenyl-phenylether
Tissue	EPA 8270D SIM	GC-MS	4-Chloro-3-methylphenol
Tissue	EPA 8270D SIM	GC-MS	4-Chloroaniline
Tissue	EPA 8270D SIM	GC-MS	4-Chlorophenyl-phenylether
Tissue	EPA 8270D SIM	GC-MS	4-Methylphenol (and/or 3-Methylphenol)
Tissue	EPA 8270D SIM	GC-MS	4-Nitroaniline
Tissue	EPA 8270D SIM	GC-MS	4-Nitrophenol
Tissue	EPA 8270D SIM	GC-MS	Acenaphthene
Tissue	EPA 8270D SIM	GC-MS	Acenaphthylene
Tissue	EPA 8270D SIM	GC-MS	Anthracene
Tissue	EPA 8270D SIM	GC-MS	Benzo(a)anthracene
Tissue	EPA 8270D SIM	GC-MS	Benzo(a)pyrene
Tissue	EPA 8270D SIM	GC-MS	Benzo(b)fluoranthene
Tissue	EPA 8270D SIM	GC-MS	Benzo(g,h,i)perylene
Tissue	EPA 8270D SIM	GC-MS	Benzo(k)fluoranthene
Tissue	EPA 8270D SIM	GC-MS	Benzoic acid
Tissue	EPA 8270D SIM	GC-MS	Benzyl alcohol
Tissue	EPA 8270D SIM	GC-MS	bis(2-Chloroethoxy)methane
Tissue	EPA 8270D SIM	GC-MS	bis(2-Chloroethyl)ether
Tissue	EPA 8270D SIM	GC-MS	bis(2-Chloroisopropyl)ether
Tissue	EPA 8270D SIM	GC-MS	bis(2-ethylhexy)phthalate

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Matrix	Standard/Method	Technology	Analyte
Tissue	EPA 8270D SIM	GC-MS	Butyl benzyl phthalate
Tissue	EPA 8270D SIM	GC-MS	Carbazole
Tissue	EPA 8270D SIM	GC-MS	Chrysene
Tissue	EPA 8270D SIM	GC-MS	Dibenzo(a,h)anthracene
Tissue	EPA 8270D SIM	GC-MS	Dibenzofuran
Tissue	EPA 8270D SIM	GC-MS	Diethyl phthalate
Tissue	EPA 8270D SIM	GC-MS	Dimethylphthalate
Tissue	EPA 8270D SIM	GC-MS	di-n-butylphthalate
Tissue	EPA 8270D SIM	GC-MS	Di-n-octylphthalate
Tissue	EPA 8270D SIM	GC-MS	Fluoranthene
Tissue	EPA 8270D SIM	GC-MS	Fluorene
Tissue	EPA 8270D SIM	GC-MS	Hexachlorobenzene
Tissue	EPA 8270D SIM	GC-MS	Hexachlorobutadiene
Tissue	EPA 8270D SIM	GC-MS	Hexachlorocyclopentadiene
Tissue	EPA 8270D SIM	GC-MS	Hexachloroethane
Tissue	EPA 8270D SIM	GC-MS	Indeno(1,2,3, cd)pyrene
Tissue	EPA 8270D SIM	GC-MS	Isophorone
Tissue	EPA 8270D SIM	GC-MS	Naphthalene
Tissue	EPA 8270D SIM	GC-MS	Nitrobenzene
Tissue	EPA 8270D SIM	GC-MS	N-Nitrosodiethylamine
Tissue	EPA 8270D SIM	GC-MS	N-Nitrosodimethylamine
Tissue	EPA 8270D SIM	GC-MS	N-Nitroso-di-n-propylamine
Tissue	EPA 8270D SIM	GC-MS	N-Nitrosodiphenylamine
Tissue	EPA 8270D SIM	GC-MS	Pentachlorophenol
Tissue	EPA 8270D SIM	GC-MS	Phenanthrene
Tissue	EPA 8270D SIM	GC-MS	Phenol
Tissue	EPA 8270D SIM	GC-MS	Pyrene
Tissue	EPA 8330B	HPLC	1,3,5-Trinitrobenzene
Tissue	EPA 8330B	HPLC	1,3-Dinitrobenzene
Tissue	EPA 8330B	HPLC	2,4,6-Trinitrotoluene
Tissue	EPA 8330B	HPLC	2,4-Dinitrotoluene
Tissue	EPA 8330B	HPLC	2,6-Dinitrotoluene
Tissue	EPA 8330B	HPLC	2-Amino-4,6-dinitrotoluene
Tissue	EPA 8330B	HPLC	2-Nitrotoluene
Tissue	EPA 8330B	HPLC	3,5-Dinitroaniline
Tissue	EPA 8330B	HPLC	3-Nitrotoluene

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Matrix	Standard/Method	Technology	Analyte
Tissue	EPA 8330B	HPLC	4-Amino-2,6-dinitrotoluene
Tissue	EPA 8330B	HPLC	4-Nitrotoluene
Tissue	EPA 8330B	HPLC	HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Tissue	EPA 8330B	HPLC	Nitrobenzene
Tissue	EPA 8330B	HPLC	Nitroglycerin
Tissue	EPA 8330B	HPLC	Pentachloronitrobenzene
Tissue	EPA 8330B	HPLC	Pentaerythritoltetranitrate
Tissue	EPA 8330B	HPLC	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)
Tissue	EPA 8330B	HPLC	Tetryl (methyl-2,4,6-trinitrophenylnitramine)
Tissue	OPPMS2	GC/MS/MS	Azinphos-methyl (Guthion)
Tissue	OPPMS2	GC/MS/MS	Chlorpyrifos
Tissue	OPPMS2	GC/MS/MS	Demeton O & S
Tissue	OPPMS2	GC/MS/MS	Diazinon
Tissue	OPPMS2	GC/MS/MS	Dichlorvos
Tissue	OPPMS2	GC/MS/MS	dimethoate
Tissue	OPPMS2	GC/MS/MS	Disulfoton
Tissue	OPPMS2	GC/MS/MS	Ethoprop
Tissue	OPPMS2	GC/MS/MS	Parathion, ethyl
Tissue	OPPMS2	GC/MS/MS	Parathion, methyl
Tissue	OPPMS2	GC/MS/MS	Phorate
Tissue	OPPMS2	GC/MS/MS	Ronnel
Tissue	OPPMS2	GC/MS/MS	Stirophos
Tissue	OPPMS2	GC/MS/MS	Sulfotepp
Tissue	SOC-Butyl	GC-FPD	Di-n-butyltin
Tissue	SOC-Butyl	GC-FPD	n-Butyltin
Tissue	SOC-Butyl	GC-FPD	Tetra-n-butyltin
Tissue	SOC-Butyl	GC-FPD	Tri-n-butyltin
Tissue	SOC-PESTMS2	GC/MS/MS	Aldrin
Tissue	SOC-PESTMS2	GC/MS/MS	Alpha-BHC
Tissue	SOC-PESTMS2	GC/MS/MS	beta-BHC
Tissue	SOC-PESTMS2	GC/MS/MS	DDD (4,4)
Tissue	SOC-PESTMS2	GC/MS/MS	DDE (4,4)
Tissue	SOC-PESTMS2	GC/MS/MS	DDT (4,4)
Tissue	SOC-PESTMS2	GC/MS/MS	delta-BHC
Tissue	SOC-PESTMS2	GC/MS/MS	Dieldrin
Tissue	SOC-PESTMS2	GC/MS/MS	Endosulfan I

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Tissue	SOC-PESTMS2	GC/MS/MS	Endosulfan II
Tissue	SOC-PESTMS2	GC/MS/MS	Endosulfan sulfate
Tissue	SOC-PESTMS2	GC/MS/MS	Endrin
Tissue	SOC-PESTMS2	GC/MS/MS	Endrin aldehyde
Tissue	SOC-PESTMS2	GC/MS/MS	Endrin ketone
Tissue	SOC-PESTMS2	GC/MS/MS	gamma-BHC
Tissue	SOC-PESTMS2	GC/MS/MS	Heptachlor
Tissue	SOC-PESTMS2	GC/MS/MS	Heptachlor Epoxide (beta)
Tissue	SOC-PESTMS2	GC/MS/MS	Methoxychlor
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	1,3,5-Trinitrobenzene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	1,3-Dinitrobenzene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	2,4,6-Trinitrotoluene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	2,4-Dinitrotoluene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	2,6-Dinitrotoluene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	2-Amino-4,6-dinitrtoluene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	3,5-Dinitroaniline
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	4-Amino-2,6-dinitrotoluene
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	Pentaerythritoltetranitrate
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)
Tissue	SOP LCP-LCMS4	HPLC/MS/MS	Tetryl (methyl-2,4,6-trinitrophenylnitramine)
Tissue	SOP LCP-Nitro	HPLC/MS/MS	2,4-Dinitrophenol
Tissue	SOP LCP-Nitro	HPLC/MS/MS	Picramic Acid
Tissue	SOP LCP-Nitro	HPLC/MS/MS	Picric Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorobutane Sulfonate
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorobutanesulfonic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorobutanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorodecane Sulfonate
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorodecanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorododecanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluoroheptanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorohexane Sulfonate
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorohexanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorohexylsulfonic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorononanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorooctane Sulfonate

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626

Lee Wolf Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorooctanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluorooctylsulfonic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluoropentanoic Acid
Tissue	SOP-LCP-PFC	HPLC/MS/MS	Perfluoroundecanoic Acid
Aqueous/Drinking Water	EPA 200.9	GFAA	Antimony
Aqueous/Drinking Water	EPA 200.9	GFAA	Selenium
Aqueous/Drinking Water	EPA 200.9	GFAA	Thallium
Aqueous/Drinking Water	EPA 537	HPLC/MS/MS	Perfluorobutanesulfonic Acid
Aqueous/Drinking Water	EPA 537	HPLC/MS/MS	Perfluoroheptanoic Acid
Aqueous/Drinking Water	EPA 537	HPLC/MS/MS	Perfluorohexanesulfonic Acid
Aqueous/Drinking Water	EPA 537	HPLC/MS/MS	Perfluorononanoic Acid
Aqueous/Drinking Water	EPA 537	HPLC/MS/MS	Perfluorooctanesulfonic Acid
Aqueous/Drinking Water	EPA 537	HPLC/MS/MS	Perfluorooctanoic Acid
Aqueous/Drinking Water	EPA 200.9	GFAA	Arsenic
Aqueous/Drinking Water	EPA 200.9	GFAA	Lead
Aqueous/Solid	ASTM D 1426-93B	ISE	Nitrogen, Total Kjeldahl (TKN)
Aqueous/Solid	EPA 1020A	Closed Cup Flashpoint	Ignitability
Aqueous/Solid	EPA 1630	CVAFS	Methyl Mercury
Aqueous/Solid	EPA 314.0	IC	Perchlorate
Aqueous/Solid	EPA 350.1	Colorimetry	Ammonia
Aqueous/Solid	EPA 365.3	Colorimetry	Total Phosphorus
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Aluminum
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Antimony
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Arsenic
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Barium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Beryllium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Boron
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Cadmium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Calcium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Chromium, total
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Cobalt
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Copper

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Iron
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Lead
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Magnesium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Manganese
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Molybdenum
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Nickel
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Potassium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Selenium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Silver
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Sodium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Strontium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Thallium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Tin
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Titanium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Vanadium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Zinc
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Aluminum
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Antimony
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Arsenic
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Barium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Beryllium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Boron
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Cadmium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Chromium, total
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Cobalt
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Copper
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Iron
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Lead
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Manganese
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Molybdenum
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Nickel
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Selenium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Silver
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Strontium

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ALS Environmental-Kelso
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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Thallium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Tin
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Titanium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Vanadium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Zinc
Aqueous/Solid	EPA 6850	HPLC/MS/MS	Perchlorate
Aqueous/Solid	EPA 7010	GFAA	Antimony
Aqueous/Solid	EPA 7010	GFAA	Arsenic
Aqueous/Solid	EPA 7010	GFAA	Chromium, total
Aqueous/Solid	EPA 7010	GFAA	Lead
Aqueous/Solid	EPA 7010	GFAA	Selenium
Aqueous/Solid	EPA 7010	GFAA	Thallium
Aqueous/Solid	EPA 7742	AA, Borohydride Reduction; GFAA	Selenium
Aqueous/Solid	EPA 8011	GC-ECD	Ethylene Dibromide
Aqueous/Solid	EPA 8015C/AK103-RRO	GC-FID	Residual Range Organics (RRO)
Aqueous/Solid	EPA 8015C; AK101-GRO; NWTPH-Gx	GC-FID	Gasoline Range Organics (GRO)
Aqueous/Solid	EPA 8015C; AK102-DRO; NWTPH-Dx	GC-FID	Diesel Range Organics (DRO)
Aqueous/Solid	EPA 8081A, B	GC-ECD	Aldrin
Aqueous/Solid	EPA 8081A, B	GC-ECD	Alpha-BHC
Aqueous/Solid	EPA 8081A, B	GC-ECD	DDD (4,4)
Aqueous/Solid	EPA 8081A, B	GC-ECD	DDE (4,4)
Aqueous/Solid	EPA 8081A, B	GC-ECD	DDT (4,4)
Aqueous/Solid	EPA 8081A, B	GC-ECD	delta-BHC
Aqueous/Solid	EPA 8081A, B	GC-ECD	Dieldrin
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endosulfan I
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endosulfan II
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endosulfan sulfate
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endrin
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endrin aldehyde
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endrin ketone
Aqueous/Solid	EPA 8081A, B	GC-ECD	gamma-BHC
Aqueous/Solid	EPA 8081A, B	GC-ECD	gamma-Chlordane

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8081A, B	GC-ECD	Heptachlor
Aqueous/Solid	EPA 8081A, B	GC-ECD	Heptachlor Epoxide (beta)
Aqueous/Solid	EPA 8081A, B	GC-ECD	Methoxychlor
Aqueous/Solid	EPA 8081A, B	GC-ECD	Toxaphene (total)
Aqueous/Solid	EPA 8081B	GC-ECD	2,4-DDD
Aqueous/Solid	EPA 8081B	GC-ECD	2,4-DDE
Aqueous/Solid	EPA 8081B	GC-ECD	2,4-DDT
Aqueous/Solid	EPA 8081B	GC-ECD	Chlorpyrifos
Aqueous/Solid	EPA 8081B	GC-ECD	cis-Nonachlor
Aqueous/Solid	EPA 8081B	GC-ECD	Hexachlorobenzene
Aqueous/Solid	EPA 8081B	GC-ECD	Hexachlorobutadiene
Aqueous/Solid	EPA 8081B	GC-ECD	Hexachloroethane
Aqueous/Solid	EPA 8081B	GC-ECD	Isodrin
Aqueous/Solid	EPA 8081B	GC-ECD	Mirex
Aqueous/Solid	EPA 8081B	GC-ECD	Oxychlordane
Aqueous/Solid	EPA 8081B	GC-ECD	trans-Nonachlor
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (PCB 206)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,3',4,4',5,6-Octachlorobiphenyl (PCB 195)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,3',4,4',5,5',6,6' Decachlorobiphenyl (PCB 209)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,3',4,4',5-Heptachlorobiphenyl (PCB 170)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,3',4,4'-Hexachlorobiphenyl (PCB 128)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4,4',5,5'-Heptachlorobiphenyl (PCB 180)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4,4',5',6-Heptachlorobiphenyl (PCB 183)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4,4',5'-Hexachlorobiphenyl (PCB 138)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4,4',6,6'-Heptachlorobiphenyl (PCB 184)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4',5,5',6-Heptachlorobiphenyl (PCB 187)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4,5'-Pentachlorobiphenyl (PCB 87)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,4',5-Pentachlorobiphenyl (PCB 90)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,5'-Tetrachlorobiphenyl (PCB 44)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',4,4',5,5'-Hexachlorobiphenyl (PCB 153)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',4,5,5'-Pentachlorobiphenyl (PCB 101)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',5,6'-Tetrachlorbiphenyl (PCB 53)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',5-Trichlorobiphenyl (PCB 18)

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3',4,4',6-Hexachlorobiphenyl (PCB 158)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3',4,4',5,5' Hexachlorobiphenyl (PCB 167)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3',4,4',5',6-Hexachlorobiphenyl (PCB 168)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,4,4',5-Pentachlorobiphenyl (PCB 114)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3',4,4',5-Pentachlorobiphenyl (PCB 118)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3',4,4',5-Pentachlorobiphenyl (PCB 123)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,4,4'-Tetrachlorobiphenyl (PCB 60)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3',4,4'-Tetrachlorobiphenyl (PCB 66)
Aqueous/Solid	EPA 8082A	GC-ECD	2,4,4'-Trichlorobiphenyl (PCB 28)
Aqueous/Solid	EPA 8082A	GC-ECD	2,4'-Dichlorobiphenyl (PCB 8)
Aqueous/Solid	EPA 8082A	GC-ECD	3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)
Aqueous/Solid	EPA 8082A	GC-ECD	3,3',4,4',5-Pentachlorobiphenyl (PCB 126)
Aqueous/Solid	EPA 8082A	GC-ECD	3,3',4,4'-Tetrachlorobiphenyl (PCB 77)
Aqueous/Solid	EPA 8082A	GC-ECD	3,4,4',5-Tetrachlorobiphenyl (PCB 81)
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1016
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1221
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1232
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1242
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1248
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1254
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1260
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1262
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1268
Aqueous/Solid	EPA 8151A	GC-ECD	2,4,5-T
Aqueous/Solid	EPA 8151A	GC-ECD	2,4,5-TP (Silvex)
Aqueous/Solid	EPA 8151A	GC-ECD	2,4-D
Aqueous/Solid	EPA 8151A	GC-ECD	2,4-DB
Aqueous/Solid	EPA 8151A	GC-ECD	Dalapon
Aqueous/Solid	EPA 8151A	GC-ECD	Dicamba
Aqueous/Solid	EPA 8151A	GC-ECD	Dichloroprop

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8151A	GC-ECD	Dinoseb
Aqueous/Solid	EPA 8151A	GC-ECD	MCPA
Aqueous/Solid	EPA 8151A	GC-ECD	MCPP
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,1,2-Tetrachloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,1-Trichloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,2-Trichloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1-Dichloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dibromoethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dichloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,3,5-Trimethylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,3-Dichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,3-Dichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,4-Dichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1-phenylpropane
Aqueous/Solid	EPA 8260B, C	GC-MS	2,2-Dichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Butanone (MEK)
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Chloroethylvinylether
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Chlorotoluene
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Hexanone
Aqueous/Solid	EPA 8260B, C	GC-MS	4-Chlorotoluene
Aqueous/Solid	EPA 8260B, C	GC-MS	4-Isopropyltoluene
Aqueous/Solid	EPA 8260B, C	GC-MS	4-Methyl-2-pentanone (MIBK)
Aqueous/Solid	EPA 8260B, C	GC-MS	Acetone
Aqueous/Solid	EPA 8260B, C	GC-MS	Acetonitrile
Aqueous/Solid	EPA 8260B, C	GC-MS	Acrolein
Aqueous/Solid	EPA 8260B, C	GC-MS	Acrylonitrile
Aqueous/Solid	EPA 8260B, C	GC-MS	Benzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromochloromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromodichloromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromoform

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromomethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Carbon disulfide
Aqueous/Solid	EPA 8260B, C	GC-MS	Carbon Tetrachloride
Aqueous/Solid	EPA 8260B, C	GC-MS	Chlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Chlorodibromomethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Chloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Chloroform
Aqueous/Solid	EPA 8260B, C	GC-MS	Chloromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	cis-1,2-Dichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	cis-1,3-Dichloropropene
Aqueous/Solid	EPA 8260B, C	GC-MS	Dibromomethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Dichlorodifluoromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Dichloromethane (Methylene Chloride)
Aqueous/Solid	EPA 8260B, C	GC-MS	Di-isopropylether (DIPE)
Aqueous/Solid	EPA 8260B, C	GC-MS	DIPE
Aqueous/Solid	EPA 8260B, C	GC-MS	ETBE
Aqueous/Solid	EPA 8260B, C	GC-MS	Ethyl Benzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Ethylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Freon 11
Aqueous/Solid	EPA 8260B, C	GC-MS	Freon 113
Aqueous/Solid	EPA 8260B, C	GC-MS	Hexachlorobutadiene
Aqueous/Solid	EPA 8260B, C	GC-MS	Isopropylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Methyl-tert-butylether (MTBE)
Aqueous/Solid	EPA 8260B, C	GC-MS	Naphthalene
Aqueous/Solid	EPA 8260B, C	GC-MS	n-Butylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	n-Propylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	sec-Butylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Styrene
Aqueous/Solid	EPA 8260B, C	GC-MS	tert-amylmethylether (TAME)
Aqueous/Solid	EPA 8260B, C	GC-MS	tert-Butyl alcohol
Aqueous/Solid	EPA 8260B, C	GC-MS	tert-butylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Tetrachloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	Toluene
Aqueous/Solid	EPA 8260B, C	GC-MS	trans-1,2-Dichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	trans-1,3-Dichloropropene

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8260B, C	GC-MS	Trichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	Trichlorofluoromethane (Freon 11)
Aqueous/Solid	EPA 8260B, C	GC-MS	Vinyl acetate
Aqueous/Solid	EPA 8260B, C	GC-MS	Vinyl chloride
Aqueous/Solid	EPA 8260B, C	GC-MS	Xylene, total
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1-Dichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1-Dichloropropene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2,3-Trichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2,3-Trichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2,4-Trimethylbenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,2-Dichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,3-Dichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,4-Dichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4,5-Trichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4,6-Trichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dimethylphenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dinitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dinitrotoluene
Aqueous/Solid	EPA 8270C, D	GC-MS	2,6-Dichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,6-Dinitrotoluene
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Chloronaphthalene
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Chlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Methyl-4,6-Dinitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Methylnaphthalene
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Methylphenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Nitroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Nitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	3,3-Dichlorobenzidine
Aqueous/Solid	EPA 8270C, D	GC-MS	3-Nitroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Bromophenyl-phenylether
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Chloro-3-methylphenol
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Chloroaniline

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Chlorophenyl-phenylether
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Methylphenol (and/or 3-Methylphenol)
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Nitroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Nitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	Acenaphthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Acenaphthylene
Aqueous/Solid	EPA 8270C, D	GC-MS	Aniline
Aqueous/Solid	EPA 8270C, D	GC-MS	Anthracene
Aqueous/Solid	EPA 8270C, D	GC-MS	Azinphos-methyl (Guthion)
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzidine
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(a)anthracene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(a)pyrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(k)fluoranthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzoic acid
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzyl alcohol
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-Chloroethoxy)methane
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-Chloroethyl)ether
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-Chloroisopropyl)ether
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-ethylhexy)phthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Butyl benzyl phthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Carbazole
Aqueous/Solid	EPA 8270C, D	GC-MS	Chlorpyrifos
Aqueous/Solid	EPA 8270C, D	GC-MS	Chrysene
Aqueous/Solid	EPA 8270C, D	GC-MS	Demeton O & S
Aqueous/Solid	EPA 8270C, D	GC-MS	Diazinon
Aqueous/Solid	EPA 8270C, D	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solid	EPA 8270C, D	GC-MS	Dibenzofuran
Aqueous/Solid	EPA 8270C, D	GC-MS	Dichlorvos
Aqueous/Solid	EPA 8270C, D	GC-MS	Diethyl phthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	dimethoate
Aqueous/Solid	EPA 8270C, D	GC-MS	Dimethylphthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	di-n-butylphthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Di-n-octylphthalate

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270C, D	GC-MS	Disulfoton
Aqueous/Solid	EPA 8270C, D	GC-MS	Ethoprop
Aqueous/Solid	EPA 8270C, D	GC-MS	Fluoranthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Fluorene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachlorobutadiene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachlorocyclopentadiene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachloroethane
Aqueous/Solid	EPA 8270C, D	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Isophorone
Aqueous/Solid	EPA 8270C, D	GC-MS	Naphthalene
Aqueous/Solid	EPA 8270C, D	GC-MS	Nitrobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitrosodiethylamine
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitrosodimethylamine
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitroso-di-n-propylamine
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitrosodiphenylamine
Aqueous/Solid	EPA 8270C, D	GC-MS	o-Toluidine
Aqueous/Solid	EPA 8270C, D	GC-MS	Parathion, ethyl
Aqueous/Solid	EPA 8270C, D	GC-MS	Parathion, methyl
Aqueous/Solid	EPA 8270C, D	GC-MS	Pentachlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	Pentachlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	Phenanthrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Phenol
Aqueous/Solid	EPA 8270C, D	GC-MS	Phorate
Aqueous/Solid	EPA 8270C, D	GC-MS	Pyrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Pyridine
Aqueous/Solid	EPA 8270C, D	GC-MS	Ronnel
Aqueous/Solid	EPA 8270C, D	GC-MS	Stirophos
Aqueous/Solid	EPA 8270C, D	GC-MS	Sulfotepp
Aqueous/Solid	EPA 8270C, D	GC-MS	2,3,4,6-Tetrachlorophenol
Aqueous/Solid	EPA 8270C,D	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solid	EPA 8270 SIM	GC-MS	2-Methylnaphthalene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Acenaphthene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Acenaphthylene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Anthracene

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(a)anthracene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(a)pyrene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(k)fluoranthene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Chrysene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Fluoranthene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Fluorene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Naphthalene
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 100
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 128
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 138
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 153
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 154
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 17
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 183
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 190
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 203
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 206
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 209
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 28
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 47
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 66
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 71
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 85
Aqueous/Solid	EPA 8270 SIM	GC-MS	PBDE 99
Aqueous/Solid	EPA 8270 SIM	GC-MS	p-Dioxane
Aqueous/Solid	EPA 8270 SIM	GC-MS	Phenanthrene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Pyrene
Aqueous/Solid	EPA 8330B	HPLC	1,3,5-Trinitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	1,3-Dinitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	2,4,6-Trinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	2,4-Dinitrotoluene

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8330B	HPLC	2,6-Dinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	2-Amino-4,6-dinitrtoluene
Aqueous/Solid	EPA 8330B	HPLC	2-Nitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	3,5-Dinitroaniline
Aqueous/Solid	EPA 8330B	HPLC	3-Nitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	4-Amino-2,6-dinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	4-Nitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Aqueous/Solid	EPA 8330B	HPLC	Nitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	Nitroglycerin
Aqueous/Solid	EPA 8330B	HPLC	Pentachloronitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	Pentaerythritoltetranitrate
Aqueous/Solid	EPA 8330B	HPLC	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)
Aqueous/Solid	EPA 8330B	HPLC	Tetryl (methyl-2,4,6-trinitrophenylnitramine)
Aqueous/Solid	EPA 9012B	Colorimetry	Total Cyanide
Aqueous/Solid	EPA 9030B	Distillation Unit	Sulfide
Aqueous/Solid	EPA 9056A	IC	Bromide
Aqueous/Solid	EPA 9056A	IC	Chloride
Aqueous/Solid	EPA 9056A	IC	Fluoride
Aqueous/Solid	EPA 9056A	IC	Sulfate
Aqueous/Solid	EPA 9065	Spectrophotometer	Total Phenolics
Aqueous/Solid	LCP-NITG	HPLC/UV	Nitroguanidine
Aqueous/Solid	NWTPH-Dx	GC-FID	Residual Range Organics
Aqueous/Solid	SM4500 NH3 G	Colorimetry	Ammonia
Aqueous/Solid	SOC-Butyl	GC-FPD	Di-n-butyltin
Aqueous/Solid	SOC-Butyl	GC-FPD	n-Butyltin
Aqueous/Solid	SOC-Butyl	GC-FPD	Tetra-n-butyltin
Aqueous/Solid	SOC-Butyl	GC-FPD	Tri-n-butyltin
Aqueous/Solid	SOC-OTTO	GC-ECD	Otto Fuel
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Aldrin
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Alpha-BHC
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	beta-BHC
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	DDD (4,4)
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	DDE (4,4)
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	DDT (4,4)

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	delta-BHC
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Dieldrin
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endosulfan I
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endosulfan II
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endosulfan sulfate
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endrin
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endrin aldehyde
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endrin ketone
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	gamma-BHC
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Heptachlor
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Heptachlor Epoxide (beta)
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Methoxychlor
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorobutane sulfonate
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorobutanesulfonic Acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorobutanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorodecane Sulfonate
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorodecanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorododecanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluoroheptanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorohexane sulfonate
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorohexanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorohexylsulfonic Acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorononanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorooctane sulfonate
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorooctanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluorooctylsulfonic Acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluoropentanoic acid
Aqueous/Solid	SOP-LCP-PFC	HPLC/MS/MS	Perfluoroundecanoic acid

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Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 1640	Reductive Metals Precipitation	Prep Method
Aqueous	EPA 3010A	Acid Digestion	Metals Digestion
Aqueous	EPA 3020A	Acid Digestion	Metals Digestion
Aqueous	EPA 3520C	Continuous Liquid-Liquid Extraction	Extractable Prep
Aqueous	EPA 3535A	Solid Phase Extraction	Prep Method
Aqueous	EPA 5030B	Purge and Trap for Volatiles	Volatile Prep
Aqueous	SOP-MET-DIG	Acid Digestion	Metals Digestion
Solid	EPA 3050B	Acid Digestion	Metals Digestion
Solid	EPA 3060	Alkaline Digestion for Cr(VI)	Alkaline Digestion for Cr(VI) only
Solid	EPA 3541	Automated Soxhlet Extraction	Extractable Prep
Solid	EPA 3550B	Ultrasonic Extraction	Extractable Prep
Solid	EPA 5035A	Purge and Trap for Volatiles	Voc Organics
Solid	EPA 5050	Bomb Digestion	Prep Method
Solid	EPA 9013	Midi-Distillation	Cyanides
Solid	SOP-GEN-AVS	Acid Digestion	Simultaneously Extracted Metals
Aqueous/Solids	ASTM D3590-89	Digestion	TKN
Aqueous/Solids	EPA 1311	TCLP Extraction	Physical Extraction
Aqueous/Solids	EPA 3620C	Florisil clean up	Extractable Cleanup
Aqueous/Solids	EPA 3630C	Silica gel clean up	Extractable Prep
Aqueous/Solids	EPA 3640A	Gel-Permeation Clean-up	Extractable Cleanup
Aqueous/Solids	EPA 3660	Sulfur Clean-up	Extractable Prep
Aqueous/Solids	EPA 3665A	Acid clean up	Extractable Cleanup

END

OF

DOCUMENT

ALS Standard Operating Procedure

DOCUMENT TITLE:	1,2-DIBROMOETHANE (EDB), 1,2-DIBROMO-3-CHLORO-PROPANE (DBCP), AND 1,2,3-TRICHLOROPROPANE (123TCP) IN WATER BY MICROEXTRACTION AND GAS CHROMATOGRAPHY
REFERENCED METHOD:	EPA METHOD 504.1
SOP ID:	SVD-504.1
REVISION NUMBER:	11
EFFECTIVE DATE:	09/15/2015

ALS Environmental

1,2-DIBROMOETHANE (EDB), 1,2-DIBROMO-3-CHLORO-PROPANE (DBCP), AND 1,2,3-TRICHLOROPROPANE (123TCP) IN WATER BY MICROEXTRACTION AND GAS CHROMATOGRAPHY

METHOD 504.1

ALS-KELSO

SOP ID:	SVD-504.1	Rev. Number:	11	Effective Date:	09/15/2015

Approved By: _____ Date: 8/31/15
Department Supervisor/Technical Director – Loren Portwood

Approved By: _____ Date: 8/31/15
QA Manager – Carl Degner

Approved By: _____ Date: 9/1/15
Laboratory Director – Jeff Grindstaff

Issue Date: _____ Doc Control ID#: _____ Issued To: _____

ANNUAL REVIEW

SIGNATURES BELOW INDICATE NO PROCEDURAL CHANGES HAVE BEEN MADE TO THE SOP SINCE THE APPROVAL DATE ABOVE. THIS SOP IS VALID FOR TWELVE ADDITIONAL MONTHS FROM DATE OF THE LAST SIGNATURE UNLESS INACTIVATED OR REPLACED BY SUBSEQUENT REVISIONS.

Signature	Title	Date

TABLE OF CONTENTS

1,2-DIBROMOETHANE (EDB), 1,2-DIBROMO-3-CHLORO-PROPANE (DBCP), AND 1,2,3-TRICHLOROPROPANE (123TCP) IN WATER BY MICROEXTRACTION AND GAS CHROMATOGRAPHY

1. SCOPE AND APPLICATION

1.1. This Standard Operating Procedure (SOP) describes the procedure used for the analysis of 1,2-Dibromoethane (EDB), 1,2-Dibromo-Chloropropane (DBCP), and 1,2,3-Trichloropropane (123TCP) by micro-extraction and gas chromatography using Method 504.1. This procedure describes both the preparation and analysis procedures used to determine the target analytes and reporting limits listed.

1.2. This procedure is used to determine the analytes of interest in drinking waters. The Method Reporting Limits (MRLs) for target analytes are presented in Table 1. Method Detection Limits (MDLs) that have been achieved are also given.

1.3. 1.3. In cases where there is a project-specific quality assurance plan (QAPP), the project manager identifies and communicates the QAPP-specific requirements to the laboratory. In general, project specific QAPP's supersede method specified requirements. An example of this are projects falling under DoD ELAP. QC requirements defined in the SOP Department of Defense Projects – Laboratory Practices and Project Management (ADM-DOD) may supersede the requirements defined in this SOP.

2. METHOD SUMMARY

2.1. This Standard Operating Procedure (SOP) describes the procedure used for the analysis of 1,2-Dibromoethane (EDB), 1,2-Dibromo-Chloropropane (DBCP), and 1,2,3-Trichloropropane (123TCP) by micro-extraction and gas chromatography using Method 504.1. This procedure describes both the preparation and analysis procedures used to determine the target analytes and reporting limits listed.

3. DEFINITIONS

3.1. Analysis Sequence - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration (initial or continuing verification) followed by sample extracts interspersed with calibration standards (CCBs, CCVs, etc...) The sequence ends when the set of samples has been injected or when qualitative and/or quantitative QC criteria indicate an out-of-control situation.

3.2. Independent Calibration Verification (ICV) - Initial calibration verification standards are analyzed after initial calibration with newly prepared standards but prior to sample analysis, in order to verify the validity of the standards used in calibration. The ICV standards are prepared from materials obtained from a source different from that used to prepare calibration standards.

3.3. Matrix Spike/Duplicate Matrix Spike (MS/DMS) Analysis - In the matrix spike analysis, predetermined quantities of target analytes are added to a sample matrix prior to sample

preparation and analysis. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the method used for the analysis. Samples are split into duplicates, spiked, and analyzed as a MS/DMS pair. Percent recoveries are calculated for each of the analytes detected. The relative percent difference (RPD) between the duplicate spikes (or samples) is calculated and used to assess analytical precision.

3.4. Standard Curve - A standard curve is a calibration curve which plots concentrations of a known analyte standard versus the instrument response to the analyte. The appropriate criteria for assessing the validity of the calibration curve must be followed prior to quantitation of target analytes in actual sample analyses.

3.5. Method Blank (MB) - The method blank is an artificial sample composed of analyte-free water or solid matrix and is designed to monitor the introduction of artifacts into the analytical process. The method blank is carried through the entire analytical procedure.

3.6. Continuing Calibration Verification Standard (CCV) - A standard analyzed at specified intervals. Used to verify that the initial calibration curve is still valid for quantitative purposes.

3.7. Instrument Blank (CCB) - The instrument blank (also called continuing calibration blank) is a volume of clean solvent analyzed on each column and instrument used for sample analysis. The purpose of the instrument blank is to determine the levels of contamination associated with the instrumental analysis itself, particularly with regard to the carry-over of analytes from standards or highly contaminated samples into subsequent sample analyses.

3.8. Laboratory Control Sample (LCS): The laboratory control sample is an artificial sample composed of analyte-free water which is spiked with a known concentration of the analytes of interest.

3.9. Laboratory Fortified Blank (LFB) – A laboratory blank fortified at the MRL used to verify the minimum reporting limit. The LFB is carried through the entire extraction and analytical procedure.

4. INTERFERENCES

4.1. Impurities contained in the extracting solvent may account for problems with interferences. Solvent blanks should be analyzed on each new lot of solvent before use. Monitoring the method blanks also checks the extracting solvent. Whenever interferences are noted in the method blank, the analyst should retest the extracting solvent. It may be necessary to obtain a new source of solvent. Alternatively, low-level interferences generally can be removed by distillation or column chromatography. Protect interference-free solvents by storing in an area free of organochlorine solvents.

4.2. This liquid/liquid extraction technique efficiently extracts a wide boiling range of non-polar organic compounds and, in addition, extracts polar organic components of the sample with varying efficiencies. These co-extracted materials may interfere with the chromatographic determination. Low concentrations of EDB may be masked by very high levels of dibromochloromethane (DBCM), a common disinfection byproduct of chlorinated drinking waters. A DBCM standard should be analyzed periodically to establish resolution between EDB and DBCM.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personal protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.2. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in SDSs where available. Refer to the ALS Environmental, Health and Safety Manual and the appropriate SDS prior to beginning this method.

5.3. EDB, DBCP, and 123TCP have been tentatively classified as known or suspected human or mammalian carcinogens. Pure standard materials and stock standard solutions of these compounds should be handled in a hood.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE

6.1. Sample Collection

6.1.1. Collect all samples in 40mL VOA vials into which 3mg of sodium thiosulfate crystals have been added just prior to shipping to the sampling site. Alternately, 75 µL of freshly prepared sodium thiosulfate solution (40 mg/mL) may be added to empty 40mL bottles just prior to sample collection.

6.1.2. Follow sampling instructions provided in Method 504.1 when sampling from a water tap or well.

6.1.3. Field blanks should be handled along with each sample set, which is composed of the samples collected from the same general sampling site at approximately the same time. At the laboratory, fill a minimum of two sample bottles with reagent water, seal, and ship to the sampling site along with sample bottles. Wherever a set of samples is shipped and stored, it must be accompanied by field blanks.

6.2. Sample Preservation and Storage

6.2.1. A dechlorinating agent (sodium thiosulfate) must be added to each sample to avoid the possibility of reactions that may occur between residual chlorine and indeterminate contaminants present in some solvents, yielding compounds that may subsequently interfere with the analysis. The presence of sodium thiosulfate will arrest the formation of DBCM.

6.2.2. Samples must be iced or refrigerated at 4 ± 2ºC from time of collection until extraction. The sample storage area must be free of organic solvent vapors.

6.3. Samples must be extracted within 14 days of collection. Samples not extracted within this period must be discarded and replaced. Because of the potential for solvent evaporation, it is preferred that extracts be analyzed immediately following preparation. When necessary, extracts may be stored in tightly capped vials at 4 ° C or less for up to 24 hr.

7. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

7.1. Reagents

7.1.1. Reagent grade chemicals shall be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination. The preparation for all laboratory prepared reagents and solutions must be documented in a laboratory logbook. Refer to ADM-RTL, *Reagent/Standards Login and Tracking* for the complete procedure and documentation requirements.

7.1.2. Sodium Chloride, NaCl, ACS reagent grade. This should be pulverized and heated in a muffle furnace at 400˚ for 30 minutes prior to use.

7.1.3. Sodium thiosulfate, $Na_2S_2O_3$ -- ACS reagent grade, for preparation of solution (40 mg/mL), dissolve 1 g of $Na_2S_2O_3$ in reagent water and bring to 25 mL volume in a volumetric flask.

7.1.4. Methanol, pesticide grade.

7.1.5. Hexane, pesticide grade.

7.2. Standards

7.2.1. Stock standard solutions may be purchased from a number of vendors. All standards purchased from vendors must be traceable to NIST or A2LA certified reference materials. The vendor-assigned expiration date is used. Stock solutions are purchased from Ultra Scientific, AccuStandard, or equivalent.

7.2.2. The calibration standards are extracted using the procedure in section 11.0. The analyst prepares a minimum 3-point calibration curve containing each target analyte using the working standard. CCVs are prepared with each extraction batch to demonstrate that the original calibration is acceptable. The concentrations of the standards should encompass the range of expected concentrations of the samples to be analyzed. The nominal concentrations of the standards are: 0.075, 0.125, 0.25, 0.625, 1.25, 3.75, 5.0, and 10 µg/L.

7.2.3. The ICV standards are prepared from materials obtained from a source different from that used to prepare calibration standards, and extracted using the procedure in section 11.0. The ICV is extracted in the same batch as the calibration standards and analyzed following the calibration and before any sample analysis.

7.2.4. A matrix spike solution is prepared from the stock solution in methanol. This solution is stored in the refrigerator for up to one month. Solutions may be stored for up to one month as long as the stability of the solution is demonstrated.

8. APPARATUS AND EQUIPMENT

8.1. Gas Chromatography system

8.1.1. Gas Chromatograph, equipped with cool-on-column or split/splitless injection port that is temperature programmable with an ECD, Agilent 6890 or 7890.

8.1.2. Autosampler, capable of reproducible 5.0 µL injections, Agilent 7683

8.1.3. Columns, J&W Scientific or equivalent columns are used;
Column 1: Rtx-CLPesticides (or equivalent) 30m x 0.32mm ID, 0.50 µm df
Column 2: Rtx-CLPesticides II (or equivalent) 30m x 0.32mm ID, 0.25 µm df

8.1.4. Data system, compatible with detectors and capable of measuring peak areas and retention times, Agilent EnviroQuant.

8.2. Sample Containers -- 40mL screw cap VOA vials with Teflon™-lined caps. Individual vials shown to contain at least 40.0mL can be calibrated at the 35.0mL mark so that volumetric, rather than gravimetric, measurements of sample volumes can be performed. Pre-cleaned vials may be purchased. Alternatively, wash vials and septa with detergent and rinse with tap and distilled water. Allow the vials and septa to air dry at room temperature, place in a 105°C oven for one hour, then remove and allow to cool in an area free of organic solvent vapors.

8.3. Vials -- auto sampler, crimp top or screw cap with Teflon™ faced septa, 1.8mL.

8.4. Micro Syringes – Various sizes.

8.5. Disposable Pipettes -- 2.0mL and 5.0mL transfer.

8.6. Standard Solution Storage Containers -- bottles with Teflon™ lined screw caps.

9. PREVENTIVE MAINTENANCE

9.1. All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. Maintenance entries should include date, symptom of problem, corrective actions, description of maintenance, date, and name. The log should contain a reference to return to analytical control.

9.2. Carrier gas - Inline purifiers or scrubbers should be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.

9.3. Gas Chromatograph

9.3.1. Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column. Injection port maintenance includes changing the injection port liner, column ferrule, and autosampler syringe as needed. Liners should be changed when recent sample analyses predict a problem with chromatographic performance. In some cases liners may be cleaned and re-used.

9.3.2. Clipping off a small portion of the head of the column or guard column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and “clean” (uniform, without fragmentation) by using the proper column-cutting tool.

9.3.3. Over time, the column will exhibit poorer overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on

the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

9.3.4. The autosampler should be cleaned periodically. This includes turret cleaning and cleaning or replacing the syringe. Refer to manufacturer's instructions for autosampler restarting.

9.3.5. The detector should be leak-checked and serviced as specified by the manufacturer.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP perform analysis and interpretation of the results. This demonstration is in accordance with the training program of the laboratory. The department supervisor/manager or designee performs final review and sign-off of the data.

10.2. It is the responsibility of the department supervisor/manager to document analyst training. Documenting method proficiency, as described in Method 515.4, and in ADM-TRAIN, *ALS-Kelso Training Procedure*, is also the responsibility of the department supervisor/manager.as described

11. PROCEDURE

11.1. Sample Preparation

11.1.1. For samples and field blanks contained in 40 mL VOA vials, remove the container cap. Discard a 5mL volume using a 5mL transfer pipette or 10 mL graduated cylinder. Weigh the container with contents to the nearest 0.1 g and record this weight on the benchsheet for subsequent sample volume determination. Deionized water (35mL) is used for method blanks, lab control samples and standards.

11.1.2. Add matrix spike and working solution to appropriate vessels as listed in 11.1.3. Add approximately 7 grams of muffled NaCl to the samples. Add 2ml of hexane to each extraction vessel. After replacing the cap, the sample is shaken vigorously for 2 minutes. The sample is allowed to settle for approximately 5 minutes. The hexane layer is placed in a 2 ml autosampler vial for GC analysis. The water is emptied and the sample vial is weighed to determine the sample volume extracted.

11.1.3. Aqueous standards (if needed), LCS, MS and CCVs are prepared such that the final concentrations of the final extract are as follows:

Final Conc.	Amt. of 50 µg/L spike Solution added.

Cal level 1	0.075 µg/L	3 µl
Cal level 2	0.125 µg/L	5 µl
Cal level 3	0.250 µg/L	10 µl
Cal level 4	0.625 µg/L	25 µl
Cal level 5	1.25 µg/L	50 µl
Cal level 6	3.75 µg/L	150 µl
Cal level 7	5.00 µg/L	200 µl
Cal level 8	10.0 µg/L	400 µl
ICV	1.25 µg/L	50 µl
LCS	4.375 µg/L	175 µl
MS	4.375 µg/L	175 µl
CCV1	1.25 µg/L	50 µl
CCV2	5.0 µg/L	200 µl
LFB Check	0.075 µg/L	3 µl
TCP MRL Check	0.625 µg/L	25 µl

All calibration standards, LCS, MS, CCVs and MDL checks are prepared by extracting in the same manner as samples.

11.2. Analysis

11.2.1. Establish the operating parameters on the instrument.

- Inlet – Splitless.
- Detector Temperature - 330ºC.
- Injector temperature –
  - 100ºC for 0.25 min., 250ºC/min to 250ºC, hold 10 min.
- Injection volume - 5 µl.
- Flow rate – Constant flow at 2.3 ml/min.
- Temperature program –
  - Initial 55ºC and hold 3.0 min.
  - program at 3ºC/min. to 60ºC with no hold.
  - program at 25ºC /min. to 85ºC with no hold.
  - program at 30˚C/min. to 300˚C for 4 min.
- Using the above conditions the total run time is about 22 min.

11.2.2. Calibration

NOTE: Refer to SOC-CAL, *Calibration of Instruments for Organics Chromatographic Analysis* for general calibration procedure, policies, and calculations for various calibration models. Specific calibration procedures are given below:

11.2.2.1. A calibration curve using a minimum of three points is generated using the standards prepared during extraction. Although 3-point calibrations are acceptable for EPA Method 504.1, a 5-point calibration is recommended. The standard level should bracket the expected range of concentrations expected in samples.

11.2.2.2. Starting with the standard of lowest concentration, analyze each calibration standard.

11.2.2.3. Tabulate the response (peak area) versus the concentration of the standard. The ratio of the response to the amount injected, defined as the calibration factor (CF), is calculated for each analyte at each standard concentration.

11.2.2.4. If the percent relative standard deviation (%RSD) of the calibration factor is less than 20% over the working range, linearity through the origin can be assumed, and the average calibration factor may be used in place of a calibration curve.

11.2.2.5. If %RSD exceeds 20%, the analyst may plot a linear or quadratic regression curve. Refer to the SOP SOC-CAL for procedures for evaluating alternative curve fits.

11.2.2.6. The calibration is verified by an independent source with each new stock solution. This is done by preparing an independent calibration verification standard (ICV), a dilution of a stock solution purchased from a different vendor, or from a stock solution which is different from the stock used to prepare calibration standards, every time a new stock solution is used. The ICV must meet the same criteria as for CCVs (following section).

11.2.3. Continuing Calibration Verification

11.2.3.1. Verify the calibration daily by the extraction and analysis of a calibration standard for each 12 hour shift of operation. A calibration standard will be analyzed at the beginning of each period of operation, and also at the end of each period of continuous instrument operation, or 12 hours, whichever is less. CCV concentrations will be prepared such that the final extract solution concentrations will be 1.25ug/L and 5.0ug/L. Calculate the % difference (%D) or % drift for the analytes in the CCV using either the calculated concentration or calibration factor. The %D must be within ± 30%.

11.2.3.2. If the CCV fails the ± 30% criteria, evaluate whether the prior samples can be reported: The samples are considered reportable only if the CCV has exceeded the criteria high (>130%) and there are no hits in the sample. Re-analyze any other samples under valid calibration conditions.

11.2.3.3. If a problem related to the GC system has been determined to be the cause of the failed CCV, perform whatever maintenance is necessary before injecting a CCV or recalibrating and proceeding with sample analysis.

11.2.4. Sample Analysis

11.2.4.1. Analyze the samples using the conditions established prior to calibration. Samples are analyzed in a set referred to as an analysis sequence.

11.2.4.2. Identify the method analytes in the sample chromatogram by comparing the retention time of the suspect peaks to retention times of the calibration standards and the laboratory control standards analyzed using identical conditions. Analytes are tentatively identified in samples when peaks are

observed in the RT window; however, the experience of the analyst weighs heavily in the interpretation of all chromatograms.

11.2.4.3. Confirmation of all tentative hits must be made. Injecting the sample extract on two columns with dissimilar phases simultaneously provides confirmation. If the retention time matches on both columns, then the hit for the analyte is considered a confirmed hit.

12. QA/QC REQUIREMENTS

12.1. Initial Precision and Recovery Validation

12.1.1. The accuracy and precision of the procedure must be validated before analyses of samples begin, or whenever significant changes to the procedures have been made. To do this, four water samples are spiked with the LCS spike solution, then prepared and analyzed.

12.1.2. Calculate the mean concentration found in µg/L, and the standard deviation of the concentrations in µg/L, for each analyte. Each analyte should be between 70% and 130% of the true value. The RSD should be 20% or less. If the results for all three analytes meet these criteria, the system performance is acceptable. If any analyte fails to meet the criteria, correct the source of the problem and repeat the test.

12.2. Method Detection Limits and Method Reporting Limits

12.2.1. A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike seven blank matrix (water or soil) samples with MDL spiking solution at a level below the MRL. Follow the analysis procedures in Section 10 to analyze the samples.

12.2.2. Calculate the average concentration found (x) in µg/mL, and the standard deviation of the concentrations (s) in µg/mL for each analyte. Calculate the MDL for each analyte. Refer to CE-QA011, *Performing Method Detection Limits Studies and Establishing Limits of Detection and Quantification.*

12.2.3. The Method Reporting Limits (MRLs) used at ALS are the routinely reported lower limits of quantitation, which take into account day-to-day fluctuations in instrument sensitivity as well as other factors. These MRLs are the levels to which ALS routinely reports results in order to minimize false positive or false negative results. The MRL is normally two to ten times the MDL.

12.3. Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in ADM-BATCH, *Sample Batches*. In general, these include:

12.3.1. Method Blank

12.3.1.1. A method blank is extracted and analyzed with every batch of 20 (or fewer) samples to demonstrate that there are no method interferences. If the method blank shows any hits above the reporting limit, corrective action

must be taken. Corrective action includes recalculation, reanalysis, system cleaning, or re-extraction and reanalysis.

12.3.2. Lab Control Sample (LCS)

12.3.2.1. The laboratory control sample is composed of analyte-free water into which is spiked a number of appropriate target analytes. The LCS is designed to monitor the accuracy of the procedure. The LCS is prepared such that the final concentration of the analytes is 4.375 µg/L in the final extract. Extract the LCS exactly as all samples.

12.3.3. Laboratory Fortified Blank (LFB)

12.3.3.1. A laboratory fortified blank is extracted and analyzed with every batch of 20 (or fewer) samples to demonstrate method recovery at the reporting limit. The concentration of the spike in the LFB should be at the MRL. The acceptance criterion is ±40%.

12.3.4. Matrix Spike

12.3.4.1. A matrix spike (MS) must be prepared and analyzed with every batch of 20 (or fewer) samples. Prepare the MS/DMS by adding a known volume of the matrix spike solution to the sample and determining the spiked sample concentration. Calculate percent recovery (%R) as:

$$\%R = \frac{X - X1}{TV} \times 100$$

Where X = Concentration of the analyte recovered
X1 = Concentration of unspiked analyte
TV = True value of amount spiked

12.3.4.2. Calculate Relative Percent Difference (RPD) as:

$$\%RPD = \frac{|R1 - R2|}{(R1 + R2)/2} \times 100$$

Where R1= High Result
R2= Lower Result

12.3.4.3. The acceptance limits for recoveries in the MS are 65-135%. If the MS recovery is out of acceptance limits for reasons other than matrix effects, corrective action must be taken. Corrective action includes recalculation, reanalysis, or re-extraction and reanalysis.

Note: For DoD projects, each batch of samples must contain an associated MS and MSD. If adequate sample for the MS is not available, it must be noted in the case narrative.

12.3.5. Method Detection Limit verification samples

12.3.5.1. A continuing MDL sample must be done weekly to demonstrate the ability to analyze low-level samples for EDB and DBCP. Extracting one sample prepared at 0.075 µg/L and analyzed as described in Section 11 meets this requirement. The recovery of each analyte must be 60-140%. If the sample fails, a new sample must be prepared. Repeated failure indicates a general problem of standards or equipment. If this occurs, locate and correct the problem.

12.4. Prior to preparation of samples, blanks should be analyzed to determine possible interferences from sample handling steps, reagents, or glassware. If the blanks show contamination, the source of the contamination should be isolated and minimized.

12.5. Control charts should be maintained for QC results. The charts should be reviewed periodically for trends in results. Control limits for QC analyses may be determined using the control charts or similar mechanism on an annual basis.

13. DATA REDUCTION AND REPORTING

13.1. The concentration of the analyte(s) in the sample extract (Cex) is calculated using the calibration factor or calibration curve. The concentration of analytes in the original samples is computed using the following equations:

$$Concentration\ (\mu g / L) = \frac{(Cex)\ (Vf)\ (D)}{(Vs)}$$

Where Cex = Concentration in extract in µg/mL
Vf = Final volume of extract in mL
D = Dilution factor
Vs = Volume of sample extracted, liters

Sample concentrations are reported when all QC criteria for the analysis has been met. Reported results not meeting QC criteria must be qualified with a standard ALS footnote.

13.2. Reporting

13.2.1. Refer to ADM-RG, *Data Reporting and Report Generation* for reporting guidelines.

13.2.2. Reports are generated using the STEALTH Data Reporting System which compiles the SMO login information and EnviroQuant data. This compilation is then transferred to a file, which STEALTH uses to generate a report. The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.2.3. As an alternative, reports are generated using Excel© templates located in R:\Drive. The analyst should choose the appropriate form and QC pages to correspond to required tier level and deliverables requirements. The results are then transferred, by hand or electronically, to the templates.

13.3. Data Review and Assessment

13.3.1. Following primary data interpretation and calculations, a secondary analyst reviews all data. Following generation of the report, the report is also reviewed. Refer to ADM-DREV, *Laboratory Data Review Process* for details. The person responsible for final review of the data report and/or data package should assess the overall validity and quality of the results and provide any appropriate comments and information to the Project Chemist to inclusion in the report narrative.

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Nonconformity and Corrective Action* (CE-QA008) for corrective action procedures. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example.

14.2.2. Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels
- Sample holding time missed due to laboratory error or operations
- Deviations from SOPs or project requirements
- Laboratory analysis errors impacting sample or QC results
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc)
- Sample preservation or handling discrepancies due to laboratory or operations error

15. METHOD PERFORMANCE

15.1. Available method performance data is given in the reference method. In addition, this procedure was validated through single laboratory studies of accuracy and precision as specified in Section 12.1. The method detection limit(s) and method reporting limit(s) were established for this method as specified in Section 12.2.

16. POLLUTION PREVENTION AND WASTE MANAGEMENT

16.1. It is the laboratory's practice to minimize the amount of solvents, acids and reagent used to perform this method wherever feasible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvent and reagents used in this method can be minimized when recycled or disposed of properly.

16.2. The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS EH&S Manual.

17. TRAINING

17.1 A minimum training outline is given below. Also, refer to the generic training plan given in ADM-TRAIN, *ALS-Kelso Training Procedure*.

17.1.1 Review literature (see references section). Read and understand the SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure as performed by an experienced analyst at least three times.

17.1.2 The next training step is to assist in the procedure under the guidance of an experienced analyst for a period of time. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.1.3 Perform initial precision and recovery (IPR) study as described above for water samples. Summaries of the IPR are reviewed and signed by the supervisor. Copies may be forwarded to the employee's training file. For applicable tests, IPR studies should be performed in order to be equivalent to NELAC's Initial Demonstration of Capability.

17.2 Training is documented following ADM-TRAIN, *ALS-Kelso Training Procedure*.

NOTE: When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

18. METHOD MODIFICATIONS

18.1. There are no known modifications in this laboratory standard operating procedure from the reference method.

19. REFERENCES

19.1. *1,2-Dibromoethane (EDB), 1,2-Dibromo-3-chloropropane (DBCP), and 1,2,3-Trichloropropane (123TCP) in Water by Microextraction and Gas Chromatography,* EPA Method 504.1, Revision 1.1, 1995, U.S. Environmental Protection Agency. Environmental Monitoring Systems Laboratory, Cincinnati, Ohio 45268.

19.2. *1,2-Dibromoethane (EDB) and 1,2-Dibromo-3-chloropropane (DBCP) in Water by Microextraction and Gas Chromatography,* EPA Method 504, Revision 2.0, 1989, U.S. Environmental Protection Agency. Environmental Monitoring Systems Laboratory, Cincinnati, Ohio 45268.

20. CHANGES SINCE THE LAST REVISION

20.1. Updated to current ALS format.

20.2. Minor typographical and formatting updates/corrections.
20.3. Section 11.2.1 – Initial temperature updated.
20.4. Section 12.3.3.1 – Revised acceptance criteria.

TABLE 1

TARGET COMPOUNDS, MRLs, and MDLs

Analyte	Method Detection Limit	Method Reporting Limit
	Water (µg/L)	Water (µg/L)
1,2-Dibromoethane	0.0030	0.01
1,2-Dibromo-3-chloropropane	0.0036	0.01
1,2,3-Trichloropropane	0.037	0.05

TABLE 2

Summary of Corrective Actions				
Method Reference	**Control**	**Specification and Frequency**	**Acceptance Criteria**	**Corrective Action**
EPA 504.1	ICAL	Prior to sample analysis	% RSD ≤ 20 R2 ≥ 0.995 COD ≥ 0.990	Correct problem then repeat ICAL
EPA 504.1	ICV	After ICAL	± 30% Diff	Correct problem and verify second source standard; rerun second source verification. If fails, correct problem and repeat initial calibration.
EPA 504.1	CCV	LL prior to sample analysis and Mid-Level every 10 samples	± 30% Diff	Correct problem then repeat CCV or repeat ICAL
EPA 504.1	Method Blank	Include with each analysis batch (up to 20 samples)	<MRL	If target exceeds MRL, reanalyze to determine if instrument was cause. If still noncompliant then: Re-extract or reanalyze samples containing contaminate, unless samples contain > 20x amount in blank.
EPA 504.1	Laboratory Control Sample	Include with each analysis batch (up to 20 samples)	See DQO Tables	If exceeds limits, re-extract and re-analyze
EPA 504.1	Matrix Spike	Include with each analysis batch (up to 20 samples)	See DQO Tables	Evaluate data to determine if the there is a matrix effect or analytical error
EPA 504.1	Matrix Spike Duplicate (DoD)	Include with each analysis batch (up to 20 samples)	≤ 30 %	Re-homogenize and re-analyze if result is > 5 X the MRL

ALS Standard Operating Procedure

DOCUMENT TITLE:	VOLATILE ORGANIC COMPOUNDS BY GC/MS
REFERENCED METHOD:	EPA 524.2
SOP ID:	VOC-524.2
REVISION NUMBER:	17
EFFECTIVE DATE:	1/28/2016

VOLATILE ORGANIC COMPOUNDS BY GC/MS METHOD 524.2

METHOD 524.2

ALS-KELSO

SOP ID:	VOC-524.2	Rev. Number:	17	Effective Date:	1/28/2016

Approved By: _____ Date: 1/19/16
Department Manager/Technical Director – Jon James

Approved By: _____ Date: 1/19/16
QA Manager – Carl Degner

Approved By: _____ Date: 1/19/16
Laboratory Director – Jeff Grindstaff

Issue Date: _____ Doc Control ID#: _____ Issued To: _____

ANNUAL REVIEW

SIGNATURES BELOW INDICATE NO PROCEDURAL CHANGES HAVE BEEN MADE TO THE SOP SINCE THE APPROVAL DATE ABOVE. THIS SOP IS VALID FOR TWELVE ADDITIONAL MONTHS FROM DATE OF THE LAST SIGNATURE UNLESS INACTIVATED OR REPLACED BY SUBSEQUENT REVISIONS.

Signature	Title	Date
Signature	Title	Date
Signature	Title	Date
Signature	Title	Date

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VOLATILE ORGANIC COMPOUNDS BY GC/MS METHOD 524.2

1. SCOPE AND APPLICATION

1.1. This procedure is used to determine the concentration of volatile organic compounds in surface water, ground water, and drinking water in any stage of treatment using EPA Method 524.2. The analyte reporting list and current Method Reporting Limits (MRLs) can be found in the ALS-Kelso Data Quality Objective (DQO) Tables.

1.2. Table 1 lists the compounds that can be determined by this method and the achievable method reporting limits (MRLs) in water. Other compounds may be analyzed to meet project requirements. Equivalent nomenclature for MRL includes Estimated Quantitation Limit (EQL). The reported MRL may be adjusted if required for specific project requirements; however, the capability of achieving other reported MRLs must be demonstrated. The Method Detection Limits (MDLs) that have been achieved are given in Table 1, and may change slightly as MDL studies are repeated.

2. METHOD SUMMARY

2.1. A sample aliquot is injected into the gas chromatograph (GC) by the purge and trap method. The compounds are separated on a fused silica capillary GC column. The compounds are detected by a mass selective detector (MSD), which gives both qualitative as well as quantitative information.

2.2. A 25 mL aliquot is purged and injected into the gas chromatograph (GC). In the purge and trap process an inert gas, nitrogen, is bubbled through the sample aliquot, at room temperature. This gas stream sweeps the volatile organic compounds out of the aqueous phase and into the gas stream - it purges the compounds out of the sample.

2.3. After purging the compounds out of the sample, the gas stream then passes through a sorbent column which selectively adsorbs, (traps) these compounds out of the helium. After the purging sequence is done, the sorbent column (the trap) is heated and desorbed onto the GC column. The GC column separates the compounds and passes then onto the MSD for identification and quantification.

2.4. Identification of the analytes of interest is performed by comparing the retention times of the analytes with the respective retention times of an authentic standard, and by comparing mass spectra of analytes with mass spectra of reference materials. Quantitative analysis is performed by using the authentic standard to produce a response factor and calibration curve, and using the calibration data to determine the concentration of an analyte in the extract. The concentration in the sample is calculated using the sample weight or volume and the extract volume.

3. DEFINITIONS

3.1. Analysis Window - Samples are analyzed in a set referred to as "a window". The window begins with the injection of the tune verification standard. After this standard has passed the method specific criteria a 12 hour analysis window is started. Next, a calibration curve or

a continuing calibration standard (CCV see below) is run. If the CCV meets the specified criteria, sample and QC analyses are run until the 12 hour time limit closes. A new window must then be opened and the sequence repeated.

3.2. Internal Standards - Internal standards are organic compounds which are similar to the analytes of interest but which are not found in the samples. The chosen internal standards are used to help calibrate the instrument's response and to compensate for slight instrument variations from injection to injection.

3.3. Independent Verification Standard (ICV) - A mid-level standard injected into the instrument after the calibration curve and prepared from a different source than the initial calibration standards. This is used to verify the validity of the initial calibration standards.

3.4. Standard Curve - A standard curve is a curve which plots concentrations of a known analyte standard versus the instrument response to the analyte.

3.5. Surrogate - Surrogates are organic compounds which are similar to the analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. The purpose of the surrogates is to evaluate the preparation and analysis of samples. These compounds are spiked into all blanks, standards, samples, and spiked samples prior to analysis. Percent recoveries are calculated for each surrogate.

3.6. Continuing Calibration Verification Standard (CCV) - A mid-level standard injected into the instrument at specified intervals and is used to verify the initial calibration.

3.7. Method Blank (MB) - The method blank (also called continuing calibration blank) is a volume of clean reagent water analyzed on each GC/MS used for sample analysis. The purpose of the blank is to determine the levels of contamination associated with the instrumental analysis itself, particularly with regard to the carry-over of analytes from standards or highly contaminated samples into other analyses.

3.8. Laboratory Control Sample (LCS) - In the LCS analysis, predetermined quantities of standard solutions of all analytes are added to a blank matrix prior to sample extraction and analysis. The purpose of the LCS is to monitor analytical control for the sample batch. Percent recoveries are calculated for each of the analytes.

3.9. Laboratory Fortified Blank (LFB) – A laboratory blank fortified at the MRL used to verify the minimum reporting limit. The LFB is carried through the entire extraction and analytical procedure.

4. INTERFERENCES

4.1. Interferences by common laboratory extraction solvents, such as Methylene Chloride, Acetone, and Freon 113 can cause problems. The area where volatile organic analyses are performed is kept free of these solvents through the design of the air handling systems and its isolation from other areas of the lab that use these solvent. Laboratory experience has shown that when Methylene Chloride is a problem it is due to maintenance activities or air handling equipment failures. In the rare event this happens, ultra-pure water can be used for all samples and calibration standards for that analytical batch.

4.2. Other interferences include but are not limited to impurities in the inert purge gas, dirty plumbing/purge vessels, cross contamination by highly contaminated samples to clean ones in transport and storage, and carry over from one analysis to subsequent ones.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personal protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.2. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in MSDSs where available. Refer to the ALS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

5.3. The following method analytes have been tentatively classified as known or suspected human or mammalian carcinogens: benzene, carbon tetrachloride, 1,4-dichlorobenzene, 1,2-dichlorethane, hexachlorobutadiene, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, chloroform, 1,2-dibromoethane,tetrachloroethene, trichloroethene, and vinyl chloride. Care must be taken when handling stock standard solutions of these compounds and should be handled in a hood.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION AND STORAGE

6.1. All sample containers for volatile organic analyses should be washed with soap and water, deionized water rinsed, and baked at 105°C ± 5°C for approximately 2 hours prior to use. Alternatively, one can buy precleaned sample containers from major lab equipment suppliers. All containers should be of glass or amber glass and equipped with a screw top cap and PFTE (teflon) lined septa.

6.2. Collect all samples in duplicate, triplicate when possible. Prepare the proper number of sample bottles/containers prior to the sampling event with preservatives to adjust the samples pH to <2 with 1:1 HCl.

6.3. Slowly fill sample bottles to just overflowing taking care not to flush out the preservative or to entrain air bubbles in the samples. Seal the bottles with PFTE lined septa toward the sample and invert to check for entrained air bubbles.

6.4. Experimental evidence has shown refrigeration at 4°C alone will not stop biological degradation of some aromatic volatile organics. Adjusting the pH of the replicate samples to less than two (pH <2) with 1:1 HCl (@ 2-3 drops per 40 mLs) preserves samples for 14 days after collection. Residual chlorine can also degrade some organic compounds, generating Trihalomethanes (THM's). If residual chlorine is know or suspected to be present, add ≈ 25 mg of absorbic acid to each 40 ml sample bottle just prior to collection. Store on ice and ship to the laboratory for analysis.

6.5. **When sampling for THM analysis only**, acidification may be omitted if sodium thiosulfate is used to dechlorinate the sample. This exception to acidification does not apply if ascorbic acid is used for dechlorination.

6.6. All samples must be stored at 4 ± 2°C until analyzed. Preserved samples must be analyzed within 14 days of collection. Unpreserved samples must be analyzed within 24 hours, unless

the analysis is for THMs only (where the 14 day holding time applies). Any free product samples to be tested do not have any set holding times but should be analyzed as soon as possible.

7. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

7.1. Methanol, purge and trap grade or equivalent.

7.2. Reagent water, prepared from laboratory deionized water that is purged with nitrogen for 2 hours prior to use. For reagent water used for calibration standards and reagent (method) blanks, adjust the pH to <2 with 1:1 HCl. Record the pH on the run log as is done for samples.

7.3. Helium, compressed ultra-high purity grade.

7.4. BFB Tuning Verification Stock Standard – A 25000ppm stock standard is purchased (AccuStandard). This stock solution is diluted in methanol to give a working standard of 50ppm.

7.5. Stock Standard Solutions - Commercially prepared and certified stock standards are used routinely for all the method specified analytes. All such mixtures are also routinely checked against an independent source for both analyte identification and analyte concentration. All such stock standard mixtures have expiration dates given by the manufacturer and must be replaced after one year, or sooner if the composition with the independent check standards indicates a problem. Store with minimal headspace, at -10˚ to -20˚C and protect from light.

7.6. Calibration Standards - The number of calibration standards needed depends on the calibration range desired. A minimum of 5 standards is required to calibrate. Standards should contain each analyte and surrogate at concentrations that define the range of the method. The suggested levels are 0.25, 0.5, 1, 2, 5, 10, 20 and 40 ppb. All calibration solutions are prepared fresh the day of analysis. Refer to Attachment A for detailed preparation instructions.

7.7. The ICV is prepared the same as a mid-point calibration standard, except using a standard obtained from a source different from the initial calibration standards.

7.8. The method specified internal standard is Fluorobenzene. Additional internal standards are optional. 1,4-Dichlorobenzene-d_4 and Chlorobenzene-d_5 are typically included. All internal standards are added to every calibration standard. The spike level for samples and blanks, and LCSs is 10 µg/L.

7.9. The surrogates are 1,2-Dichloroethane-d4, Dibromofluoromethane, 4-Bromofluorobenzene, and Toluene-d_8. All surrogates are calibrated for DoD projects. The surrogates are spiked in samples at 10 µg/L.

8. APPARATUS AND EQUIPMENT

8.1. Gas chromatograph/Mass Selective Detector Systems

8.1.1. Gas Chromatograph – Agilent 6890N GC or equivalent

8.1.2. Mass Selective Detector- Agilent 5973 or equivalent- The mass spectrometer must be capable of electron ionization at nominal electron energy of 70 eV. The spectrometer must be capable of scanning from 35-260 amu with a complete scan cycle time (including scan overhead) of two seconds or less. (Scan cycle time = Total MS data acquisition time in seconds divided by number of scans in the chromatogram.) The spectrometer must produce a mass spectrum that meets all tuning criteria for 4-bromofluorobenzene (BFB). Refer to Section 11.2 for BFB procedures.

8.1.3. The MSD is controlled by HP-MS DOS ChemStation software. Data analysis is performed using Agilent Environmental ChemStation.

8.2. Purge and Trap with Autosampler – Each volatile GC/MS analytical system uses a purge and trap to introduce the sample onto the GC column. A Tekmar Atomx or equivalent is needed. The purge and trap is equipped with an "K" trap and 25 mL sparge tube. Each purge and trap has an autosampler attached to run multiple samples, one at a time, and run unattended for extended periods of time. The Tekmar Atomx includes an incorporated autosampler for extended unattended automated analyses.

8.3. GC Columns

8.3.1. Restek RTX-624 (or equivalent) 20 M x 0.18 mm id fused silica column 1.0 µm film thickness

8.4. pH test strips 0-14 for EMD or equivalent.

8.5. Potassium Iodide-Starch Paper, Sargent-Welch or equivalent.

9. PREVENTIVE MAINTENANCE

9.1. All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. This includes the routine maintenance described in this section. The entry in the log must include: date of event, the initials of who performed the work, and a reference to analytical control.

9.2. Carrier gas - Inline purifiers or scrubbers should be in place for all sources of carrier gas. These are selected to remove water, oxygen, and hydrocarbons. Purifiers should be changed as recommended by the supplier.

9.3. Purge and Trap /Autosamplers

9.3.1. The purge/trap system should be baked out and back-flushed daily as needed, generally prior to use on a daily basis.

9.3.2. Replace the trap as needed. Over time, the trap will exhibit poorer overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in trap performance is evident and other maintenance options do not result in improvement, the trap should be replaced.

9.4. Gas Chromatograph

9.4.1. Clipping off a small portion of the head of the column may improve chromatographic performance. This is typically done at the same time the MS source is cleaned or if unusually dirty samples are analyzed. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column cutting tool.

9.4.2. Over time, the column will exhibit poorer overall performance, as contaminated sample matrices are analyzed. Analytes at the front end of the run will show an increase in tailing and will start to behave in a non-linear manner. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

9.5. Mass Spectrometer

9.5.1. Tune the MS as needed to result in consistent and acceptable performance (see section 11).

9.5.2. For units under service contract, certain maintenance is performed by instrument service staff, including pump oil changed, vacuuming boards, etc., as recommended by the manufacturer.

9.5.3. MS source cleaning should be performed as needed, depending on the performance of the unit. This may be done by the analyst or by instrument service staff.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

10.2. It is the responsibility of the department supervisor/manager to document analyst training. Documenting method proficiency, as described in the SOP *ALS-Kelso Training Procedure* (ADM-TRAIN), is also the responsibility of the department supervisor/manager.

11. PROCEDURE

11.1. Sample Preparation

11.1.1. No preparation is generally required, other than dilution with reagent water to bring analytes into the upper half of the calibration range. Thus, a 25 mL sample volume is run straight from the sample vial. See USEPA Method 524.2 for further discussion.

11.1.2. All water samples must be checked to have a pH < 2 after sample analysis has taken place. Narrow range pH paper is used and the results are recorded on the injection log.

11.1.3. All samples must be tested for residual chlorine after sample analysis. Presence of residual chlorine is determined using potassium iodide-starch indicator strips. Results are recorded on the analytical run log.

11.2. Initial Calibration

11.2.1. BFB Tuning

11.2.1.1. Prior to analysis of initial calibration standards, each GC/MS analytical system set up to run 524.2 must meet the method specified criteria for a 25 ng injection of BFB. Perform the BFB tune analysis via an injection of 25 ng of BFB.

Obtain the spectrum for evaluation using one of the following options:

- Three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the BFB peak or part of any other closely eluting peak.

- Use one scan at the apex of the peak. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the BFB peak or part of any other closely eluting peak.

- Use the average across the entire peak up to a total of 5 scans. Peak integration must be consistent with standard operating procedure. If the peak is wider than 5 scans, the tune will consist of the peak apex scan and the two scans immediately preceding and following the apex. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the BFB peak or part of any other closely eluting peak.

- Use the average across the entire peak. Peak integration must be consistent with standard operating procedure. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the BFB peak or part of any other closely eluting peak.

11.2.1.2.Evaluate the spectrum against the criteria specified in Table 1. The criteria must be met prior to proceeding.

11.2.2. GC/MS Analytical System Initial Calibrations

11.2.2.1.Prior to conducting any sample analyses, a multi-point (5 point minimum) calibration must be run. Recommended calibration levels are described in the standards section. Analyze each calibration standard and tabulate the area response of the characteristic quantitation ions versus concentration for each compound, surrogate, and internal standard. Calculate the response factors (RF) for each compound relative to the specified internal standard by:

$$RF_x = \frac{(A_x)(C_{ISTD})}{(A_{ISTD})(C_x)}$$

Where: A_x = Area of the characteristic quantitation ion for compound x.

A_{ISTD} = Area of the characteristic quantitation ion for the specified internal standard.

C_x = The concentration of the compound added.

C_{ISTD} = The concentration of the specified internal standard.

11.2.2.2.Calculate the mean response factor for each analyte from the five calibration levels. Calculate standard deviation (SD) and the percent relative standard deviations (%RSD) for each analyte from the mean with:

$$\%RSD = \frac{(SD)}{(\overline{RF_x})} 100.$$

The %RSD should be less than 20% for each compound.

11.2.2.3.If the % RSD for any compound is 20% or less, linearity can be assumed over the calibration range, and the relative response factor for each analyte and surrogate is used to quantitate sample analytes.

11.2.2.4.If the % RSD of any compound is > 20%, construct calibration curves of area ratio (A/A_{is}) versus concentration using alternative curve calibration models. The analyst should select the curve fit which introduces the least calibration error into the quantitation. Refer to the SOP *Calibration of Instruments for Organics Chromatographic Analysis* (SOC-CAL) for equations and descriptions of the calibration models. Method EPA 524.2 allows calibrations curves to be forced through zero.

11.3. Independent Calibration Verification

11.3.1. Following initial calibration, analyze an ICV standard. The ICV solution must contain all analytes in the calibration standards. Calculate the concentration using the typical procedure used for quantitation. Calculate the percent difference (%D) from the ICV true value. The acceptance limits for the ICV ± 30%.

11.3.2. After the initial calibration has passed all of the above criteria, and the ICV has been checked against the curve, then samples can be analyzed.

11.4. Daily GC/MS Calibration

11.4.1. Verify the MS tune and initial calibration at the beginning of each 12-hour analysis window using the following procedure.

11.4.1.1. The start of a 12 hour analysis window requires a check of the instrument tune via an injection of 25 ng of BFB. Use the same spectrum selection procedure as in the Initial Calibration Section and the criteria in Table 1. If the criteria are met, then a check of the initial calibration curve is done. If the first run of the BFB fails, retry. If the second run also fails, inform your supervisor. You may have to retune and recalibrate the system.

11.4.1.2. After the tuning criteria have been verified, the initial calibration must be checked and verified by analyzing a midrange calibration standard. A 10 ppb level is recommended. For 524.2 daily check standards, 10 µl of the 50 ppm 524.2 working standard is spiked into 50 mL of reagent water, and a 25 mL aliquot is purged. The results are compared with those of the initial calibrations. The concentration for each analyte and surrogate must be within 30% of the mean value measured in the initial calibration. If a linear or second order regression is used, the concentration measured using the calibration curve must be within 30% of the true value of the concentration in the medium calibration solution.

11.4.2. If the tune criteria and the continuing calibration criteria are met, then the retention times of all compounds, surrogates, and internal standards are checked against the initial calibration. If the retention times for any internal standard changes by more than 30 seconds from the last calibration check (12 hours), the system must be inspected for malfunctions and corrections must be made, as required. Determine that the absolute areas of the quantitation ions of the internal standard and surrogates have not decreased by more than 30% from the areas measured in the most recent continuing calibration check, or by more than 50% from the areas measured during initial calibration. If these areas have decreased by more than these amounts, adjustments must be made to restore system sensitivity.

Quantitation of all compounds is based on the initial calibration.

11.5. Identification of Analytes

The MSD data system software identifies a sample component by first finding and identifying the surrogate and internal standards. After they have been integrated, the extracted ion chromatogram is searched for all calibrated analytes. Any peak associated with the proper

time window having the primary characteristic quantitation ion identified and its results are calculated. If no peak is found in the expected retention time window and the mass spectra do not match method criteria, then the analyte is "not found". Print out spectra for all confirmed hits.

12. QA/QC REQUIREMENTS

12.1. Initial Precision and Recovery Validation

12.1.1. The precision and accuracy of the analysis procedure must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made or when training an analyst new to this procedure. To do this, four reagent water samples are spiked at a concentration in the range of 2-5 ug/L. For each analyte, the recovery must be 80-120% and the RSD $\leq$ 20% before analyses can begin.

12.2. Method Detection Limits

12.2.1. A method detection limit (MDL) study must be undertaken before analysis of samples begins. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike a minimum of seven blank replicates at a level near or below the MRL for each target analyte and analyze. Analyze the replicates on a schedule that results in the analyses being conducted over several days. The MDL studies must be done for each instrument. Refer to the ALS SOP for *Performing Method Detection Limit Studies and Establishing Limits of Detection and* Quantification (CE-QA011*).*

12.2.2. Calculate the average concentration found (x) in the sample concentration, and the standard deviation of the concentrations for each analyte. Calculate the MDL for each analyte using the correct T value for the number of replicates.

12.3. Ongoing QC Samples required are described in the ALS-Kelso Quality Assurance Manual and in the SOP for Sample Batches. Additional QC Samples may be required in project specific quality assurance plans (QAPP). These include:

12.3.1. For every 12-hour analysis window, after meeting the tune and continuing calibration criteria, at least one method blank must be run and reportable (per batch of 20 or fewer samples). No analytes should be detected at a concentration $\geq$ MRL.

12.3.2. At least one LCS, at a concentration of 5.0 ppb must be run at a frequency of 1 per batch (20 samples). Other concentrations may be specified by project or state-specific requirements (i.e. Arizona requirement of 2ppb) and the LCS is analyzed accordingly when these samples are to be analyzed. The LCS must contain all target analytes.

12.3.3. At least quarterly, replicate LCS data should be evaluated to determine the precision of the laboratory measurements. Add these results to the ongoing control charts to document data quality.

12.3.4. Per WA-DOH protocols, all VOA hits (except for Trihalomethanes) must be confirmed by analyzing a second sample vial. The hit is considered to be verified if the results

from the original and second analysis agree within ±30%. Only the higher of the two values is reported.

12.3.5. If an analyte is detected in a sample above the MRL (except for Trihalomethanes), verify the hit is not a sampling error by analyzing the trip blank associated with the sample if one is available. The result of this analysis will help identify any contamination resulting from field sampling, storage and transportation activities. If the trip blank shows unacceptable contamination, the storage blank is then analyzed. Results for the trip blank and storage blank are then reported.

12.3.6. Each day of analysis, verify the minimum reporting limit for each analyte by analyzing a laboratory fortified blank (LFB) by spiking DI water at the MRL. Results are compared against advisory limits of 50-150%.

12.3.7. Matrix spikes may be required under specific client project plans (QAPP). The recoveries are evaluated using the same acceptance criterion as the LCS.

12.4. Acceptance Criteria

12.4.1. The acceptance criteria for tuning verification, initial, and continuing calibration verification have been outlined above in the section on standards.

12.4.2. The acceptance criteria for surrogate recoveries are determined from in-house data. These criteria must be tighter than the method criteria of 70-130% recovery. The current acceptance criteria are listed below, and are subject to change as statistical criteria are updated.

12.4.3. Method 524.2 specifies the acceptance criteria for the LCS at 70-130% recovery for all target compounds. For the quarterly replicate LCS, the acceptance limit is RPD $\leq$ 30%. The acceptance criteria are subject to change as statistical criteria are updated.

Surrogate	% recovery
Dibromofluoromethane	82-124
4-Bromofluorobenzene	70-130
Toluene-d_8	82-124

12.5. Corrective action requirements have been outlined above in the Procedure section and in Table 2.

12.6. A matrix spike analysis is not required by method 524.2, unless the internal standard area of a sample exceeds 50% from the most recent CCV internal standard area. If this happens, the sample will be reanalyzed as a matrix spike to confirm the matrix affect. The sample results are flagged and the matrix spike results reported.

13. DATA REDUCTION AND REPORTING

13.1. Calculations

13.1.1. The GC/MS data stations, in current use, all use the H-P RTE Integrator to generate the raw data used to calculate the standards $\overline{RF_x}$ values, the sample amounts, and

the spike values. The software does three passes through each data file. The first two identify and integrate each internal standard and surrogate. The third pass uses the time-drift information from the first two passes to search for all method analytes in the proper retention times and with the proper characteristic quantitation ions. The results for a sample are calculated as follows when $\overline{RF}_x$ is used:

$$A_x = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF}_x)}$$

Where: A_x = the amount, in ppb, of the analytes in the sample;

$Resp_x$ = the peak area of the analytes of interest;

$Resp_{ISTD}$ = the peak area of the associated internal standard;

Amt_{ISTD} = the amount, in ppb, of internal standard added

$\overline{RF}_x$ = the average response from the five-point for the analytes of interest.

13.1.2. If a non-linear calibration curve is used for initial calibration (section 11.2.2.4), calculate the sample results using the calibration curve rather than average response factor. Refer to the SOC-CAL SOP (Section 13) for equations and descriptions of the calibration models.

13.2. Data Review

Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the *SOP for Laboratory Data Review Process* (ADM-DREV) for details.

13.3. Reporting

13.3.1. Reports are generated using the STEALTH Data Reporting System which compiles the SMO login information and Enviroquant data. This compilation is then transferred to a file, which STEALTH uses to generate a report. The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.3.2. Alternatively, Excel templates located in R:\VOA\forms may be used to prepare reports from hard-copy data. The analyst should choose the appropriate form and QC pages to correspond to required tier level. The detected analytes, surrogates, and spikes are then transferred, by hand, to the templates.

14. CONTINGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

14.1. Refer to the SOP for *Nonconformity and Corrective Action* (CE-QA008) for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

14.2. Handling out-of-control or unacceptable data

14.2.1. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example.

14.2.2. Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels
- Sample holding time missed due to laboratory error or operations
- Deviations from SOPs or project requirements
- Laboratory analysis errors impacting sample or QC results
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc.)
- Sample preservation or handling discrepancies due to laboratory or operations error

15. METHOD PERFORMANCE

15.1. This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

15.2. The method detection limit (MDL) is established using the procedure described in the SOP for Performing Method Detection Limit Studies and Establishing Limits of Detection and Limits of Quantitation (CE-QA011). Method Reporting Limits are established for this method based on MDL studies and as specified in the SOP CE-QA011.

16. POLLUTION PREVENTION AND WASTE MANAGEMENT

16.1. It is the laboratory's practice to minimize the amount of solvents and reagents used to perform this method wherever technically sound, feasibly possible, and within method requirements. Standards are prepared in volumes consistent with laboratory use in order to minimize the volume of expired standards to be disposed of. The threat to the environment from solvents and/or reagents used in this method may be minimized when recycled or disposed of properly.

16.2. The laboratory will comply with all Federal, State and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS EH&S Manual.

16.3. This method uses non-halogenated solvents and any waste generated from this solvent must be placed in the collection cans in the lab. The solvent will then be added to the hazardous waste storage area and disposed of in accordance with Federal and State regulations.

17. TRAINING

17.1. Training Outline

17.1.1. Review literature by reading references. Review the EPA methodology and any applicable state-specific methods. Review the SOP. Also review the MSDS for methanol.

17.1.2. Observe the procedure as performed by an experienced analyst at least three times.

17.1.3. Assist in the procedure under the guidance of an experienced analyst for a period of three months. During this training process, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

17.1.4. Following the three-month training period the analyst is expected to complete an initial precision and recovery (IPR) study for water samples.

17.1.4.1. Perform IPR studies by preparing and analyzing four replicate laboratory control samples as described in the QA/QC section of this SOP. Calculate average percent recovery and relative standard deviation for the four replicate analyses. Summaries of the IPR are reviewed and signed by the supervisor and forwarded to the employee's training file.

17.2. Training is documented following *ALS-Kelso Training Procedure* (ADM-TRAIN).

NOTE: When the analyst training is documented by the supervisor on internal training documentation forms, the supervisor is acknowledging that the analyst has read and understands this SOP and that adequate training has been given to the analyst to competently perform the analysis independently.

18. METHOD MODIFICATIONS

18.1. This SOP includes no known modifications to the reference methods.

19. REFERENCES

19.1. *Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry*, Revision 4.1, Method 524.2. Environmental Protection Agency Office of Research and Development, National Exposure Research Laboratory, Cincinnati, OH, 1995.

19.2. *Technical Notes on Drinking Water Methods,* Environmental Protection Agency Office of Water, Environmental Monitoring Systems Laboratory, Cincinnati, OH, October, 1994.

19.3. EPA Manual for the Certification of Laboratories Analyzing Drinking Water, 5th Edition, January 2005.

19.4. Related Documents – These documents are used in the laboratory to support this procedure and are reviewed at the same time this SOP is reviewed each year.

R:\VOA\Recipes\524\524_ICAL.xls
R:\VOA\Recipes\524|524_CCV.xls

20. CHANGES SINCE THE LAST REVISION

20.1. Updated to current ALS format.
20.2. Formatting revisions and text corrections.
20.3. Revised all references to 10 mL purge to 25 mL purge volume.
20.4. Section 7.9 – Removed reference to spiking surrogates. Surrogates are calibrated for DoD work.
20.5. Section 8.2 – Updated purge and trap and autosampler to current equipment.
20.6. Section 18.1 – Removed reference to modified purge volume.
20.7. Attachment A – Updated template to include surrogates.

TABLE 1

4-Bromofluorobenzene Characteristic Ion Abundance Criteria

Mass	Ion Abundance Criteria
50	15-40% of mass 95
75	30-80% 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;<101% of mass 174
177	5-9% of mass 176

TABLE 2

Summary of Corrective Actions				
Method Reference	**Control**	**Specification and Frequency**	**Acceptance Criteria**	**Corrective Action**
EPA 524.2	ICAL	Prior to sample analysis	% RSD ≤ 20 R2 ≥ 0.995 COD ≥ 0.990	Correct problem then repeat ICAL
EPA 524.2	ICV	After ICAL	± 30% Diff	Correct problem and verify second source standard; rerun second source verification. If fails, correct problem and repeat initial calibration.
EPA 524.2	CCV	Prior to sample analysis and every 12 hours	± 30% Diff	Correct problem then repeat CCV or repeat ICAL
EPA 524.2	Method Blank	Include with each analysis batch (up to 20 samples)	<MRL	If target exceeds MRL, reanalyze to determine if instrument was cause. If still noncompliant then: Re-extract or reanalyze samples containing contaminate, unless samples contain > 20x amount in blank.
EPA 524.2	Laboratory Control Sample	Include with each analysis batch (up to 20 samples)	70-130%	If exceeds limits, re-extract and re-analyze
EPA 524.2	Matrix Spike	As required by project QAPP or if IS area is>50% of the CCV IS area	70-130%	Evaluate data to determine if the there is a matrix effect or analytical error

Attachment A
Detailed Calibration Standard Preparation Instructions

INTIAL CALIBRATION CURVE

Date_____ Analysis: 524
Prepared By_____ Instrument:
Matrix: Water

Stock Solution #1_____ Analytes_____ Init. Concentration_____
Stock Solution #2_____ Analytes Low 524/Ketones Init. Concentration 5/25/100ppm
Stock Solution #3_____ Analytes 524 Init. Concentration 50/250ppm
Stock Solution #4_____ Analytes Ketones Init. Concentration 2000ppm

Aliquot of Stock Solution #1 (µL)	Final Conc. of #1 (µg/L)	Aliquot of Stock Solution #2 (µL)	Final Conc. of #2 (µg/L)	Aliquot of Stock Solution #3 (µL)	Final Conc. of #3 (µg/L)	Aliquot of Stock Solution #4 (µL)	Final Conc. of #4 (µg/L)	Final Volume (mL)	Notes
		1.0	.1/2.0	-	-	-	-	50	
		2.5	.25/5.0	-	-	-	-	50	
		5.0	.5/10	-	-	-	-	50	
		10	1.0/20	-	-	-	-	50	
		20	2.0/40	-	-	-	-	50	
		-	-	5	5	2.5	100	50	
		-	-	10	10	5.0	200	50	
		-	-	20	20	10	400	50	
		-	-	40	40	20	800	50	
		-	-	60	60	30	1200	50	
		-	-	80	80	40	1600	50	

ICV: 10uL of 50/250ppm Crescent ICV ( ) + 5.0uL of 200/1000 Oxygenates ( ) +) +
10uL 50ppm 1,3-Butadiene ( ) + 5ul of 100ppm Freon-22 ( ) to 50mL water

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ALS Environmental

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QUALITY ASSURANCE MANUAL

ALS Environmental – Simi Valley Facility
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QUALITY ASSURANCE MANUAL

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1) Introduction and Scope

The purpose of this Quality Assurance Manual is to outline the quality system for the Simi Valley location of ALS Environmental (ALS Group USA Corp. dba ALS Environmental). ALS Environmental is a professional analytical services laboratory which performs chemical and microbiological analyses on a wide variety of sample matrices, including drinking water, groundwater, surface water, wastewater, soil, sludge, sediment, tissue, industrial and hazardous waste, air, and other material. Refer to Appendix J for a list of analytical capabilities specific to the Simi Valley location and corresponding accreditation status.

Quality Control (QC) procedures are used to continually assess performance of the laboratory and quality systems. ALS Environmental maintains control of analytical results by adhering to written standard operating procedures (SOPs), using analytical control parameters with all analyses, and by observing sample custody requirements. All analytical results are calculated and reported in units consistent with project specifications to allow comparability of data. Appendix H includes a list of data qualifiers and acronyms.

This QAM is applicable to the facility listed on the title page and the off-site extraction facility located at 2360 Shasta Way, Unit G, Simi Valley California.

The information in this QAM has been organized according to requirements found in the National Environmental Laboratory Accreditation Program (NELAP) Quality Systems Standards (2003 and 2009), the EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5, USEPA, 2001; and *General Requirements for the Competence of Testing and Calibration Laboratories*, ISO/IEC 17025:2005.

2) Organization

2.1 Laboratory Organizational Structure

ALS Environmental – Simi Valley is legally identifiable as ALS Group USA, Corp., dba ALS Environmental. ALS Group USA Corp. is a component of ALS Limited, a publicly held Australian company. The ALS global website may be referred to for corporate ownership information (www.alsglobal.com/Our-Company). Organizational charts detailing the operational structure and reporting relationships in the laboratory are provided in Appendix B.

2.2 Avoiding Conflict of Interest through Organizational Structure

2.2.1 Through application of the policies and procedure outlined in this QA Manual and use of a defined organizational structure, the laboratory assures that it is impartial and that personnel are free from undue commercial, financial, or other undue pressures that might influence their technical judgment.

2.2.2 Policies are in place to prevent outside pressures or involvement in activities that may affect competence, impartiality, judgment, operational integrity, or the quality of the work performed at the laboratory.

2.2.3 Management and technical personnel have the authority and resources to carry out their duties and have procedures to identify and correct departures from the laboratory's management system.

2.2.4 Personnel understand the relevance and importance of their duties as related to the maintenance of the laboratory's management system. Ethics and data integrity procedure ensure that personnel do not engage in activities that diminish confidence in the laboratory's capabilities. Procedures and policies are also established to ensure confidentiality is maintained.

3) Management

The purpose of the QA program at ALS Environmental is to ensure that our clients are provided with analytical data that is scientifically sound, legally defensible, and of known and documented quality.

3.1 Quality Policy Statement

The policy at ALS is to use good professional practices, to maintain quality, to uphold the highest standard of service, and to operate in accordance with these requirements and those of regulatory agencies, accrediting authorities, and certifying organizations. We recognize that quality assurance requires a commitment to quality by everyone in the organization - individually, within each operating unit, and throughout the entire laboratory. Laboratory management is committed to ensuring the effectiveness of its quality systems and to ensure that all tests are carried out in accordance to customer requirements. Key elements of this commitment are set forth in the *SOP for Laboratory Ethics and Data Integrity* (CE-GEN001) and in this Quality Assurance Manual (QAM). ALS Environmental is committed to operate in accordance with these requirements and those of regulatory agencies, accrediting authorities, and certifying organizations. The laboratory also strives for improvement through varying continuous improvement initiatives and projects.

Quality Management Systems are established, implemented and maintained by management. Policies and procedures are established in order to meet requirements of accreditation bodies and applicable programs as well as client's quality objectives. The laboratory's management is committed to complying with the National Environmental Laboratory Accreditation Program (NELAP) Quality Systems Standards (2003 and 2009 NELAP/TNI standards), ISO/IEC 17025:2005, and the Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories. Systems are designed so that there will be sufficient Quality Assurance (QA) activities conducted in the laboratory to ensure that all analytical data generated and processed will be scientifically sound, legally defensible, of known and documented quality, and will accurately reflect the material being tested. Quality Systems are applicable to all fields of testing in which the laboratory is involved. All personnel involved with environmental testing and calibration activities must familiarize themselves with the quality documentation and implement the policies and procedures in their work.

3.2 Quality Management Systems

The laboratory has developed a Quality Management System to ensure all products and services meet our client's needs. The system is implemented and maintained by the Quality Assurance Manager (QA Manager) with corporate oversight by the Corporate Quality Assurance Manager (CQAM). These systems are based upon ISO 17025:2005 standards, upon which fundamental programs (AIHA, TNI/NELAP, and DoD QSM) are based. Implementation and documentation against these standards are communicated in corporate policy statements, this QAM, and SOPs. Actual procedures, actions and documentation are defined in both administrative and technical SOPs. Figure 3-1 shows the relationships of the quality systems and associated documentation. Quality systems include:

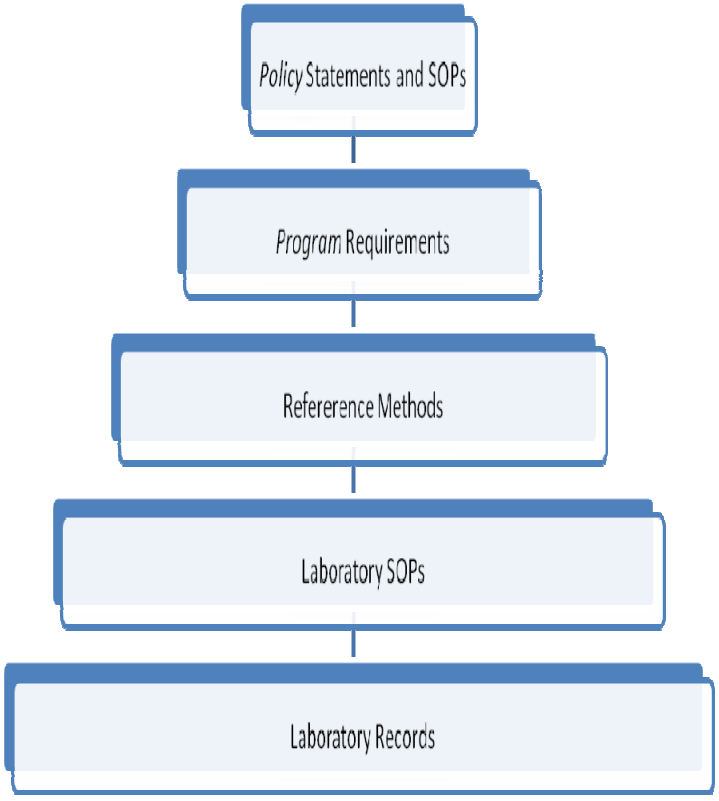
- Standard Operating Procedures
- Sample Management and Chain of Custody procedures
- Statistical Control Charting
- Standards Traceability
- Ethics Training
- Document Control
- Corrective Action Program
- Management Reviews
- Demonstration of Capability

The effectiveness of the quality system is assessed in several ways, including:

- Internal and External Audits covering all aspects of the organization
- Annual Management Reviews
- Analysis of Customer Feedback
- Internal and External Proficiency Testing

Figure 3-1

Relationships of Quality Management Systems and Documentation



3.3 Technical Elements of the Quality Assurance Program

The laboratory's technical procedures are based upon procedures published by various agencies or organizations (See Section 23). The Quality Assurance Program provides laboratory organization, procedures, and policies by which the laboratory operates. The necessary certifications and approvals administered by external agencies are maintained by the QA department. This includes method approvals and audit

administration. In addition, internal audits are performed to assess compliance with policies and procedures. SOPs are maintained for technical and administrative functions. A document control system is used for SOPs, as well as laboratory notebooks, and this QA Manual. A list of QA Program documents is provided in Appendix I and SOPs in Appendix G.

Acceptable calibration procedures are defined in the SOP for each test procedure. Calibration procedures for other laboratory equipment (balances, thermometers, etc.) are also defined. Quality Control (QC) procedures are used to monitor the testing performed. Each analytical procedure has associated QC requirements to be achieved in order to demonstrate data quality. The use of method detection limit studies, control charting, technical training and preventive maintenance procedures further ensure the quality of data produced. Proficiency Testing (PT) samples are used as an external means of monitoring the quality and proficiency of the laboratory. PT samples are obtained from qualified vendors and are performed on a regular basis. In addition to method proficiency, documentation of analyst training is performed to ensure proficiency and competency of laboratory analysts and technicians. Sample handling and custody procedures are defined in SOPs. Procedures are also in place to monitor the sample storage areas. The technical elements of the QA program are discussed in further detail in later sections of this QA manual.

3.4 Professional Conduct

One of the most important aspects of the success of ALS Environmental is the emphasis placed on the integrity of the data provided and the services rendered. This success is reliant on both the professional conduct of all employees within ALS Environmental as well as established laboratory practices.

To promote quality, ALS Environmental requires certain standards of conduct and ethical performance among employees. The following examples of documented ALS Environmental policy are representative of these standards, and are not intended to be limiting or all-inclusive:

- Under no circumstances is the willful act of fraudulent manipulation of analytical data condoned. Such acts are to be reported immediately to senior management for appropriate corrective action.
- Unless specifically required in writing by a client, alteration, deviation or omission of written contractual requirements is not permitted. Such changes must be in writing and approved by senior management.
- Falsification of data in any form will not be tolerated. While much analytical data is subject to professional judgment and interpretation, outright falsification, whenever observed or discovered, will be documented, and appropriate remedies and punitive measures will be taken toward those individuals responsible.
- It is the responsibility of all ALS Environmental employees to safeguard sensitive company information, client data, records, and information; and matters of national security concern should they arise. The nature of our business and the well-being of our company and of our clients is dependent upon protecting and maintaining proprietary company/client information. All information, data, and reports (except that in the public domain) collected or assembled on behalf of a client is treated as confidential. Information may not be given to third parties without the consent of the client. Unauthorized release of confidential information about the company or its clients is taken seriously and is subject to formal disciplinary action. All employees sign a confidentiality agreement upon hire to protect the company and client's confidentiality and proprietary rights.

3.5 Prevention and Detection of Improper, Unethical or Illegal Actions

It is the intention of ALS Environmental to proactively prevent and/or detect any improper, unethical or illegal action conducted within the laboratory.

This is performed by the implementation of a program designed for not only the detection but also prevention. Prevention consists of educating all laboratory personnel of their roles and duties as employees, company policies, inappropriate practices, and their corresponding implications as described here.

In addition to education, appropriate and inappropriate practices are included in SOPs such as manual integration, data review and specific method procedures. Electronic and hardcopy data audits are performed regularly, including periodic audits of chromatographic electronic data. Requirements are described in the *SOP for Internal Audits* (CE-QA001) and details are listed in laboratory administrative SOPs. All aspects of this program are documented and retained on file according to the company policy on record retention.

The *SOP for Laboratory Ethics and Data Integrity* (CE-GEN001) also contains information on the ALS Environmental ethics and data integrity program, including mechanisms for reporting and seeking advice on ethical decisions.

3.6 Laboratory Data Integrity and Ethics Training

New employees are given a QA and Ethics orientation within the first month of hire. On an ongoing basis, all employees receive annual ethics refresher training. Topics covered are documented in writing and all training is documented. It is the responsibility of the QA Manager to ensure that the training is conducted as described.

Key topics covered are the organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting, how and when to report data integrity issues and record keeping. Training includes discussion regarding all data integrity procedures, data integrity training documentation, in-depth data monitoring and data integrity procedure documentation.

Data integrity training provides assurance that a highly ethical approach to testing is a key component of all laboratory planning, method implementation, and training. There are four elements to the laboratory's procedures for data integrity. These include:

1) Data integrity training (conducted initially and at least annually);
2) Signed data integrity documentation for all employees;
3) In-depth periodic monitoring of data integrity;
4) Data integrity procedure documentation (*SOP for Laboratory Ethics and Data Integrity* (CE-GEN001)).

There is specific emphasis on the importance of proper written narration on the part of the analyst with respect to those cases where analytical data may be useful, but are in one sense or another partially deficient. A signature attestation sheet of data integrity training including their understanding of their obligations related to data integrity and as specified in the training is generated for attendees and maintained on file for review. Trainees are required to understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences including immediate termination, or civil/criminal prosecution.

The training session includes many concepts and topics, numerous examples of improper actions (defined by DoD as deviations from contract-specified or method-specified analytical practices and may be intentional or unintentional), legal and liability implications (company and personal), causes, prevention, awareness, and reporting mechanisms.

3.7 Management and Employee Commitment

ALS Environmental makes every attempt to ensure that employees are free from any commercial, financial, or other undue pressures that might affect their quality of work. Related policies are described in the *SOP for Laboratory Ethics and Data Integrity* (CE-GEN001). This includes:

- ALS Environmental Open Door Policy – Employees are encouraged to bring any work related problems or concerns to the attention of local management or their Human Resources representative. However, depending on the extent or sensitivity of the concern, employees are encouraged to directly contact any member of upper management.
- FAIRCALL – An anonymous and confidential reporting system available to all employees that is used to communicate misconduct and other concerns. The program shall help minimize negative morale, promote a positive work place, and encourage reporting suspected misconduct without retribution. Associated upper management is notified and the investigations are documented.
- Use of flexible work hours. Within reason and as approved by supervisors, employees are allowed flexible work hours in order to help ease schedule pressures which could impact decision-making and work quality.
- Operational and project scheduling assessments are continually made to ensure that project planning is performed and that adequate resources are available during anticipated periods of increased workloads. Procedures for subcontracting work are established, and within the ALS Environmental laboratory network additional capacity is typically available for subcontracting, if necessary.
- Gifts and Favors (Code of Conduct Agreement) – To avoid possible conflict of interest implications, employees do not receive unusual gifts or favors to, nor accept such gifts or favors from, persons outside the Company who are, or may be, in any way concerned with the projects on which the Company is professionally engaged.

All employees are required to sign and adhere to the requirements set forth in the *Code of Conduct Agreement, Confidentiality Agreement,* and *Ethics and Data Integrity Agreement*. The *Ethics and Data Integrity Agreement* is signed by all employees on an annual basis (see Appendix C).

3.8 The ALS Environmental-Simi Valley staff, consisting of approximately 30 employees, includes chemists, technicians and support personnel. They represent diverse educational backgrounds, experience, and provide the comprehensive skills that the laboratory requires. As seasonal workload increases, temporary employees may be hired to perform specific tasks.

ALS Environmental is committed to providing an environment that encourages excellence. All employees share the responsibility for maintaining and improving the quality of our analytical services. The responsibilities of key personnel within the laboratory are described below. Table 3-1 lists the ALS Environmental-Simi Valley personnel assigned to these key positions. Managerial staff members are provided the authority and resources needed to perform their duties. An organizational chart of the laboratory, as well as the resumes of key personnel, can be found in Appendix B.

- The role of the **Laboratory Director** is to provide technical, operational, and administrative leadership through planning, allocation and management of personnel and equipment resources. The Laboratory Director provides leadership and support for the QA program including ensuring compliance with ISO/IEC 17025:2005 and is responsible for overall laboratory efficiency and the financial performance of the Simi Valley facility.

  The Laboratory Director has the authority to stop work in response to quality problems. The Laboratory Director also provides resources for implementation of the QA program, reviews and approves this QA Manual, reviews and approves standard operating procedures (SOPs), and provides support for business development by identifying and developing new markets through continuing support of the management of existing client activities.

- The **Quality Assurance Manager** (QA Manager) has the authority and responsibility for implementing, maintaining, and improving the quality system. This includes coordination of QA activities within the laboratory, ensuring that all personnel understand their contributions to the quality system, ensuring communication takes place at all levels within the laboratory regarding the effectiveness of the quality system, evaluating the effectiveness of training; and monitor trends and continually improve the quality system. Audit and surveillance results, control charts, proficiency testing results, data analysis, corrective and preventive actions, customer feedback, and management reviews can all be used to support quality system implementation. The QA Manager is responsible for ensuring compliance with all applicable regulatory compliance quality standards (i.e. NELAP/TNI, ISO/IEC 17025:2005, DoD QSM, etc.). The QA Manager works with laboratory staff to establish effective quality control and assessment plans and has the authority to stop work in response to quality problems. The QA Manager is responsible for maintaining the QA Manual and performing an annual review of it; reviewing and approving SOPs and ensuring the annual review of technical SOPs; maintaining QA records such as metrological records, archived logbooks, PT results, etc.; document control; conducting PT sample studies; approving nonconformity and corrective action reports; maintaining the laboratory's certifications and approvals; and performing internal QA audits.

  The QA Manager reports directly to the Laboratory Director and also reports indirectly to the Manager of Quality Assurance, USA. It is important to note that when evaluating data, the QA Manager does so in an objective manner and free of outside, or managerial, influence.

- The Manager of Quality Assurance, USA is responsible for the overall QA program at all the ALS Environmental Group laboratories. The Manager of Quality Assurance, USA is responsible for oversight of QA Managers regulatory compliance efforts (NELAP/TNI, ISO, DoD, etc) and may perform internal audits to evaluate compliance. The Manager of Quality Assurance, USA approves company-wide SOPs and provides assistance to the laboratory QA staff and laboratory managers as necessary.

➢ In the case of absence of the Laboratory Director or QA Manager, deputies are assigned to act in that role. Default deputies for these positions are a Project Manager or Volatile Organics Technical Manager (for the Laboratory Director) and the Laboratory Director (for the QA Manager).

- In the event that work is stopped in response to quality problems, only the Laboratory Director or QA Manager have the authority to resume work.

- The **Environmental Health and Safety Coordinator** (EH&S) is responsible for the administration of the laboratory health and safety policies.

  This includes the formulation and implementation of safety policies, the supervision of new-employee safety training, the review of accidents, incidents and prevention plans, the monitoring of hazardous waste disposal and the conducting of departmental safety inspections. The EH&S Coordinator is also designated as the Chemical Hygiene Officer. The EH&S Coordinator has a dotted-line reporting responsibility to ALS North America EH&S Director.

- The **Data Validation Coordinator/Reporting Supervisor** is responsible for data review, data package preparation, review and coordination, and preparation of case narratives (based on the information provided by the laboratory).

- The **Client Services Manager** is responsible for the Client Services Department defined for the laboratory (i.e. Project Managers, data reporting, etc.) and the sample management office/bottle preparation sections. The Client Services Department provides a complete interface with clients from initial project specifications to final deliverables. Sample management handles all activities associated with receiving, storage, and disposal of samples. The Client Services Manager has the authority to stop subcontractor work in response to quality problems.

- The **Project Manager** is a scientist assigned to each client to act as a technical liaison between the client and the laboratory. The Project Manager is responsible for ensuring that the analyses performed by the laboratory meet all project, contract, and regulatory-specific requirements. This entails coordinating with the ALS Environmental laboratory and administrative staff to ensure that client-specific needs are understood and that the services ALS Environmental provides are properly executed and satisfy the requirements of the client.

- The Analytical Laboratory is divided into operational units based upon specific disciplines. Each department is responsible for establishing, maintaining and documenting a QC program meeting department needs. Each **Department Manager and Supervisor** has the responsibility to ensure compliance with ISO/IEC 17025:2005, ensure that QC functions are carried out as planned, and to guarantee the production of high quality data. Department managers and bench-level supervisors have the responsibility to monitor the day-to-day operations to ensure that productivity and data quality objectives are met. Each department manager has the authority to stop work in response to quality problems in their area. Analysts have the responsibility to carry out testing according to prescribed methods, SOPs, and quality control guidelines particular to the laboratory in which he/she is working.

- The **Sample Management Office** plays a key role in the laboratory QA program by performing and/or assisting in the proper preparation and shipment of sampling media. In addition, personnel are responsible for the verification of sample receipt information, performing sample acceptance and log-in and distribution of documentation per laboratory defined procedures and the initial storage of samples in the proper environment and location and performing proper sample

disposal. Responsibilities also include monitoring and recording of critical thermal preservation equipment temperatures and calibration of associated thermometers against NIST traceable thermometers.

- **Information Technology** (IT) staff is responsible for the administration of the Laboratory Information Management System (LIMS) and other necessary support services. Other functions of the IT staff include laboratory network maintenance, IT systems development and implementation, education of analytical staff in the use of scientific software, Electronic Data Deliverable (EDD) generation, and data back-up, archival and integrity operations.
- The **Procurement Manager** is responsible for directing and coordinating activities of personnel engaged in buying materials and supplies.

Table 3-1
Summary of Technical Experience and Qualifications

Personnel	Years of Experience	Project Role
Kelly Horiuchi, B.A.	15	Laboratory Director / Project Manager
Chaney Humphrey, B.S.	11	Quality Assurance Manager
Robin Gill	35	Data Validation Coordinator / Reporting Supervisor
Ku-Jih Chen, B.S.	40	Principle Chemist
Sue Anderson, B.S.	25	General (WET) Chemistry Technical Manager / Project Manager
Samantha Henningsen, B.S.	6	Project Manager
Kathleen Aguilera, B.A.	26	Client Services Manager / Project Manager
Wade Henton, B.S.	29	Volatiles (GC) Technical Manager
Chris Parnell, B.S.	29	Operations Manager / Volatiles (GC/MS) Technical Manager
Wida Ang, B.S.,M.S.	30	Volatiles (GC/MS) Team Leader
Madeleine Dangazyan, B.S.	20	Semi-Volatiles / Industrial Hygiene Technical Manager
Jeff Christian, B.S.	36	Director of Operations – Western U.S.

Additional Key Personnel	Project Role
Joe Caulfield	LIMS Manager
Steve Manak	Procurement Group Leader

4) Document Control

4.1 Procedures for control and maintenance of documents are described in the *SOP for Document Control* (CE-GEN005). The requirements of the SOP apply to all laboratory logbooks (standards, maintenance, run logbooks, etc), certificates of analysis, SOPs, QAMs, quality assurance project plans (QAPPs), Environmental Health & Safety (EHS) manuals, and other controlled ALS Environmental documents.

4.2 The contents of this manual are reviewed, revised (as needed) and approved for use at least annually by authorized personnel (QA Manager, Laboratory Director, and Technical Directors) where the scope of the review ensures that it continuously reflects current policies and practices and incorporates all applicable requirements. Additionally, the date the review was completed is indicated by the date of the last approval signature on the title page.

4.3 Each controlled copy of a controlled document will be released only after a document control number is assigned and the recipient is recorded on a document distribution list. Filing and distribution is performed by the QA Manager, or designee, and ensures that only the most current version of the document is distributed and in use. A document control number is assigned to logbooks. Completed logbooks that are no longer in use are archived in a master logbook file. Logbook entries are standardized following the *SOP for Making Entries onto Analytical Records* (CE-QA007). The entries made into laboratory logbooks are reviewed and approved at a regular interval (quarterly).

4.4 A records system is used which ensures all laboratory records (including raw data, reports, and supporting records) are retained and available. The archiving system is described in the *SOP for Data and Record Archiving* (ADM-ARC).

4.5 External documents relative to the management system are managed by the QA Manager. To prevent the use of invalid and/or outdated external documents, the laboratory maintains a master list of current documents and their availability. The list is reviewed before making the documents available. External documents are not issued to personnel.

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

To authenticate the electronic signature the identity of the signatory is verified before their electronic signature can be created. Each electronic signature shall be unique to a single individual and shall not be used by any other individual. These signatures are established using only defined procedures within the software and are verified using the two distinct components of *username* and *password*. Each use of the electronic

signature requires entry of the username and the password. The report may not be changed once the signature has been applied.

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

5) Review of Requests, Tenders and Contracts

5.1 Procedure for the Review of Work Requests

5.1.1 Requests for new work are reviewed prior to signing any contracts or otherwise agreeing to perform the work. The specific methods to be used are agreed upon between the laboratory and the client. A capability review is performed to determine if the laboratory has or needs to obtain certification to perform the work, to determine if the laboratory has the resources (personnel, equipment, materials, capacity, skills, expertise) to perform the work, and if the laboratory is able to meet the client's required reporting and QC limits. The results of this review are communicated to the client and any potential conflict, deficiency, lack of appropriate accreditation status, or concerns of the ability to complete the client's work are resolved.

5.1.2 Any differences between the request or tender and the contract shall be resolved before any work commences. The client should be notified at this time if work is expected to be subcontracted. Each contract shall be acceptable both to the laboratory and the client. Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work.

5.1.3 If a contract needs to be amended after work has commenced, the contract review process is repeated and any amendments are communicated to all affected personnel. Changes in accreditation status affecting ongoing projects must be reported to the client.

5.2 Allowed Deviations from Standard Operating Procedures

5.2.1 When a client requests a modification to an SOP the Project Manager must discuss the proposed deviation with the laboratory supervisor and obtain approval to accept the project. The Laboratory Director and QA Manager may also be involved. The Project Manager is responsible for documenting the approved or allowed deviation from the SOP.

5.2.2 When a client request necessitates a deviation or departure from company policies or procedure involving any non-technical function, the allowed deviation must be approved by the laboratory or the Laboratory Director. Frequent departure from policy is not encouraged. However, if frequent departure from any policy is noted, the Laboratory Director will address the possible need for a change in policy.

6) Subcontracting of Tests

Analytical services are subcontracted when the laboratory needs to balance workload or when the requested analyses are not performed by the laboratory. Subcontracting, to capable qualified laboratories is only done with the knowledge and approval of the client.

Subcontracting to another ALS Environmental laboratory is preferred over external-laboratory subcontracting. Established procedures are used to qualify external subcontract laboratories. These procedures are described in the *SOP for Qualification of Subcontract Laboratories* (CE-QA004). The QA Manager is responsible for maintaining a list of qualified subcontract laboratories.

7) Purchasing Services and Supplies

The quality level of reagents and materials (grade, traceability, etc.) required is specified in the analytical SOPs. Department supervisors ensure that the proper materials are purchased. Inspection and verification of material ordered is performed at the time of receipt by receiving personnel. The receiving staff labels the material with the date received. Expiration dates are assigned as appropriate for the material. Storage conditions and expiration dates are specified in the analytical SOP. The *SOP for Handling Consumable Materials* (ADM-CONSUM) provides default expiration requirements. Supplies and services that are critical in maintaining the quality of laboratory testing are procured from pre-approved vendors. The policy and procedure for purchasing and procurement are described in the *SOP for Procurement and Control of Laboratory Services and Supplies* (CE-GEN007). Also, refer to section 13.5 for a discussion of reference materials.

Receipt procedures include technical review of the purchase order/request to verify that what was received is identical to the item ordered. The laboratory checks new lots of reagents for unacceptable levels of contamination prior to use in sample preservation, sample preparation, and sample analysis by following the *SOP for Quality of Reagents and Standards* (CE-QA012).

8) Service to the Client

The laboratory uses a number of systems to assess its daily operations. In addition to the routine quality control (QC) measurements, the senior laboratory management examines a number of other indicators to assess the overall ability of the laboratory to successfully perform analyses for its clients including; on-time performance, customer complaints, training reports and non-conformity reports. A frequent, routine assessment must also be made of the laboratory's facilities and resources in anticipation of accepting an additional or increased workload.

ALS Environmental utilizes a number of different methods to ensure that adequate resources are available for service demands. Senior staff meetings, tracking of outstanding proposals and an accurate, current synopsis of incoming work all assist the senior staff in properly allocating sufficient resources. All Requests for Proposal (RFP) documents are reviewed by Project Managers, Business Development and appropriate managerial staff to identify any project specific requirements that differ from the standard practices of the laboratory. Any requirements that cannot be met are noted and communicated to the client, as well as requesting the client to provide any project specific Quality Assurance Project Plans (QAPPs) if available. Status/production meetings are also conducted regularly with the laboratory and project managers to inform the staff of the status of incoming work, future projects, or project requirements.

When a customer requests a modification to an SOP, policy, or standard specification the Project Manager will discuss the proposed deviation with the Laboratory Director and department manager to obtain approval for the deviation. The QA Manager may also be involved. All project-specific requirements must be on-file and with the service request upon logging in the samples. The modification or deviation must be documented. A Project-Specific Communication Form, LIMS comments, or similar, may be used to document such deviations.

The laboratory shall afford clients cooperation to clarify the client's request and to monitor the laboratory's performance in relation to the work performed, provided that the laboratory ensures confidentiality to other clients. The laboratory maintains and documents timely communication with the client for the purposes of seeking feedback and clarifying customer requests. Feedback is used and analyzed to improve the quality of services. The *SOP for Handling Customer Feedback* (CE-GEN010) is in place for these events.

9) Complaints

The laboratory maintains a system for dealing with customer complaints. The person who initially receives the feedback (typically the Project Manager) is responsible for documenting the complaint. If the Project Manager is unable to satisfy the customer, the complaint is brought to the attention of the Client Services Manager, Laboratory Director, or QA Manager for final resolution. The complaint and resolution are documented. The procedure is described in the *SOP for Handling Customer Feedback* (CE-GEN010).

10) Facilities and Equipment

ALS Environmental-Simi Valley maintains approximately 20,000 square feet of laboratory and administrative workspace. The laboratory has been designed and constructed to provide safeguards against cross-contamination of samples and is arranged according to work function, which enhances the efficiency of analytical operations. The ventilation system is designed to meet any needs of analyses performed in the separate work areas. ALS Environmental-Simi Valley minimizes laboratory contamination sources by employing janitorial staff to ensure good housekeeping. In addition, the segregated laboratory areas are designed for safe and efficient handling of a variety of sample types. These specialized areas (and access restrictions) include:

- Sample Management Office; Shipping and Receiving
- Records Archival
- Volatile Organics Laboratory (GC and GC/MS)
- Semi-Volatiles Laboratory (GC, GC/MS and HPLC)
- Ultra-Low Level Volatile Organics GC/MS
- General/Wet Chemistry Laboratory
- R&D Laboratory
- Canister Conditioning and Maintenance
- Flow Controller and Critical Orifice Calibration Station
- Sample Storage Walk-in Refrigerator
- Sample, Standards, and Media Storage
- Waste Disposal
- Laboratory Deionized Water System
- Laboratory Management, Client Service, Report Generation and Administration
- Information Technology (IT)

The designated areas for sample receiving, refrigerated sample storage, dedicated sample container preparation and shipping provide for the efficient and safe handling of a variety of sample types. Refer to Appendix D for facility floor plan. The laboratory is equipped with state-of-the-art analytical and administrative support equipment. The equipment and instrumentation are appropriate for the procedures in use. Appendix E lists the major equipment, illustrating the laboratory's overall capabilities and depth.

ALS Environmental-Simi Valley also maintains a satellite extraction facility located at 2360 Shasta Way, Unit G, Simi Valley, California. The approximately 2,000 square foot building contains five fume hoods and is designed with the purpose of performing semi-volatile

organics extraction of air, liquid and solid matrices. The extraction facility is equipped with sufficient bench space, glassware washing equipment and materials, flammable solvent storage, sample/extract storage refrigerators and an electric kiln. Refer to Appendix D for the floor plan of the facility.

10.1 Preventive Maintenance

Preventive maintenance is a crucial element of the Quality Assurance program. Instruments at ALS Environmental (e.g., GC/MS systems, gas and liquid chromatographs, analytical balances, gas and liquid chromatographs, etc.) are maintained under commercial service contracts or by qualified, in-house personnel. All instruments are operated and maintained according to the instrument operating manuals. All routine and special maintenance activities pertaining to the instruments are recorded in instrument maintenance logbooks. The maintenance logbooks used at ALS Environmental contain extensive information about the instruments used at the laboratory.

An initial demonstration of analytical control is required on every instrument used at ALS Environmental before it may be used for sample analysis. Each instrument must be recalibrated following any instrument maintenance which may change or effect the sensitivity or linearity of the instrument or if the continuing calibration verification acceptance criteria have not been met as specified in the standard operating procedure. If an instrument is modified or repaired, a return to analytical control is required before subsequent sample analyses can occur. When an instrument is acquired at the laboratory, the following information is noted in a bound maintenance notebook specifically associated with the new equipment:

- The equipment's serial number;
- Date the equipment was received;
- Date the equipment was placed into service;
- Condition of equipment when received (new, used, reconditioned, etc.); and
- Prior history of damage, malfunction, modification or repair (if known).

Preventive maintenance procedures, frequencies, etc. are available for each instrument used at ALS Environmental. They may be found in the various SOPs for routine methods performed on an instrument and may also be found in the operating or maintenance manuals provided with the equipment at the time of purchase.

Responsibility for ensuring that routine maintenance is performed lies with the department supervisor or laboratory director. The supervisor may perform the maintenance or assign the maintenance task to a qualified bench level analyst who routinely operates the equipment. In the case of non-routine repair of capital equipment, the department supervisor is responsible for providing the repair, either by performing the repair themselves with manufacturer guidance or by acquiring on-site manufacturer repair. The laboratory maintains an adequate supply of expendable maintenance items (expected lifetime of part of less than 1 year.) These parts include items needed to perform the preventive maintenance procedures listed in Table 16-1.

When performing maintenance on an instrument (whether preventive or corrective), additional information about the problem, attempted repairs, etc. is also recorded in the notebook. Typical logbook entries include the following information:

- Details and symptoms of the problem;
- Repairs and/or maintenance performed;
- Description and/or part number of replaced parts;
- Source(s) of the replaced parts;
- Analyst's signature and date; and

- Demonstration of return to analytical control.

See the Table 16-1 for a list of preventive maintenance activities and frequency for each instrument.

For further information regarding Instrumentation see the *SOP for Analytical Instrument Acquisition, Reassignment, Maintenance and Documentation* (ADM-INSTRUM).

10.2 Temperature Control

Temperatures are monitored and recorded for all critical measurement temperature-regulating devices including freezers, refrigerators and ovens. Each piece of equipment is labeled with a unique identifier, the required temperature or range of use according to the needs of the analysis or application. Temperature record books are kept which contain equipment identifier, daily-recorded temperatures (if in use, business days), acceptance criteria and the initials of the laboratory staff member who performed the checks for all temperature-regulating devices in daily use.

10.3 Water Purification Systems

Purified water is utilized for a number of laboratory functions including instrument and method blanks, trip blanks, washes and sample dilutions. The water purification system utilizes three mixed-ion beds, four filters, and resistively lights with constant water recirculation. It is designed to produce deionized water of ASTM Type II quality, with 16-18 megohm-cm resistance at 25˚C and is checked and recorded daily (prior to and if in use). Maintenance and repair on the system is conducted by an approved service supplier and all records including purification checks/verifications are maintained on file for review. For procedures on additional purification (i.e., boiling and/or purging) and purification checks/verifications, refer to the applicable method standard operating procedures.

11) Sample Management

Standard operating procedures have been established for all aspects of sample management within the laboratory including sample receiving, handling, acceptance, log-in, protection, storage, retention, transportation, and disposal. The procedures include provisions necessary to protect the integrity of the sample (as received) and to protect the interests of the laboratory as well as the client. These procedures ensure that samples are handled properly and that all associated documentation is complete and consistent. The sample handling factors that must be taken into account to ensure accurate, defensible analytical results include but are not limited to:

- Amount of sample taken (sampling)
- Type of container used
- Existence and type of sample preservation
- Holding Time
- Proper custodial documentation
- Sample storage, tracking and/or transfer
- Retention
- Disposal

A record of all procedures to which a sample is subjected while in the possession of the laboratory including acceptance, rejection, login, identification, preservation checks, storage, tracking, and disposal are documented and maintained. In addition, all indirect procedures which support each record of a sample and protects the integrity of a sample is documented and maintained (i.e., refrigerator and freezer temperature checks, thermometer calibrations, etc.).

11.1 Sampling

The quality of analytical results is highly dependent upon the quality of the procedures used to collect, preserve and store samples.

ALS Environmental-Simi Valley does not provide sampling services. The laboratory only provides materials needed for sample collection; therefore, ALS Environmental-Simi Valley recommends that clients follow sampling guidelines described in the specific reference methods including 40 CFR 136 and/or USEPA SW-846, NIOSH, OSHA, ASTM, CARB and SCAQMD as appropriate.

When transporting samples to the laboratory, the most expedient but lawful route of transport should be utilized. Also, the hazardous potential of the samples needs to be considered when shipping samples via air freight or passenger airlines.

11.2 Preservation

ALS Environmental-Simi Valley uses sample preservation, container, and holding time recommendations published in a number of referenced documents including, but not limited to USEPA SW 846, USEPA 600/4-79-020, USEPA 600/r-93-100 (inorganic substances), 600/4-91-010, and EPA/625/R-96/010b (air samples) and the US EPA Methods Update Rule effective 4/11/07. The complete citation for each of these and other references can be found in Section 23 of this document. The appropriate container, preservation and holding time information are summarized in Appendix F. Additional information on this is addressed in each corresponding method SOP.

11.3 Shipping of Containers and Samples

ALS Environmental-Simi Valley provides sample containers to clients via media requests for all matrices (soil, water, air) with the appropriate preservatives (as applicable). These containers include Tedlar bags, Summa canisters, silica-gel tubes, etc. ALS Environmental-Simi Valley keeps client-specific shipping requirements on file and utilizes all major transportation carriers to guarantee that sample shipping requirements (same-day, overnight, etc.) are met. ALS Environmental-Simi Valley also provides its own courier service that makes scheduled courier runs in the greater Los Angeles metropolitan area. The procedures for all requirements directed toward media requests follow the requirements detailed in the *SOP for Media Request Fulfillment* (ADM-Media_Req).

11.4 Sample Receiving and Acceptance

It is the policy of ALS Environmental-Simi Valley to check and record the condition of each sample (i.e. pressure, temperature, etc.) delivered to the Sample Management Office (SMO) and received by the Sample Management Custodian or alternates against certain acceptance criteria as documented in the *SOP for Sample Receiving, Acceptance, and Log-In* (SMO-SMPL_REC). This policy is available to all sample management personnel for reference. Any samples, which deviate from these outlined areas, will be clearly flagged with the nature and substance of the deviation. Assessment and condition checks utilized by ALS Environmental-Simi Valley for the acceptance or rejection of samples are based on the criteria found in Appendix F, applicable Quality Assurance Project Plan (QAPP), permit, program or rule where appropriate. This verification of sample integrity is conducted by the Sample Custodian and may be dependent on the matrix (i.e., temperature, preservation, and headspace) being submitted.

Any abnormalities or departures from specified condition requirements (as described herein) as observed during the initial assessment are recorded. When there is any doubt as to the suitability of a sample for testing, including signs of damage, when a sample does not conform to the description provided, or when the test method required is not specified in sufficient detail the appropriate Project Manager (PM) is notified.

The Project Manager is to consult with the client, whenever possible, regarding specific integrity issues documented during sample receipt for further instructions before proceeding and retain a written record of discussion. There may be instances where the client is unavailable, in which case the PM shall document all attempts at contacting the client.

There may be a need to inform the client that a sample(s) is rejected and cannot be accepted for analysis into the laboratory. This situation includes, but is not limited to loss of sample or insufficient amount (subsampling may be performed if it would not cause loss of sample integrity, but the procedure must be indicated with the test results). Subsampling as in the case of air samples is not appropriate.

The procedures for sample documentation, handling acceptance requirements and deviations from the sample acceptance policy are discussed in detail in the *SOP for Sample Receiving, Acceptance and Log-In* (SMO-SMPL_REC). This procedure is also in place to ensure samples are received and properly logged into the laboratory, and that all associated sample documentation, including Chain-of-Custody (COC) records are complete and consistent with the samples received. All associated documentation, including chain of custody forms, memos, transmittal forms, and phone logs, are kept with each project file.

11.5 Sample Log-in

Each sample is logged into the laboratory in such a way as to ensure traceability and cross-reference with regards to the unique laboratory job number, sample identifications and client sample identifications. The laboratory identification is retained throughout the life of the sample in the laboratory. The identification system is designed and operated to ensure that samples cannot be confused physically or in laboratory documentation. Additional information is provided in the *SOP for Sample Receiving, Acceptance, and Log-In* (SMO_SMPL_REC).

11.6 Sample Custody

A sample is in someone's "custody" if:

1. It is in one's actual physical possession;
2. It is in one's view, after being in one's physical possession;
3. It is in one's physical possession and then locked up so that no one can tamper with it;
4. It is kept in a secured area, restricted to authorized personnel only.

Chain-of-Custody (COC) records are used to establish the legal custody of samples, showing the continuous possession of samples from sample collection and transportation to final destination at the laboratory. Custody of each sample is maintained from receipt through disposal (internally utilizing LIMS). When environmental samples are shipped to other laboratories for analysis, the sample management office follows formalized procedures for maintaining the chain of custody, which is written in SOPs for Sample Receiving, Acceptance and Login and Laboratory Storage, Analysis, and Tracking.

When samples are removed from the fixed lab and transported to the off-site extraction facility for sample preparation, internal chain of custody procedures still apply. When sample preparation is completed, sample extracts are returned to the laboratory.

Laboratory security and access is important in maintaining the integrity of samples received at ALS Environmental-Simi Valley.

Access to the building is limited to the reception area and sample receiving doors, which are manned during business hours and locked at all other times. In addition, the sample storage area within the laboratory is a controlled access area.

The laboratory is equipped with an alarm system which is monitored by a private security firm who provides nighttime and weekend security.

11.7 Sample Storage, Analysis and Tracking

The procedures and requirements for documenting the storage, analysis and tracking as well as maintaining integrity of samples are detailed in the *SOP for Laboratory Storage, Analysis, and Tracking* (ADM-LabSAT).

11.8 Sample Retention and Waste Disposal

Upon completion of all analyses, the laboratory samples are retained in accordance with the requirements specified in the method SOPs and the *SOP for Waste Disposal* (ADM-Waste). The samples are disposed according to approved disposal practices or returned to the client (if applicable). All samples are characterized according to hazardous/non-hazardous waste criteria and are segregated accordingly. This evaluation is generally based on results from analyses performed on the sample by ALS Environmental-Simi Valley or an approved subcontract laboratory. It should be noted that all wastes produced at the laboratory, including the laboratory's own various hazardous waste streams, are treated in accordance with all applicable local, State and Federal laws. Complete documentation is maintained for samples from initial receipt through final disposal. This ensures an accurate record of the samples from "cradle to grave."

11.9 Intra-laboratory / Inter-laboratory Transfer of Samples

When environmental samples are shipped to another laboratory for analysis, samples are properly packed for shipment and preserved if necessary. Sample bottles are wrapped in protective material and placed in a plastic bag (preferably Ziploc®) to avoid any possible cross-contamination of samples during the transportation process. Blue or wet ice is used for temperature preservation, where necessary.

Figure 11-1
Air 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.

Company Name & Address (Reporting Information)

Project Name

Project Number

ALS Contact:

Analysis Method

Project Manager

P.O. # / Billing Information

Phone | Fax

Email Address for Result Reporting

Sampler (Print & Sign)

Comments
e.g. Actual Preservative or specific instructions

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			

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

Figure 11-2
Soil / Water Chain of Custody Form

Soil / Water - 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	Analysis			Comments
	Project Number				
Project Manager	P.O. # / Credit Card / Billing Information				
Phone / Fax					
Email Address for Result Reporting					

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Water	Soil	Solid	Other				

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____ Tier III (Results + QC & Calibration Summaries) ____ EDD required Yes / No
Tier II (Results + QC Summaries) ____ Tier IV (Data Validation Package) 10% Surcharge ____ Type: _____ Units:_____
Chain of Custody Seal: (Circle) INTACT BROKEN ABSENT

Project Requirements (MRLs)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:

Cooler / Blank / Ice / No Ice
Temperature _____ °C

Figure 11-3

ALS Environmental
Sample Acceptance Check Form

Client: _____ Work order: _____
Project: _____
Sample(s) received on: _____ Date opened: _____ by: _____

Note: This form is used for all samples received by ALS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	No	N/A
1	Were **sample containers** properly marked with client sample ID?	☐	☐	☐
2	Container(s) **supplied by ALS**?	☐	☐	☐
3	Did **sample containers** arrive in good condition?	☐	☐	☐
4	Were **chain-of-custody** papers used and filled out?	☐	☐	☐
5	Did **sample container labels** and/or tags agree with custody papers?	☐	☐	☐
6	Was **sample volume** received adequate for analysis?	☐	☐	☐
7	Are samples within specified holding times?	☐	☐	☐
8	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☐
9	Was a **trip blank** received?	☐	☐	☐
10	Were **custody seals** on outside of cooler/Box?	☐	☐	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☐
	Were signature and date included?	☐	☐	☐
	Were seals intact?	☐	☐	☐
	Were custody seals on outside of sample container?	☐	☐	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☐
	Were signature and date included?	☐	☐	☐
	Were seals intact?	☐	☐	☐
11	Do containers have appropriate **preservation**, according to method/SOP or Client specified information?	☐	☐	☐
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☐
	Were **VOA vials** checked for presence/absence of air bubbles?	☐	☐	☐
	Does the client/method/SOP require that the analyst check the sample pH and if necessary alter it?	☐	☐	☐
12	**Tubes:** Are the tubes capped and intact?	☐	☐	☐
	Do they contain moisture?	☐	☐	☐
13	**Badges:** Are the badges properly capped and intact?	☐	☐	☐
	Are dual bed badges separated and individually capped and intact?	☐	☐	☐

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments

Explain any discrepancies: (include lab sample ID numbers): _____

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

12) Analytical Procedures

ALS Environmental employs methods and analytical procedures from a variety of external sources. Reference documents include but are not limited to: ASTM, CARB, NCASI, NIOSH, OSHA, SCAQMD, USEPA SW-846, USEPA 600/4-79-020, 600/4-91-010, 600/R-93/100 (inorganic substances), 600/625/R-96/010b (air samples), EPA 40 CFR part 136 and associated Method Update Rules and Supplements, and *Standard Methods for the Examination of Water and Wastewater* for water and wastewater samples. Complete citations for these references can be found in Section 23. Other published procedures, such as state-specific methods, program-specific methods, or in-house methods may be used. Several factors are involved with the selection of analytical methods to be used in the laboratory. These include the method detection limit, the concentration of the analyte being measured, method selectivity, accuracy and precision of the method, the type of sample being analyzed, and the regulatory compliance objectives. The implementation of methods by ALS Environmental is described in SOPs specific to each method. A list of NELAP-accredited methods is given in Appendix J. Further details are described below.

12.1 Standard Operating Procedures (SOPs) and Laboratory Notebooks

ALS Environmental maintains SOPs for use in both technical and administrative functions (Refer to Appendix G). SOPs are written following standardized format and content requirements as described in the *SOP for Establishing Standard Operating Procedures* (CE-GEN009). Each SOP is reviewed and approved by a minimum of two managers (the Laboratory Director and/or Department Manager and the QA Manager). All SOPs undergo a documented annual review to make sure current practices are described. The QA Manager maintains a comprehensive list of current SOPs. The document control process ensures that only the most currently prepared version of an SOP is being used. The QA Manual, QAPPs, SOPs, standards preparation logbooks, maintenance logbooks, et al., are controlled documents, unless otherwise noted. The procedures for document control are described in the *SOP for Document Control* (CE-GEN005). In addition to SOPs, each laboratory department maintains a current file, accessible to all laboratory staff, of the current methodology used to perform analyses. Laboratory notebook entries are standardized following the guidelines in the *SOP for Making Entries onto Analytical Records* (CE-QA007). Entries made into laboratory notebooks are reviewed and approved by the appropriate supervisor at a regular interval.

12.2 Modified Procedures

ALS Environmental strives to perform published methods as described in the referenced documents. If there is a material deviation from the published method, the method is cited as a "Modified" method in the analytical report. Modifications to the published methods are listed in the standard operating procedure. Standard operating procedures are available to analysts and are also available to our clients for review, especially those for "Modified" methods. Client approval is obtained for the use of "Modified" methods prior to the performance of the analysis.

12.3 Analytical Batch

The basic unit for analytical quality control is the analytical batch. The definition that ALS Environmental-Simi Valley has adopted for the analytical batch is listed below. The overriding principle for describing an analytical batch is that all the samples in a batch, both field samples and quality control samples are to be handled exactly the same way, and all of the data from each analysis is to be manipulated in exactly the same manner. The minimum requirements of an analytical batch are:

1) The number of (field) samples in a batch is not to exceed 20.
2) All (field) samples in a batch are of the same matrix.
3) The QC samples to be processed with the (field) samples include:
   a) Method Blank (a.k.a. Laboratory Reagent Blank)

      Function: Determination of laboratory contamination

   b) Laboratory Control Sample

      Function: Assessment of method performance

   c) Matrix Spiked (field) Sample (a.k.a. Laboratory Fortified Sample Matrix)*

      Function: Assessment of matrix bias

   d) Duplicate Matrix Spiked (field) Sample or Duplicate (field) Sample (a.k.a. Laboratory Duplicate)*

      Function: Assessment of batch precision

   * A sample identified as a field blank, an equipment blank, or a trip blank is not to be matrix spiked or duplicated.
4) A single lot of reagents is used to process the batch of samples.
5) Each operation within the analysis is performed by a single analyst, technician, chemist, or by a team of analysts/technicians/chemists.
6) Samples are analyzed in a continuous manner over a timeframe not to exceed 24-hours between the start of processing of the first and last sample of the batch.
7) (Field) samples are assigned to batches commencing at the time that sample processing begins. For example: for analysis of metals, sample processing begins when the samples are digested. For analysis of organic constituents, it begins when the samples are extracted.
8) The QC samples are to be analyzed in conjunction with the associated field samples prepared with them. However, for tests which have a separate sample preparation step that defines a batch (digestion, extraction, etc.), the QC samples in the batch do not require analysis each time a field sample within the preparation batch is analyzed (multiple instrument sequences to analyze all field samples in the batch need not include re-analyses of the QC samples).
9) The batch is to be assigned a unique identification number that can be used to correlate the QC samples with the field samples.
10) Batch QC refers to the QC samples that are analyzed in a batch of (field) samples.
11) Project-specific requirements may be exceptions. If project, program, or method requirements are more stringent than these laboratory minimum requirements, then the project, program, or method requirements will take precedence. However, if the project, program, or method requirements are less stringent than these laboratory minimum requirements, these laboratory minimum requirements will take precedence.

Note: Matrix spiked samples are often not feasible for air matrices. Therefore, the MS shall be used as required by the test method and as specified by the corresponding method SOP.

12.4 Specialized Procedures

ALS Environmental not only strives to provide results that are scientifically sound, legally defensible, and of known and documented quality; but also strives to provide the best solution to analytical challenges. Procedures using specialized instrumentation and methodology have been developed to improve sensitivity (provide lower detection limits), selectivity (minimize interferences while maintaining sensitivity), and overall data quality for low concentration applications. Examples are specialized GC/MS analyses, and low level organics analyses (including PAHs, pesticides and PCBs).

12.5 Demonstration of Capability

A demonstration of capability (DOC) is made prior to using any new test method or when a technician is new to the method. This demonstration is made following regulatory, accreditation, or method specified procedures. In general, this demonstration does not test the performance of the method in real world samples, but in the applicable clean matrix free of target analytes and interferences.

A quality control sample material may be obtained from an outside source or may be prepared in the laboratory. The analyte(s) is (are) diluted in a volume of clean matrix (for analytes which do not lend themselves to spiking, e.g., TSS, the demonstration of capability may be performed using quality control samples). Where specified, the method-required concentration levels are used. Four aliquots are prepared and analyzed according to the test procedure. The mean recovery and standard deviations are calculated and compared to the corresponding acceptance criteria for precision and accuracy in the test method or laboratory-generated acceptance criteria (if there are not established mandatory criteria). All parameters must meet the acceptance criteria. Where spike levels are not specified, actual Laboratory Control Sample results may be used to meet this requirement, provided acceptance criteria are met.

12.6 Method Detection Limits and Method Reporting Limits & Limits of Detection/ Quantitation

Method Detection Limits (MDL) for methods performed at ALS Environmental-Simi Valley are determined during initial method set up and if any significant changes are made. If an MDL study is not performed annually, the established MDL is verified by performing a limit of detection (LOD) verification on every instrument used in the analysis. The MDLs are determined by following the *SOP for Performing Method Detection Limits Studies and Establishing Limits of Detection and Quantitation* (CE-QA011), which is based on the procedure in 40 CFR Part 136, Appendix B. As required by NELAP and DoD protocols, the validity of MDLs is verified using LOD verification samples.

The Method Reporting Limit (MRL) is the lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (i.e. limit of quantitation - LOQ). LOQ are analyzed on an annual basis and cannot be lower than the lowest calibration standard. Current MDLs and MRLs are available from the laboratory.

13) Measurement Traceability and Calibration

All equipment and instruments used at ALS Environmental are operated, maintained and calibrated according to the manufacturer's guidelines and recommendations, as well as to criteria set forth in the applicable analytical methodology. Operation and calibration are performed by personnel who have been properly trained in these procedures. Documentation of calibration information is maintained in appropriate reference files. Brief descriptions of the calibration procedures for our major laboratory equipment and instruments are described below. Calibration verification is performed according to the applicable analytical methodology. Calibration verification procedures and criteria are listed in laboratory Standard Operating Procedures. Documentation of calibration verification is maintained in appropriate reference files. Records are maintained to provide traceability of reference materials.

Traceability is defined as the property of a measurement result or value of a standard which can be related to stated references through an unbroken chain, each with stated uncertainties and is documented for all material used to perform calibrations. The documentation, a certificate of analysis containing, at a minimum, the manufacturer, address, accreditation number (where applicable), how traceability was achieved, the traceable values, their associated uncertainty, and the unique serial or laboratory identification number of the equipment or standard reference material (SRM) shall serve as initial point in the chain of traceability. The unique serial number or laboratory identification number is used throughout the laboratory to trace equipment and materials back to the original certificate of analysis.

Laboratory support equipment (thermometers, balances, and weights) are verified on an annual basis by a vendor accredited to ISO/IEC 17025:2005 International Standards. All analytical measurements generated at ALS Environmental are performed using materials and/or processes that are traceable to a reference material. Metrology equipment (analytical balances, thermometers, etc.) is calibrated using reference materials traceable to the National Institute of Standards and Technology (NIST). These primary reference materials are themselves recertified on an annual basis. Vendors used for metrology support are required to verify compliance to International Standards by supplying the laboratory with a copy of their scope of accreditation.

Equipment subjected to overloading or mishandling, or has been shown by verification to be defective, is taken out of service and labeled until repaired. That piece of equipment is placed back in service only after verifying, by calibration, that it performs satisfactorily.

13.1 Temperature Measuring Devices

All thermometers are identified by a unique identifying number (i.e., serial number), and the calibration of these thermometers is checked annually against a National Institute of Standards and Technology (NIST) certified thermometer. All corresponding correction factors are noted on the device as well as in the thermometer calibration logbook. The NIST calibrated thermometer is recertified by an approved vendor accredited ISO/IEC 17025:2005 International Standard on an annual basis and certificates are retained on file for review. All temperature monitoring is conducted in accordance with the *SOP for Sample Receipt, Acceptance and Log-In* (SMO-SMPL_REC) and thermometer calibration requirements are performed in accordance with the *SOP for Calibration and Use of the Laboratory Support Equipment* (ADM-SupEQ).

A number of thermometers include a temperature range per certain project requirements (complies with Department of Defense Quality Systems Manual for Environmental Laboratories); this range is recorded to document consistent compliance with required temperatures for refrigerators and freezers, where applicable.

13.2 Volumetric Dispensing Devices

The accuracy of pipettes used to make critical-volume measurements is verified on a quarterly basis. Typically, the indicated volume or range (where applicable) of the pipette is checked and both the accuracy and precision verification are performed using the above-mentioned procedure. The calibrations are evaluated against the intended use (volume or range) of the pipette and if the calibration is not approved for the specified volume(s) it is tagged accordingly (i.e. "Do Not Use Below 5uL"). The results for all calibration verifications are recorded and maintained.

Note: Glass microliter syringes including gas-tight syringes are considered in the same manner as Class A glassware and are not held to the calibration/verification requirements as are other volumetric dispensing devices.

13.3 Analytical Balances and Weights

Analytical balances and weights are calibrated/recertified and certificates issued annually by an approved vendor accredited to ISO/IEC 17025:2005 International Standard. The calibration of each balance is checked once each day of use in the expected range, utilizing the calibrated weights. Bound record books are kept which contain the identification of balance (serial number), recorded measurements and the initials of the analyst who performed the check. All certificates for the balances and weights are available for review.

13.4 Pressure/Vacuum Gauges

ALS Environmental-Simi Valley digital pressure/vacuum gauges are used in a number of critical measurements within the laboratory. The following is a list of the uses for this gauge type.

- Canister cleaning and conditioning
- Measure the vacuum on canisters before they are sent to the client for sampling.
- Measure the initial/final vacuum/pressure of canisters prior to analysis.
- Measure pressure during the preparation of selected standards.

Digital pressure/vacuum gauges are calibrated and certificates issued once per year by an approved metrology organization. All calibrations are performed against standards traceable to the National Institute of Standards and Technology (NIST) or other recognized national metrology institutes. In addition, ALS Environmental-Simi Valley performs a calibration check for each gauge six months following the calibration date. The laboratory retains all corresponding calibration and verification documentation for review.

13.5 Source and Preparation of Standards and Reference Materials

Consumable reference materials routinely purchased by the laboratories (e.g., analytical standards) are purchased from nationally recognized, reputable vendors. All vendors where possible have fulfilled the requirements for ISO 9001 certification and/or are ISO 17025 accredited. ALS Environmental-Simi Valley relies on a primary vendor for the majority of its analytical supplies. Consumable primary stock standards are obtained from certified commercial sources or from sources referenced in a specific method. Supelco, Ultra Scientific, AccuStandard, Chem Services, Inc., Aldrich Chemical Co., etc. are examples of the vendors used. Reference material information is recorded in the appropriate logbook(s) and materials are stored under conditions that provide maximum protection against deterioration and contamination.

The logbook entry includes such information as an assigned logbook identification code, the source of the material (i.e. vendor identification), solvent (if applicable) and concentration of analyte(s), reference to the certificate of analysis and an assigned expiration date. The date that the standard is received in the laboratory is marked on the container. When the reference material is used for the first time, the date of usage and the initials of the analyst are also recorded on the container.

Stock solutions and calibration standard solutions are prepared fresh as often as necessary according to their stability. All standard solutions are properly labeled as to analyte concentration, solvent, date, preparer, and expiration date; these entries are also recorded in the appropriate notebook(s) following the *SOP for Making Entries onto Analytical Records* (CE-QA007). Prior to sample analysis, all calibration reference materials are verified with a second, independent source of the material.

13.6 Instrument Calibration

The laboratory specifies the procedures and documentation for initial instrument calibration and continuing calibration verification in the applicable method standard operating procedures to ensure that data is of known quality and is appropriate for a specific regulation and/or client requirement. The procedural steps for calibration including, frequency, number of points, integration, calculations, acceptance criteria (appropriate to the calibration technique employed), corrective action, associated statistics, and data qualifications are included in applicable methods, method standard operating procedures and/or client project plans. The essential elements that define the procedures and required documentation for initial instrument calibrations are specified below.

- Sufficient raw data records are retained to permit reconstruction of all calibrations.
- If a reference or mandated method does not specify the number of calibration standards, the initial calibration range shall consist of a minimum of 5 contiguous calibration points for organics and a minimum of 3 contiguous calibration points for inorganics. The actual numbers of points utilized is specified in the corresponding method SOP.
- The concentrations should bracket the expected concentration range of samples.
- Initial instrument calibration procedures referenced in test methods (either directly or indirectly) are readily available to the analysts.
- All sample results are quantitated from the initial instrument calibration and are not quantitated from any continuing instrument calibration verification unless otherwise specified by regulation, method or program.
- The initial instrument calibration is verified with a standard obtained from a second manufacturer or lot and traceability to a national standard is maintained, where available.
- The acceptance criteria utilized is appropriate for the calibration technique employed.
- The lowest calibration standard in the initial calibration is at or below the lowest concentration for which quantitative data are to be reported and is referred to at this laboratory as the method reporting limit (MRL). Some programs and/or agencies refer to this limit as the practical quantitation limit (PQL) or Limit of Quantitation (LOQ).
- Any data reported below the MRL or above the highest calibration standard is considered to have an increased quantitative uncertainty and is appropriately qualified in the report.

- The lowest calibration standard is above the limit of detection or method detection limit (MDL).

13.7 Internal and External Calibrations

Internal standard calibration involves the comparison of instrument responses from the target compounds in the sample to the responses of specific standards added to the sample or sample extract prior to injection. The ratio of the peak area of the target compound in the sample or sample extract to the peak area of the internal standard in the sample or sample extract is compared to a similar ratio derived for each calibration standard. The ratio is termed the response factor (RF) or relative response factor (RRF) in some methods.

External standard calibration involves comparison of instrument responses from the sample to the responses from the target compounds in the calibration standards. Sample peak areas are compared to peak areas of the standards. The ratio of the detector responses to the amount (mass) of analyte in the calibration standard is defined as the calibration factor or in some cases it may be referred to as response factor.

13.8 Continuing Calibration Verification

The essential elements that define the procedures and required documentation for continuing instrument calibration verification are specified below.

- When an initial calibration is not performed on the day of analysis, continuing instrument calibration verification is analyzed with each batch.
- Calibration is verified for each reported compound, element or parameter; however, for multi-component analytes such as aroclors or total petroleum hydrocarbons a representative chemical related substance or mixture may be used. The allowance for this exception is dependent on applicable regulatory, method, or client project plans.
- Generally, the instrument calibration verification is performed at the beginning, end, and every ten samples of each analytical batch (except, if an internal standard is used, only one verification needs to be performed at the beginning of the analytical batch); whenever it is suspected that the analytical system may be out of calibration; if the time period for calibration or most previous calibration verification has expired; or for analytical systems that contain a specific calibration verification requirement. Specific requirements for the frequency of continuing calibration verification, for a particular method, is specified in the corresponding method standard operating procedure.

14) Assuring the Quality of Results

A primary focus of ALS Environmental's QA Program is to ensure the accuracy, precision and comparability of all analytical results. Prior to using a procedure for the analysis on field samples, acceptable method performance is established by performing demonstration of capability analyses. Performance characteristics are established by performing method detection limit studies and assessing accuracy and precision according to the reference method. ALS Environmental has established Quality Control (QC) objectives for precision and accuracy that are used to determine the acceptability of the data that is generated. These QC limits are either specified in the test methodology or are statistically derived based on the laboratory's historical data. Quality Control objectives are defined below.

14.1 Quality Control Objectives

14.1.1 Accuracy - Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value. Accuracy is determined by calculating the mean value of results from ongoing analyses of laboratory-fortified blanks, standard reference materials, and standard solutions. In addition, laboratory-fortified (i.e. matrix-spiked) samples are also measured; this indicates the accuracy or bias in the actual sample matrix. Accuracy is expressed as percent recovery (% REC.) of the measured value, relative to the true or expected value. If a measurement process produces results whose mean is not the true or expected value, the process is said to be biased. Bias is the systematic error either inherent in a method of analysis (e.g., extraction efficiencies) or caused by an artifact of the measurement system (e.g., contamination).

ALS Environmental utilizes several quality control measures to eliminate analytical bias, including systematic analysis of method blanks, laboratory control samples and independent calibration verification standards. Because bias can be positive or negative, and because several types of bias can occur simultaneously, only the net, or total, bias can be evaluated in a measurement.

14.1.2 Precision - Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability, or random error, in sampling, sample handling and in laboratory analysis. The American Society of Testing and Materials (ASTM) recognizes two levels of precision: repeatability - the random error associated with measurements made by a single test operator on identical aliquots of test material in a given laboratory, with the same apparatus, under constant operating conditions, and reproducibility - the random error associated with measurements made by different test operators, in different laboratories, using the same method but different equipment to analyze identical samples of test material.

"Within-batch" precision is measured using replicate sample or QC analyses and is expressed as the relative percent difference (RPD) between the measurements. The "batch-to-batch" precision is determined from the variance observed in the analysis of standard solutions or laboratory control samples from multiple analytical batches.

14.1.3 Control Limits - The control limits for accuracy and precision originate from two different sources. For analyses having enough QC data, control limits are calculated at the 99% confidence limits. For analyses not having enough QC data, or where the method is prescriptive, control limits are taken from the method on which the procedure is based. If the method does not have stated control limits, then control limits are assigned method-default or reasonable values. Control limits are updated periodically when new statistical limits are generated for the appropriate surrogate, laboratory control sample, and matrix spike compounds (typically once a year) or when method prescribed limits change. The updated limits are reviewed by the QA Manager. The new control limits replace the previous limits and data is assessed using the new values. Current acceptance limits for accuracy and precision are available from the laboratory. For inorganics, the precision limit values listed are for laboratory duplicates. For organics, the precision limit values listed are for duplicate laboratory control samples or duplicate matrix spike analyses.

14.1.4 Representativeness - Representativeness is the degree to which the field sample, being properly preserved, free of contamination, and analyzed within holding time, represents the overall sample site or material. This can be extended to the sample itself, in that representativeness is the degree to which the subsample that is analyzed represents the entire field sample submitted for analysis. ALS Environmental has sample handling procedures to ensure that the sample used for analysis is representative of the entire sample. Further, analytical SOPs specify appropriate sample handling and sample sizes to further ensure the sample aliquot that is analyzed is representative in entire sample. Air samples received by the laboratory in canisters and bags are considered to be homogenous and therefore, no special sample preparation procedures are necessary.

14.1.5 Comparability – Comparability expresses the confidence with which one data set can be compared to another and is directly affected by data quality (accuracy and precision) and sample handling (sampling, preservation, etc). Only data of known quality can be compared. The objective is to generate data of known quality with the highest level of comparability, completeness, and usability. This is achieved by employing the quality controls listed below and standard operating procedures for the handling and analysis of all samples. Data is reported in units specified by the client and using ALS Environmental or project-specified data qualifiers.

14.2 Quality Control Procedures

The specific types, frequencies, and processes for quality control sample analysis are described in detail in method-specific standard operating procedures and listed below. These sample types and frequencies have been adopted for each method and a definition of each type of QC sample is provided below.

14.2.1 Method Blank (a.k.a. Laboratory Reagent Blank)

The method blank is an analyte-free matrix (air, water, soil, etc.) subjected to the entire analytical process. When analyte-free soil is not available, anhydrous sodium sulfate, organic-free sand, or an acceptable substitute is used. The method blank is analyzed to demonstrate that the analytical system itself does not introduce contamination. The method blank results should be below the Method Reporting Limit (MRL) or, if required for DoD projects, < ½ MRL for the analyte(s) being tested. Otherwise, corrective action must be taken. A method blank is included with the analysis of every sample preparation batch, every 20 samples, or as stated in the method, whichever is more frequent.

14.2.2 Calibration Blanks

For some methods, calibration blanks are prepared along with calibration standards in order to create a calibration curve. Calibration blanks are free of the analyte of interest and, where applicable, provide the zero point of the calibration curve. Additional project-specific requirements may also apply to calibration blanks.

14.2.3 Continuing Calibration Blanks

Continuing calibration blanks (CCBs) are solutions of analyte-free water, reagent, or solvent that are analyzed in order to verify the system is contamination-free when CCV standards are analyzed.

The frequency of CCB analysis is once every ten samples or as indicated in the method, whichever is greater. Additional project-specific requirements may also apply to continuing calibration blanks.

14.2.4 Calibration Standards

Calibration standards are vapors, liquids or solutions of known concentration prepared from primary standard or stock standard materials. Calibration standards are used to calibrate the instrument response with respect to analyte concentration. Standards are analyzed in accordance with the requirements stated in the particular method being used.

14.2.5 Initial (or Independent) Calibration Verification Standards

Initial (or independent) calibration verification standards (ICVs) are standards that are analyzed *after* calibration but *prior to* sample analysis, in order to verify the validity and accuracy of the standards used for calibration. Once it is determined that there is no defect or error in the calibration standard(s), standards are considered valid and may be used for subsequent calibrations and quantitative determinations (as expiration dates and methods allow). The ICV standards are prepared from materials obtained from a source independent of that used for preparing the calibration standards ("second-source"). ICVs are also analyzed in accordance with method-specific requirements.

14.2.6 Continuing Calibration Verification Standards

Continuing calibration verification standards (CCVs) are midrange standards that are analyzed in order to verify that the calibration of the analytical system is still acceptable. The frequency of CCV analysis is either once every ten samples, or as indicated in the method.

14.2.7 Internal Standards

Internal standards are known amounts of specific compounds that are added to each sample prior to instrument analysis. Internal standards are generally used for GC/MS procedures to correct sample results that have been affected by changes in instrument conditions or changes caused by matrix effects. The requirements for evaluation of internal standards are specified in each method and SOP.

14.2.8 Surrogates

Surrogates are organic compounds which are similar in chemical composition and chromatographic behavior to the analytes of interest, but which are not normally found in environmental samples. Depending on the analytical method, one or more of these compounds is added to method blanks, calibration and check standards, and samples (including duplicates, matrix spike samples, duplicate matrix spike samples and laboratory control samples) prior to extraction and analysis in order to monitor the method performance on each sample. The percent recovery is calculated for each surrogate, and the recovery is a measurement of the overall method performance.

Recovery (%) = (M/T) x 100

Where: M = The measured concentration of analyte,
T = The theoretical concentration of analyte added.

14.2.9 Laboratory Control Samples

The laboratory control sample (LCS) is an aliquot of analyte-free liquid, solid or air matrix to which known amounts of the method analyte(s) is (are) added. A reference material of known matrix type, containing certified amounts of target analytes, may also be used as an LCS. An LCS is prepared and analyzed at a minimum frequency of one LCS per 20 samples, with every analytical batch or as stated in the method, whichever is more frequent. The LCS sample is prepared and analyzed in exactly the same manner as the field samples.

The percent recovery of the target analytes in the LCS is compared to established control limits and assists in determining whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements at the required reporting limit. Comparison of batch-to-batch LCS analyses enables the laboratory to evaluate batch-to-batch precision and accuracy.

Recovery (%) = (M/T) x 100

Where: M = The measured concentration of analyte,
T = The theoretical concentration of analyte added.

14.2.10 Laboratory Fortified Blanks - LFB

A laboratory blank fortified at the MRL used to verify the minimum reporting limit. The LFB is carried through the entire extraction and analytical procedure. A LFB is required with every batch of drinking water samples.

14.2.11 Matrix Spikes (a.k.a. Laboratory Fortified Sample Matrix)

Matrix spiked samples are aliquots of samples to which a known amount of the target analyte (or analytes) is (are) added. The samples are then prepared and analyzed in the same analytical batch, and in exactly the same manner as are routine samples. For the appropriate methods, matrix spiked samples are prepared and analyzed and at a minimum frequency of one spiked sample (and one duplicate spiked sample, if appropriate) per twenty samples. The spike recovery measures the effects of interferences caused by the sample matrix and reflects the accuracy of the method for the particular matrix in question. Spike recoveries are calculated as follows:

Recovery (%) = (S - A) x 100 ÷ T

Where: S = The observed concentration of analyte in the spiked sample,
A = The analyte concentration in the original sample, and
T = The theoretical concentration of analyte added to the spiked sample.

Note: Matrix spiked samples are often not feasible for air matrices. Therefore, the MS shall be used as required by the test method and as specified by the corresponding method SOP.

14.2.12 Laboratory Duplicates and Duplicate Matrix Spikes

Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample.

Depending on the method of analysis, either a duplicate analysis (and/or a matrix spiked sample) or a matrix spiked sample and duplicate matrix spiked sample (MS/DMS) are analyzed. The relative percent difference between duplicate analyses or between an MS and DMS is a measure of the precision for a given method and analytical batch. The relative percent difference (RPD) for these analyses is calculated as follows:

$$\textit{Relative Percent Difference (RPD)} = (S1 - S2) \times 100 \div S_{ave}$$

Where S1 and S2 = The observed concentrations of analyte in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike, and

S_{ave} = The average of observed analyte concentrations in the sample and its duplicate, or in the matrix spike and its duplicate matrix spike.

Depending on the method of analysis, either duplicates (and/or matrix spikes) or MS/DMS analyses are performed at a minimum frequency of one set per 20 samples. If an insufficient quantity of sample is available to perform a laboratory duplicate or duplicate matrix spikes, duplicate LCSs will be prepared and analyzed.

14.2.13 Control Charting

The generation of control charts is routinely performed at ALS Environmental. Surrogate, Matrix Spike and LCS recoveries are all monitored and charted. In addition, the laboratory also monitors the Relative Percent Difference (RPD) measurement of precision. Control charts are available to each individual laboratory unit to monitor the data generated in its facility using control charts that have been programmed to identify various trends in the analytical results. If trends in the data are perceived, various means of corrective action may then be employed in order to prevent future problems with the analytical system(s). Finally, data quality reports using control charts are generated for specific clients and projects pursuant to contract requirements. The control charting procedure is described in the SOP for *Control Limits* (CE-QA009).

14.2.14 Glassware Washing

Glassware washing and maintenance play a crucial role in the daily operation of a laboratory. The glassware used at ALS Environmental undergoes a rigorous cleansing procedure prior to every usage. The *SOP for Glassware Cleaning* (ADM-GLASS) has been generated and outlines the various procedures used at ALS Environmental-Simi Valley; each procedure is specific to the end-use of the equipment as well as to the overall analytical requirements of the project. In addition, other equipment that may be routinely used at the laboratory is also cleaned following instructions in the appropriate SOP.

14.2.15 Collection Efficiency

In the case of sampling trains (consisting of one or more multi-section sorbent tubes), which are received intact by the laboratory, the “front” and “back” sections shall be separated if required by the client. Each section shall be processed and analyzed separately and the analytical results reported accordingly.

14.2.16 Desorption Efficiency and Method Reporting Limits (Industrial Hygiene)

Desorption efficiency (DE) is the ability of an analytical method to recover the analyte from the collection media. Desorption efficiencies are determined initially and for each analyte to be reported. In addition, a DE study is performed each time there is a change in the test method, or with each new lot of media. Desorption efficiency shall be determined using sorbent media from the same lot number used for the field samples, if possible, and of the identical size and type. The DE values are used to correct the sample results (for all samples except passive samplers) before reporting.

Minimum reporting limits for each reportable analyte are determined initially by the analysis of spiked media, prepared at the desired reporting limit and carried through the entire analytical process. The reporting limit is verified or re-established annually (or if there is a change in methodology or instrumentation) and instrument performance is checked with each analytical batch through the analysis of an analytical standard prepared at the reporting limit.

14.2.17 Field and Trip Blanks

Field and trip blanks are analyzed when they are submitted to the laboratory for analysis. The actual field samples are flagged (when analytes are found in the blank) if and only if the laboratory is able to analyze the samples in the same analytical sequence as the corresponding field or trip blank. If this is not possible due to client submission restrictions then the results for the samples and blanks shall be reported independently with no flag. However, an explanation of this is included in the final report. This laboratory does not feel that Summa canisters are suitable for use as trip blanks. It is for this reason that the results for these types of containers are reported as separate samples and flagging is not considered appropriate.

14.3 Uncertainty

When requested by the client or relevant to the validity of reported results, the estimation of measurement uncertainty will be provided to a client or regulatory agency. How the uncertainty will be reported may be dictated by the client's reporting specifications. Procedures for determining and reporting uncertainty are given in the *SOP for Estimation of Uncertainty of Analytical Measurements* (CE-QA010).

15) Control of Non-Conforming Environmental Testing Work

If a quality control measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s) (See Appendix H). Failure to meet established analytical controls, such as the quality control objectives, prompts corrective action. Corrective action may take several forms and may involve a review of the calculations, a check of the instrument maintenance and operation, a review of analytical technique and methodology, and reanalysis of quality control and field samples. If a potential problem develops that cannot be solved directly by the responsible analyst, the supervisor, team leader, department manager, and/or the QA Manager may examine and pursue alternative solutions. In addition, the appropriate Project Manager is notified in order to ascertain if the client needs to be notified.

16) Corrective Action, Preventive Action, and Improvement

The laboratory takes all appropriate steps necessary to ensure all sample results are reported with acceptable quality control results. When sample results do not conform to established quality control procedures, responsible management will evaluate the significance of the nonconforming work and take corrective action to address the nonconformance.

Nonconforming events such as errors, deficiencies, deviations from SOP, proficiency (PT) failure or results that fall outside of established QC limits are documented using a *Nonconformity and Corrective Action Report* form. The procedure and responsibilities for addressing nonconforming work is defined in the *SOP for Nonconformance and Corrective Action* (CE-QA008). Nonconformances are reported to the client using various means (voice, email, narrative, etc). When a nonconformance occurs that casts doubt on the validity of the test results or additional client instructions are needed, the Project Manager notifies the client the same business day that the nonconformance is confirmed and reported. The QA Manager reviews each problem, ensuring that appropriate corrective action has been taken by the appropriate personnel. The Nonconformity and Corrective Action Report (NCAR) is filed in the associated service request file and a copy is kept by the QA Manager. The QA Manager periodically reviews all NCARs looking for chronic, systematic problems that need more in-depth investigation and alternative corrective action consideration. In addition, the appropriate Project Manager is promptly notified of any problems in order to inform the client and proceed with any action the client may want to initiate.

Part of the corrective action process involves determining the root cause. Identifying the root cause of a nonconformance can be difficult, but important for implementing effective corrective action. Root cause principles are used to determine assignable causes, which leads to corrective action taken to prevent recurrence.

16.1 Preventive Action and Improvement

Various preventive action and improvement processes are used for eliminating potential problems or averting problems before they occur. This is explained in the *SOP for Preventive Action* (CE-GEN004).

Table 16-1

Equipment Maintenance Procedures

Instrument	Applicable Activity	Frequency	Performed
Gas Chromatographs	Replace septum	As required	In-House and Outside Vendor
	Check system for gas leaks, loose/fray wires and insulation	With cylinder change/Open system	
	Replace injection port liner	As required	
	ECD wipe test	Every 6 months	
	Thermally Clean ECD	As needed	
	Clean FID	As required	
	Change TCD assembly	As required	
	SCD – Change reaction tube	As required	
	Catalyst check	As required	
Gas Chromatography / Mass Spectrometers	Tune MSD	As needed	In-House and Outside Vendor
	Change Semi-VOA capillary column	As needed	
	Change Semi-VOA injection port septum	As required	
	Change Semi-VOA injection port liner	As required	
	Replace trap (VOA)	As required	
	Clean ion source	As required	
	Change filament	As required	
	Change electron multiplier	As required	
	Vacuum System: • Mechanical pumps: change oil, change trap pellets (HP only) • Diffusion pump: check oil, check cooling fan, change oil • Turbo pump	• Check every 6 months, check level monthly, change at least annually or sooner is necessary • As required • Replace as required	In-House
	Air Preconcentrators / Autosampler: • Change traps • Inspect Rotors • Calibrate Mass Flow Controllers	• As required • As required • Every 6 months	In-House

Instrument	Applicable Activity	Frequency	Performed
HPLC	Replace/clean check valve filter	As required	In-House
	Replace lamp UV/vis detector	As required	
	Replace flow cell	As required	
	Check flow	Quarterly	
Analytical Balances	Clean pan and compartment	Prior to and after use	In-House and Outside Vendor
	Check with NIST traceable weights	Prior to use	
	Field service	Annually	
Refrigerators and Freezers	Monitor Temperature	Daily	In-House
	Adjust Temperature	As required	
	Clean, Defrost	As required	
Ovens	Clean	As needed or if temperature is outside limit	In-House
pH probes	Condition probe	When fluctuations occur	In-House
	Change Filling Solution	Weekly	
Fluoride ISE	Store in storage solution	Between uses	In-House
Ammonia ISE	Store in storage solution	Between uses	In-House
UV-visible Spectrophotometer	Wavelength check	Annually	In-House
Ion Chromatographs	Change column bed supports	Monthly or as needed	In-House
	Clean column	Monthly or as needed	
	Change column	Every six months or as needed	
	Change valve port face and hex nut	Every six months or as needed	
	Clean valve slider	Every six months or as needed	
	Change tubing	Annually or as needed	
	Eluent pump	Annually	
Restek Thermal Gas Purifier	Check getter tube	Monthly, change as required	In-House

17) Control of Records

17.1 Documentation

ALS Environmental maintains a records system which ensures that all laboratory records of analysis data are retained and available. Analysis data is retained for 5 years from the report date unless contractual terms or regulations specify a longer retention time. Archival procedures are described in the *SOP for Data and Record Archiving* (ADM-ARC).

17.1.1 Documentation and Archiving of Sample Analysis Data

The archiving system includes, but is not limited to, the following items (where applicable) for each set of analyses performed:

- Benchsheets describing sample preparation (if appropriate) and analysis;
- Instrument parameters (or reference to the data acquisition method);
- Sample analysis sequence;
- Instrument printouts, including chromatograms and peak integration reports for all samples, standards, blanks, spikes, duplicates and reruns;
- Applicable standard identification numbers;
- Chain of custody, service request and sample acceptance check forms;
- Initial calibration and data review checklist(s);
- Copies of report sheets submitted to the work request file; and
- Copies of Nonconformity and Corrective Action Reports, if necessary.

Individual sets of analyses are identified by analysis date and service request number. Since many analyses are performed with computer-based data systems, the final sample concentrations can be automatically calculated. If additional calculations are needed, they are written on the integration report or securely stapled to the chromatogram, if done on a separate sheet.

For organics analysis, data applicable to all analyses within the batch, such as GCMS tunes, CCVs, batch QC, and analysis sequences; are kept using a separate documentation system. This system is used to archive data on a batch-specific basis and is segregated according to the date of analysis. This system also includes results for the most recent calibration curves, as well as method validation results.

17.2 Information Technology

The generation, compilation, reporting, and archiving of electronic data is a critical component of laboratory operations. In order to generate data of known and acceptable quality, the quality assurance systems and quality control practices for electronic data systems must be complete and comprehensive and in keeping with the overall quality assurance objectives of the organization. ALS Environmental management provides the tools and resources to implement electronic data systems and establishes information technology standards and policies.

17.2.1 Software Quality Assurance

Practices are defined for assuring the quality of the computer software used throughout all laboratory operations to generate, compile, report, and store electronic data. These practices are described in the *SOP for Software and Data Quality Assurance* (ADM-SftwreQA).

The purpose of the SOP is to describe the policies and practices for the procurement, configuration management, development, validation and verification, data security, maintenance, and use of computer software. The policies and practices described in the plan apply to purchased computer software as well as to internally developed computer software. Key components of this plan are policies for software validation and control.

17.2.2 IT Support

The local ALS Environmental Information Technology (IT) department is established to provide technical support for all computing systems. The IT department staff continually monitors the performance and output of operating systems. The IT department oversees routine system maintenance and data backups to ensure the integrity of all electronic data described in the *SOP for Electronic Data Backup, Archiving, and Restoration* (ADM-DATA_BU). A software inventory is maintained. Additional IT responsibilities are described in the *SOP for Software and Data Quality Assurance* (ADM-SftwreQA).

In addition to the local IT department, ALS Environmental corporate IT provides support for network-wide systems. ALS Environmental also has personnel assigned to information management duties such as development and implementation of reporting systems; data acquisition, and Electronic Data Deliverable (EDD) generation.

17.2.3 Information Management Systems

ALS Environmental has various systems in place to address specific data management needs. The Laboratory Information Management System (LIMS) is used to manage sample information and invoicing. Access is controlled by password. This system defines sample identification, analysis specifications, and provides a means of sample tracking. This system is used during sample login to generate the internal service request.

Included on the service request is a summary of client information, sample identification, required analyses, work instructions, and deliverable requirements. The LIMS is used to track the status of a sample and is important in maintaining internal chain of custody.

Where possible, instrument data acquired locally is immediately moved to a server (Microsoft Windows Server 2008 R2). This provides a reliable, easily maintained, high-volume acquisition and storage system for electronic data files. With password entry, users may access the system from many available computer stations, improving efficiency and flexibility. The server is also used for data reporting, EDD generation, and administrative functions. Access to these systems is controlled by password. A standardized EDI (electronic data interchange) format is used as a reporting platform, providing functionality and flexibility for end users. With a common standardized communication platform, the EDI provides data reporting in a variety of hardcopy and electronic deliverable formats.

17.2.4 Backup and Security

Laboratory data is either acquired directly to the centralized acquisition server or acquired locally and then transferred to the server. All data is eventually moved to the centralized data acquisition server for reporting and archiving.

Full backups onto a hard drive are performed on all file server information once per day. In addition, the laboratory's data warehouse located in Canada performs an offsite full backup nightly.

Access to sample information and data is on a need-to-know basis. Access is restricted to the person's areas of responsibility. Passwords are required on all systems. No direct external, non-ALS Environmental access is allowed to any of our network systems.

The external e-mail system and Internet access is established via a single gateway to discourage unauthorized entry. ALS Environmental uses a closed system for company e-mail. Files, such as electronic deliverables, are sent through the external e-mail system only via a trusted agent or comparable service. The external messaging system operates through a single secure gateway. E-mail attachments sent in and out of the gateway are subject to a virus scan. Because the Internet is not regulated, we use a limited access approach to provide a firewall for added security. Virus screening is performed continuously on all network systems with Internet access.

18) Audits

Quality audits are an essential part of ALS Environmental-Simi Valley's quality assurance program. There are two types of audits used at the facility: System Audits are conducted to qualitatively evaluate the operational details of the QA program, while Performance Audits are conducted by analyzing proficiency testing samples in order to quantitatively evaluate the outputs of the various measurement systems.

18.1 System Audits

The system audit examines the presence and appropriateness of laboratory systems. External system audits of ALS Environmental-Simi Valley are conducted regularly by various regulatory agencies and clients. Appendix J lists the certification and accreditation programs in which ALS Environmental-Simi Valley participates. Programs and certifications are added as required. Additionally, internal system audits of ALS Environmental-Simi Valley are conducted regularly under the direction of the QA Manager. The internal audit procedures are described in the *SOP for Internal Audits* (CE-QA001). The internal audits are performed as follows:

- Comprehensive lab-wide system audit – performed annually. This audit is conducted such that all elements of the ALS Quality System are assessed.
- Technical/method audits
- Hardcopy report audits

All audit findings, and corrective actions are documented. The results of each audit are reported to the Laboratory Director and Department Managers for review. Any deficiencies identified are summarized in the audit report. Managers must respond with corrective actions correcting the deficiency within a defined timeframe. Should problems impacting data quality be found during an internal audit, any client whose data is adversely impacted will be given written notification within the corrective action period (if not already provided).

Electronic data audits may be performed in conjunction with hardcopy data audits. The electronic audits focus on organic chromatographic data and include an examination of audit trails, peak integrations, calibration practices, GCMS tuning data, peak response data, use of appropriate files, and other components of the analysis. The audit also verifies that the electronic data supports the hardcopy reported data.

Additional internal audits or data evaluations may be performed as needed to address any potential data integrity issues that may arise.

18.2 Performance Audits

ALS Environmental-Simi Valley also participates in the analysis of interlaboratory proficiency testing (PT) samples. Participation in PT studies is performed on a regular basis and is designed to evaluate all analytical areas of the laboratory. General procedures for these analyses are described in the *SOP for Proficiency Sample Testing Analysis* (CE-QA006). ALS Environmental-Simi Valley routinely participates in the following studies:

- American Industrial Hygiene Association (AIHA) PT Program, 4 per year
- Air and Emissions PT studies, 2 per year
- Other studies as required for specific certifications, accreditations, or validations.

PT samples are processed by entering them into the LIMS system as samples (assigned Service Request, due date, testing requirements, etc.) and are processed the same as field samples. The laboratory sections handle samples the same as field samples, performing the analyses following method requirements and performing data review. The laboratory sections submit results to the QA Manager for subsequent reporting to the appropriate agencies or study provider. Results of the performance evaluation samples and audits are reviewed by the QA Manager, Laboratory Director, the laboratory staff, and the Manager of Quality Assurance, USA. For any results outside acceptance criteria, the analysis data is reviewed to identify a root cause for the deficiency, and corrective action is taken and documented through nonconformance (NCAR) procedures.

19) Management Review

Quality assurance requires an active, ongoing commitment by ALS Environmental personnel at all levels of the organization. Communication and feedback mechanisms are designed so that analysts, supervisors and managers are aware of QA issues in the laboratory. Analysts performing routine testing are responsible for generating a data quality narrative or data review document with every analytical batch processed. This report also allows the analyst to provide appropriate notes and/or a narrative if problems were encountered with the analyses. A Non-Conformity and Corrective Action Report (NCAR) may also be initiated. Supervisors or qualified analysts review all of the completed analytical batches to ensure that all QC criteria have been examined and any deficiencies noted and addressed.

It is the responsibility of each laboratory unit to provide the reporting department with reviewed data accompanied by signature approval. The data validation coordinators provide the Project Manager with a final report of the data. Footnotes and/or narrative notes must accompany any data package if problems were encountered that require further explanation to the client. Each data package is submitted to the appropriate Project Manager, who in turn reviews the entire collection of analytical data for completeness and to ensure that any and all client-specified objectives were successfully achieved. A case narrative is written (or approved) by the Project Manager to explain any unusual problems with a specific analysis or sample, etc.

The QA Manager provides overview support to the Project Managers as required (e.g., contractually specified, etc.). The QA Manager is also responsible for the oversight of all internal and external audits, for all proficiency testing sample and analysis programs, and for all laboratory certification/accreditation responsibilities. The QA Manager regularly communicates with the Laboratory Director to review the various QA/QC activities, priorities, and status of program implementation; including such topics as the following:

- Status, schedule, and results of internal and external audits;
- Status, schedule, and results of internal and external proficiency testing studies;
- Status of certifications, accreditations, and approvals;
- Status of QA Manual and SOP review and revision;
- Status of MDLs studies;
- Discussion of QC problems in the laboratory;
- Discussion of corrective action program issues;
- Status of staff training and qualification; and
- Other topics as appropriate.

An annual management review of the quality and testing systems is performed as described in the *SOP for Laboratory Management Review* (CE-QA005). This is done to identify any necessary changes or improvements to the quality system or quality assurance policies. This review is documented in a Managerial Review of the Laboratory's Quality Systems and Testing Activities and sent to senior management.

20) Personnel

Technical position descriptions are available for all employees, regardless of position or level of seniority. These documents are maintained by the Human Resources personnel and are available for review. In order to assess the technical capabilities and qualifications of a potential employee, all candidates for employment at ALS Environmental are evaluated, in part, against the appropriate technical description.

Training begins the first day of employment at ALS Environmental when the company policies are presented and discussed. Safety and QA/QC requirements are integral parts of all technical SOPs and, consequently, are integral parts of all training processes at ALS Environmental. Safety training begins with reading the *Environmental Health and Safety Manual.* Employees are also required to participate in periodic safety training performed by the Environmental, Health and Safety Coordinator.

Employees are responsible for complying with the requirements of the QA Manual and QA/QC requirements associated with their function(s). Quality Systems training begins with Quality Assurance orientation for new employees and reading the Quality Assurance Manual. During the employee's first month, the employee receives Ethics training and learns about ALS Environmental quality systems. Each employee participates in annual Ethics Refresher training.

ALS Environmental also encourages its personnel to continue to learn and develop new skills that will enhance their performance and value to the Company. Ongoing training occurs for all employees through a variety of mechanisms. The corporate, company-wide training and development program, external and internal technical seminars and training courses, and laboratory-specific training exercises are all used to provide employees with professional growth opportunities.

All technical training is documented and records are maintained by the QA department. Training requirements and its documentation are described in the *SOP for Training Policy* (CE-QA003). A training plan is developed whenever an employee starts a new procedure or new position. The training plan includes a description of the step-by-step process for training an employee and for initial demonstration of capability. Where the analyst performs the entire procedure, a generic training plan may be used.

20.1 Initial Demonstration of Capability (IDOC)

Training in analytical procedures typically begins with the reading of the Standard Operating Procedure (SOP) for the method. Hands-on training begins with the observation of an experienced analyst performing the method, followed by the trainee performing the method under close supervision, and culminating with independent performance of the method on quality control samples. Successful completion of the applicable Demonstration of Capability analysis qualifies the analyst to perform the method independently. Demonstration of Capability is performed by one of the following:

- Successful completion of an Initial Precision and Recovery (IPR) study (required where mandated by the method).
- Analysis of 4 consecutive Laboratory Control Samples, with acceptable accuracy and precision.
- Where spiking is not possible but QC standards are used ("non-spiked" Laboratory Control Samples), analysis of 4 consecutive Laboratory Control Samples with acceptable accuracy and precision.
- Where one of the three above is not possible training is performed and supervisor approval is documented.

A flowchart identifying the Demonstration of Proficiency requirements is given in Figure 20-1. The flowchart identifies allowed approaches to assessing Demonstration of Capability when a 4-replicate study is not mandated by the method, when spiking is not an option, or when QC samples are not readily available.

20.2 Continuing Demonstration of Proficiency

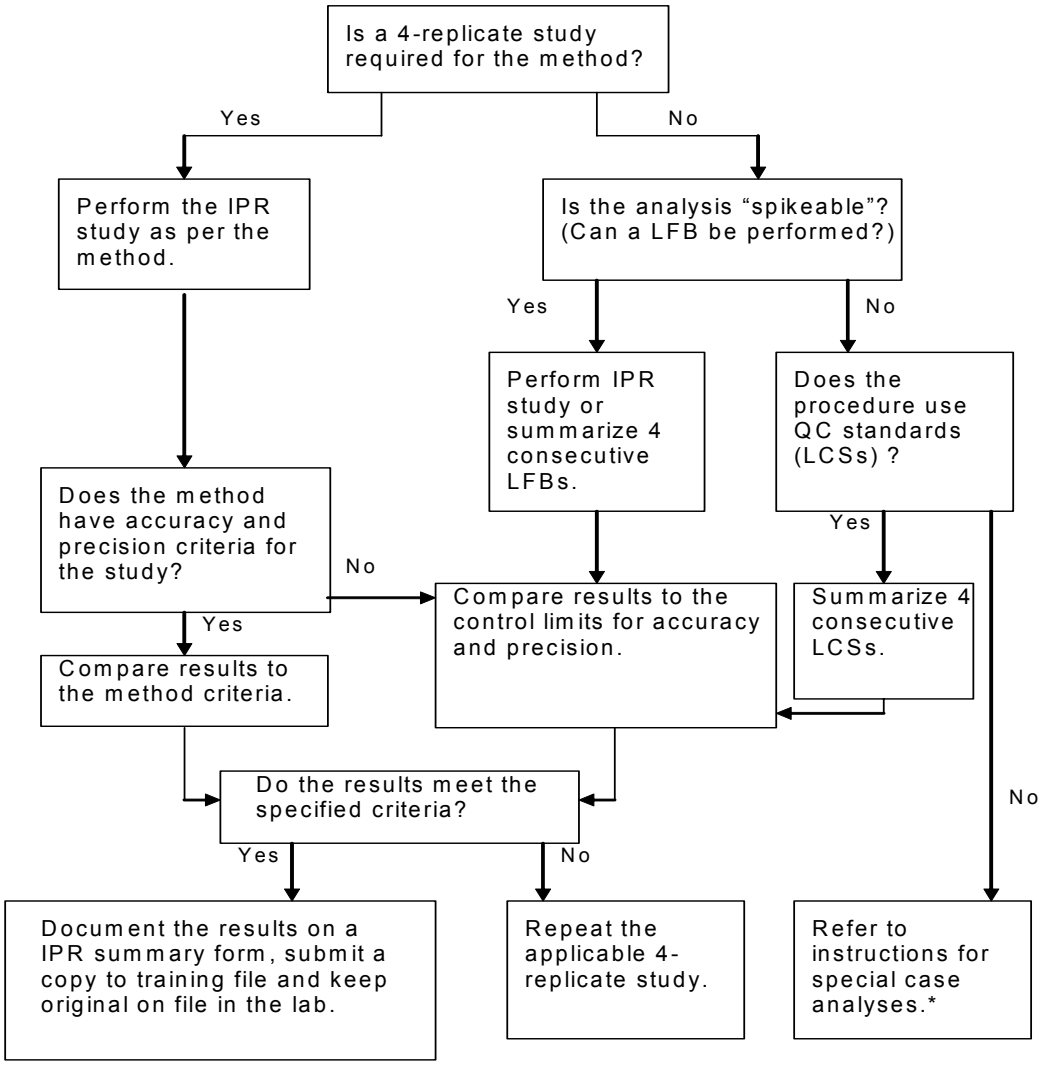
A periodic demonstration of proficiency is required to maintain continuing qualification. Continuing Demonstration of Proficiency is required each year, and may be performed one of the following ways:

- Successful performance on external (independent) single-blind sample analyses using the test method, or a similar test method using the same technology. I.e. PT sample or QC sample blind to the analyst.
- Performing Initial Demonstration of Capability as described above, with acceptable levels of precision and accuracy.
- Analysis of at least 4 consecutive LCSs with acceptable levels of accuracy and precision from in-control analytical batches.
- If the above cannot be performed, analysis of authentic samples with results statistically indistinguishable from those obtained by another trained analyst.
- For methods for which PT samples are not available and a spiked analysis (LFB, MDL, etc.) is not possible, analysis of field samples that have been analyzed by another analyst with statistically indistinguishable results.

20.3 Documentation of Training

Records are maintained to indicate the employee has the necessary training, education, and experience to perform their functions. Information of previously acquired skills and abilities for a new employee is maintained in Human Resources personnel files and ALS Environmental resumes. QA maintains a database to record the various technical skills and training acquired while employed by ALS Environmental. Information includes the employee's name, a description of the skill including the appropriate method and SOP reference, the mechanism used to document proficiency, and the date the training was completed. General procedures for documenting technical training are described in the *SOP for Training Policy* (CE-QA003).

Figure 20-1
Initial Demonstration of Capability Requirements[a]



[a] For IDOC IPR or LFB studies, "second-source" reference materials are used, as per TNI/NELAP requirements
* Refer to the SOP for Training Policy for details. References for Quality Systems, External Documents, Manuals, Standards, and Analytical Procedures

21) Reporting of Results

ALS Environmental reports the analytical data produced in its laboratories to the client via the certified analytical report. This report includes a transmittal letter, a case narrative, client project information, specific test results, quality control data, chain of custody information, and any other project-specific support documentation. The following procedures describe our data reduction, validation and reporting procedures.

21.1 Data Reduction and Review

Results are generated by the analyst who performs the analysis and works up the data. All data is initially reviewed and processed by analysts using appropriate methods (e.g., chromatographic software, instrument printouts, hand calculation, etc.). Equations used for calculation of results are found in the applicable analytical SOPs. The resulting data set is either manually entered into an electronic report form or is electronically transferred into the report from the software used to process the original data set (e.g., chromatographic software). The data is then reviewed by the analyst for accuracy. Once the primary analyst has checked the data for accuracy and acceptability, the supervisor or second qualified analyst reviews the data for errors. Where calculations are not performed using a validated software system, the reviewer rechecks a minimum of 10% of the calculations. When the entire data set has been found to be acceptable it is turned into the reporting department where final reports are generated and then validated by a Data Validation Coordinator. The hardcopy or electronic final report is physically or electronically signed by the project manager and the final report may be stored electronically or in hardcopy format. Test analysis data shall be kept in the appropriate service request folder. Data review and reporting procedures are described in the *SOP for Data Review and Reporting* (ADM-DATA_REV).

Policies and procedures for manual editing of data are established. The analyst making the change must initial and date the edited data entry, without obliteration of the original entry. The policies and procedures are described in the *SOP for Making Entries onto Analytical Records* (CE-QA007).

Policies and procedures for electronic manual integration of chromatographic data are established. The analyst performing the integration must document the integration change by printing both the "before" and "after" integrations and including them in the raw data records. The policies and procedures are described in the *SOP for Manual Integration Policy* (CE-QA002).

21.2 Confirmation Analysis

21.2.1 Gas Chromatographic and Liquid Chromatographic Analyses

For gas chromatographic (GC) and liquid chromatographic (LC) analyses, all positive results are confirmed as required by the method, typically by a second column, a second detector, a second wavelength (HPLC/UV), or by GC/MS analysis, unless exempted by one of the following situations:

- The analyte of interest produces a chromatogram containing multiple peaks exhibiting a characteristic pattern, which matches appropriate standards. This is limited to petroleum hydrocarbon analyses (e.g., gasoline and diesel) and does not include polychlorinated biphenyls.
- The sample meets all of the following requirements:
    1. All samples (liquid or solid) come from the same source (e.g., groundwater samples from the same well) for continuous monitoring.

Samples of the same matrix from the same site, but from different sources (e.g., different sampling locations) are not exempt.

2. All analytes have been previously analyzed in sample(s) from the same source, identified and confirmed by a second column or by GC/MS. The chromatogram is largely unchanged from the one for which confirmation was carried out. The documents indicating previous confirmation must be available for review.

21.2.2 Confirmation Data

Confirmation data will be provided as specified in the method. Identification criteria for GC, LC or GC/MS methods are summarized below:

- GC and LC Methods
  1. The analyte must fall within plus or minus three times the standard deviation (established for the analyte/column) of the retention time of the daily midpoint standard in order to be qualitatively identified. The retention-time windows will be established and documented, as specified in the appropriate Standard Operating Procedure (SOP).
  2. When sample results are confirmed by two dissimilar columns or detectors, the agreement between quantitative results must be evaluated. The relative percent difference between the two results is calculated and evaluated against SOP and/or method criteria.
- GC/MS Methods - Two criteria are used to verify identification:
  1. Elution of the analyte in the sample will occur at the same relative retention time (RRT) as that of the analyte in the standard.
  2. The mass spectrum of the analyte in the sample must, in the opinion of a qualified analyst or the department manager, correspond to the spectrum of the analyte in the standard or the current GC/MS reference library.

21.3 Data Review and Validation of Results

The integrity of the data generated is assessed through the evaluation of the sample results, calibrations, and QC samples (method blanks, laboratory control samples, sample duplicates, matrix spikes, trip blanks, etc.). A brief description of the evaluation of these analyses is described below, with details listed in applicable SOPs. The criteria for evaluation of QC samples are listed within each method-specific SOP. Other data evaluation measures may include (as necessary) a check of the accuracy check of the QC standards and a check of the system sensitivity. Data transcriptions and calculations are also reviewed.

Note: Within the scope of this document, all possible data assessment requirements for various project protocols cannot be included in the listing below. This listing gives a general description of data evaluation practices used in the laboratory in compliance with NELAP Quality Systems requirements. Additional requirements exist for certain programs, such as projects under the DoD QSM protocols, and project-specific QAPPs.

- Method Calibration – Following the analysis of calibration blanks and standards according to the applicable SOP the calibration correlation coefficient, average response factor, etc. is calculated and compared to specified criteria. If the calibration meets criteria analysis may continue. If the calibration fails, any

problems are isolated and corrected and the calibration standards reanalyzed. Following calibration and analysis of the independent calibration verification standard(s) the percent difference for the ICV is calculated. If the percent difference is within the specified limits the calibration is complete. If not, the problem associated with the calibration and/or ICV are isolated and corrected and verification and/or calibration is repeated.

- Continuing Calibration Verification (CCV) – Following the analysis of the CCV standard the percent difference is calculated and compared to specified criteria. If the CCV meets the criteria analysis may continue. If the CCV fails, routine corrective action is performed and documented and a 2nd CCV is analyzed. If this CCV meets criteria, analysis may continue, including any reanalysis of samples that were associated with a failing CCV. If the routine corrective action failed to produce an immediate CCV within criteria, then either acceptable performance is demonstrated (after additional corrective action) with two consecutive calibration verifications or a new initial calibration is performed.
- Method Blank – Results for the method blank are calculated as performed for samples. If results are less than the MRL (<½ MRL for DoD projects), the blank may be reported. If not, associated sample results are evaluated to determine the impact of the blank result. If possible, the source of the contamination is determined. If the contamination has affected sample results the blank and samples are reanalyzed. If positive blank results are reported, the blank (and sample) results are flagged with an appropriate flag, qualifier, or footnote.
- Sample Results (Inorganic) – Following sample analysis and calculations (including any dilutions made due to the sample matrix) the result is verified to fall within the calibration range. If not, the sample is diluted and analyzed to bring the result into calibration range. When sample and sample duplicates are analyzed for precision, the calculated RPD is compared to the specified limits.

  The sample and duplicate are reanalyzed if the criteria are exceeded. The samples may require re-preparation and reanalysis. Results are reported when within the calibration range, or as estimates when outside the calibration range. When dilutions are performed the MRL is elevated accordingly.
- Sample Results (Organic) – For GC/MS analyses, it is verified that the analysis was within the prescribed tune window. If not, the sample is reanalyzed. Following sample analysis and calculations (including any dilutions made due to the sample matrix) peak integrations, retention times, and spectra are evaluated to confirm qualitative identification. Internal standard responses and surrogate recoveries are evaluated against specified criteria. If internal standard response does not meet criteria, the sample is diluted and reanalyzed. Results outside of the calibration range are diluted to within the calibration range. When dilutions are performed the MRL is elevated accordingly.
- Surrogate Results (Organic) – The percent recovery of each surrogate is compared to specified control limits. If recoveries are acceptable, the results are reported. If recoveries do not fall within control limits, the sample matrix is evaluated. When matrix interferences are present or documented, the results are reported with a qualifier that matrix interferences are present.

  If no matrix interferences are present and there is no cause for the outlier, the sample is reanalyzed. However, if the recovery is above the upper control limit

with non-detected target analytes, the sample may be reported. All surrogate recovery outliers are appropriately qualified on the report.

- Duplicate Sample and/or Duplicate Matrix Spike Results – The RPD is calculated and compared to the specified control limits. If the RPD is within the control limits the result is reported. If not, an evaluation of the sample is made to verify that a homogenous sample was used and the results are compared to the MRL. The samples and duplicates are reanalyzed and if re-analysis also produces out-of-control results, the results are reported with an appropriate qualifier.
- Laboratory Control Sample Results – Following analysis of the LCS the percent recovery is calculated and compared to specified control limits. If the recovery is within control limits, the analysis is in control and results may be reported. If not, this indicates that the analysis is not in control. Samples associated with the 'out of control' LCS, shall be considered suspect and the samples reanalyzed or the data reported with the appropriate qualifiers.
- Matrix Spike Results – Following analysis of the MS the percent recovery is calculated and compared to specified control limits. If the recovery is within control limits the results may be reported. If not, and the LCS is within control limits, this indicates that the matrix potentially biases analyte recovery. It is verified that the spike level is at least five times the background level. If not, the results are reported with a qualifier that the background level is too high for accurate recovery determination. If matrix interferences are present or results indicate a potential problem with sample preparation, steps may be taken to improve results; such as dilution and reanalysis, or re-preparation and reanalysis. Results that do not meet acceptance limits are reported with an appropriate qualifier.

21.4 Data Reporting

When an analyst determines that a data package has met the data quality objectives (and/or any client-specific data quality objectives) of the method and has qualified any anomalies in a clear, acceptable fashion, the data package will undergo a peer review by a trained chemist. Prior to release of the report to the client, the Project Manager reviews and approves the entire report for completeness and to ensure that any and all client-specified objectives were successfully achieved. The original raw test data, along with a copy of the final report, is retained by service request number for archival purposes. ALS Environmental maintains control of analytical results by adhering to standard operating procedures and by observing sample custody requirements. All data is calculated and reported in units consistent with project specifications, to enable easy comparison of data from report to report.

To the extent possible, samples shall be reported only if all QC measures are acceptable. If a QC measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s). The *SOP for Data Review and Reporting* (ADM-DATA_REV) addresses the flagging and qualification of data. The ALS Environmental-defined data qualifiers, state-specific data qualifiers, or project-defined data qualifiers are used depending on project requirements. A case narrative may be written by the analyst or project manager to explain problems with a specific analysis or sample, etc.

For subcontracted analyses, the Project Manager verifies that the report received from the subcontractor is complete. This includes checking that the correct analyses were

performed, the analyses were performed for each sample as requested, a report is provided for each analysis, and the report is signed. The Project Manager accepts the report if all verification items are complete. Acceptance is demonstrated by forwarding the report to the ALS Environmental client.

21.5 Deliverables

In order to meet individual project needs, ALS Environmental provides several levels of analytical reports. Standard specifications for each level of deliverable are described in Table 21-1. Variations may be provided based on client or project specifications.

When requested, ALS Environmental provides Electronic Data Deliverables (EDDs) in the format specified by client need or project specification. ALS Environmental is capable of generating EDDs with many different formats and specifications. The EDD is prepared by report production staff using the electronic version of the laboratory report to minimize transcription errors. User guides and EDD specification outlines are used in preparing the EDD. The EDD is reviewed and compared to the final report for accuracy.

Table 21-1
Descriptions of ALS Environmental Standard Data Deliverables

Tier I. Routine Certified Analytical Report includes the following:

1. Transmittal letter
2. Chain of custody documents and sample/cooler receipt documentation
3. Sample analytical results
4. Method blank results
5. Surrogate recovery results and acceptance criteria for applicable organic methods
6. Dates of sample preparation and analysis for all tests
7. Case narrative - optional

Tier II. In addition to the Tier I Deliverables, this includes the following:

1. Matrix spike result(s) with calculated recovery and including associated acceptance criteria
2. Duplicate or duplicate matrix spike result(s) (as appropriate to method), with calculated relative percent difference
3. Laboratory Control Sample result(s) with calculated recovery and including associated acceptance criteria
4. Case narrative - optional

Tier III. Data Validation Package. In addition to the Tier II Deliverables, this includes the following:

1. Case narrative - required
2. Summary forms for all associated QC and Calibration parameters, with associated control criteria/acceptance limits

Note: Other summary forms specified in QAPPs or project/program protocols, or those related to specialized analyses such as HRGC/MS will be included.

Tier IV. Full Data Validation Package:

1. All raw data associated with the sample analysis, including but not limited to:
   a. Preparation and analysis bench sheets and instrument printouts,
   b. For organics analyses, all applicable chromatograms, spectral, confirmation, and manual integration raw data. For GC/MS this includes tuning results, mass spectra of all positive hits, and the results and spectra of TIC compounds when requested.
   c. QC data,
   d. Calibration data (initial, verification, continuing, etc),
   e. Calibration blanks or instrument blanks (as appropriate to method).
2. If a project QAPP or program protocol applies, the report will be presented as required by the QAPP.

22) Summary of Changes and Document History

Revision Number	Effective Date	Document Editor	Description of Changes
29	05/30/15	C. Humphrey	2.1 – Revised and added company website
			3.1 – Revised to update NELAC references to NELAP
			3.2 – Revised to update NELAC references to NELAP
			3.8 – Revised to update NELAC references to NELAP
			3.8 – Added Procurement Manager
			Table 3-1 – Added LIMS Manager and Procurement Manager. Updated years of experience.
			12 – Revised to be inclusive of all Method Update Rules and Supplements
			21.1 – Reworded to include both electronic and hardcopy data reduction and review procedures.
			23 – Updated AIHA Policy Modules reference Appendix A – Removed 'NELAC' from glossary
			Appendix B – Updated organization charts
			Appendix E – Updated
			Appendix G – Updated
			Appendix I – Updated
			Appendix J - Updated

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

The analytical methods used at ALS Environmental generally depend upon the end-use of the data. Since most of our work involves the analysis of environmental samples for regulatory purposes, specified federal and/or state testing methodologies are used and followed closely. Typical methods used at ALS Environmental are taken from the references listed below. Additional QA program documents are listed in Appendix I.

- National Environmental Laboratory Accreditation Program (NELAP), 2003 Quality Standards.
- 2009 TNI Standards.
- American National Standard *General requirements for the competence of testing and calibration laboratories,* ANSI/ISO/IEC 17025:2005(E).
- *DoD Quality Systems Manual for Environmental Laboratories,* Version 4.2, 10/25/2010.
- *DoD Quality Systems Manual for Environmental Laboratories,* Version 5.0, July 2013.
- American Industrial Hygiene Association-LAP, LLC Policy Document Modules (2A Revision 14, Effective July 1, 2015; 2B Revision 13, Effective July 1, 2015; 6 Revision 3, Effective July 1, 2015), Appendix G (Revision 4, Effective July 1, 2015), and Appendix H (Revision 3, Effective July 1, 2015).
- 3M Organic Vapor Monitor Sampling and Analysis Guide, *Organic Vapor Monitors 3500/3510 and Organic Vapor Monitors 3520/3530*, Technical Bulletin 1028, January 1, 2004.
- 40 CFR Part 60, Test Methods for Standards of Performance for New Stationary Sources, Appendix A.

- 40 CFR Part 63, Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, Appendix A.
- 40 CFR Part 63, National Emission Standards for Hazardous Air Pollutants for Source Categories, Subchapter C.
- 40 CFR Part 136, Definition and Procedure for the Determination of the Method Detection Limit, Appendix B
- American Society for Testing and Materials (ASTM), Gaseous Fuel, Coal and Coke, Volume 05.06, September 2006.
- American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards, Philadelphia, PA.
- Arizona Administrative Code, *Department of Health Services – Laboratories*, Title 9, Ch. 14, Article 6. *Licensing of Environmental Laboratories*, R9-14-601 through R9-14-621, December 31, 2006 (Supp. 06-4)
- California Environmental Protection Agency Air Resources Board, *Methods for Determining Emissions of Toxic Air Contaminants from Stationary Sources*, Volume 3, July 28, 1997.
- California Code of Regulations (CCR), Title 22, Chapter 11 *Identification and Listing of Hazardous Waste*, 7/20/05.
- Minnesota Administrative Rules, *Department of Health*, Chapter 4740, Laboratories; Accreditation Requirements.
- *Good Automated Laboratory Practices, Principles and Guidance to Regulations For Ensuring Data Integrity In Automated Laboratory Operations*, EPA 2185 (August 1995).
- Environmental Protection Agency, Methods Update Rule (MUR), Guidelines for Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Analysis and Sampling Procedures; 40 CFR Parts 122, 136, 143, 430, 455 & 465; Final Rule 3/12/07, Effective April 11, 2007.
- Environmental Protection Agency, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846, Third Edition, 1986 and Updates I (7/92), II (9/94), III (12/96), IIIA (4/98), IIIB (11/04), IVA & IVB. See Chapters 1, 2, 3, 4, 5, 6, and 8.
- Environmental Protection Agency, *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, 1983.
- Environmental Protection Agency, *Methods for the Determination of Inorganic Substances in Environmental Samples,* EPA 600/R-93-100, August 1993.
- Environmental Protection Agency, *EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*, Second Edition, EPA/625/R-96-010b, January 1999.
- Environmental Protection Agency, *EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*, Second Edition Addendum, October 4, 2000.
- National Institute for Occupational Safety and Health (NIOSH) *Manual of Analytical Methods*, Third Edition (August 1987); Fourth Edition (August 1994); 1st Supplement Publication 96-135, 2nd Supplement Publication 98-119, 3rd Supplement 2003-154
- National Council for Air and Stream Improvement, Inc. (NCASI). 2007. *Appendix E - Technical Bulletin Cross Reference Guide for NCASI Methods.* Methods Manual (05).

- *SKC 575 Series Passive Sampler Rate/Selection Guide,* Form #37021, Rev 0012.
- *Standard Methods for the Examination of Water and Wastewater*, 20th Edition (1998).
- South Coast Air Quality Management District, *Laboratory Methods of Analysis for Enforcement Samples.*
- U.S. Department of Labor, Occupational Safety and Health Administration *OSHA Analytical Methods Manual.*

APPENDIX A – Glossary

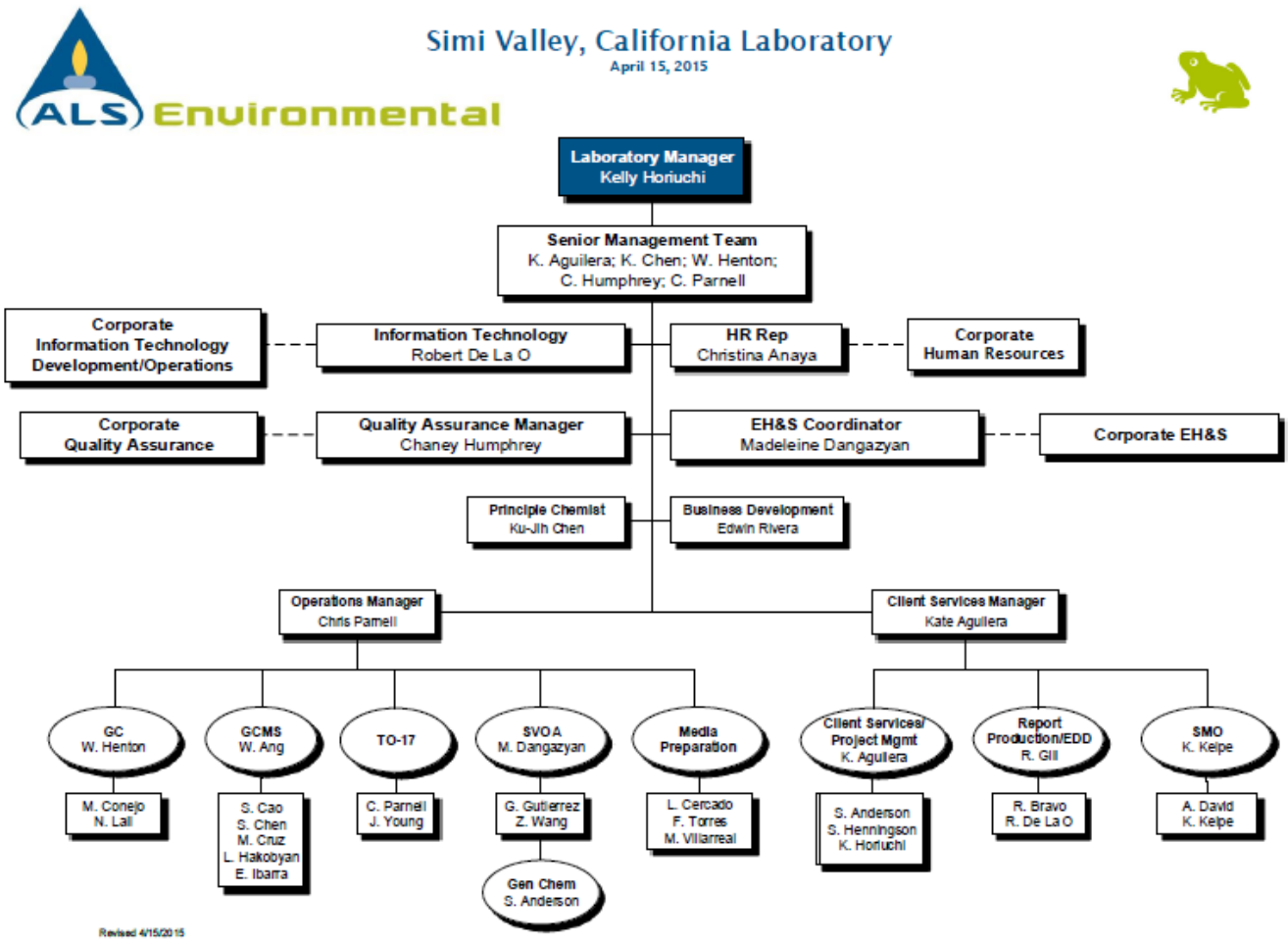
Acronym	Definition
AB	Accrediting Body
ACS	American Chemical Society
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
BFB	4-Bromofluorobenzene
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service Registry Number
CCB	Continuing Calibration Blank sample
CCC	Continuing Calibration Check sample
CCV	Continuing Calibration Verification sample
CDC	Ongoing Demonstration of Capability
CLP	Contract Laboratory Program (through USEPA)
COC	Chain-of-Custody
DCM	Dichloromethane (aka Methylene Chloride)
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOC	Demonstration of Capability
DOE	Department of Ecology (state or federal)
DOH	Department of Health
EPA	U.S. Environmental Protection Agency (aka USEPA)
EPCRA	Emergency Planning & Community Right-to-Know Act
ERA	Environmental Resource Associates
ELAP	Environmental Laboratory Accreditation Program
FID	Flame Ionization Detector
FIFRA	Federal Insecticide, Fungicide & Rodenticide Act
FR	Federal Register
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
HP	Hewlett-Packard (mfg. GC instruments)

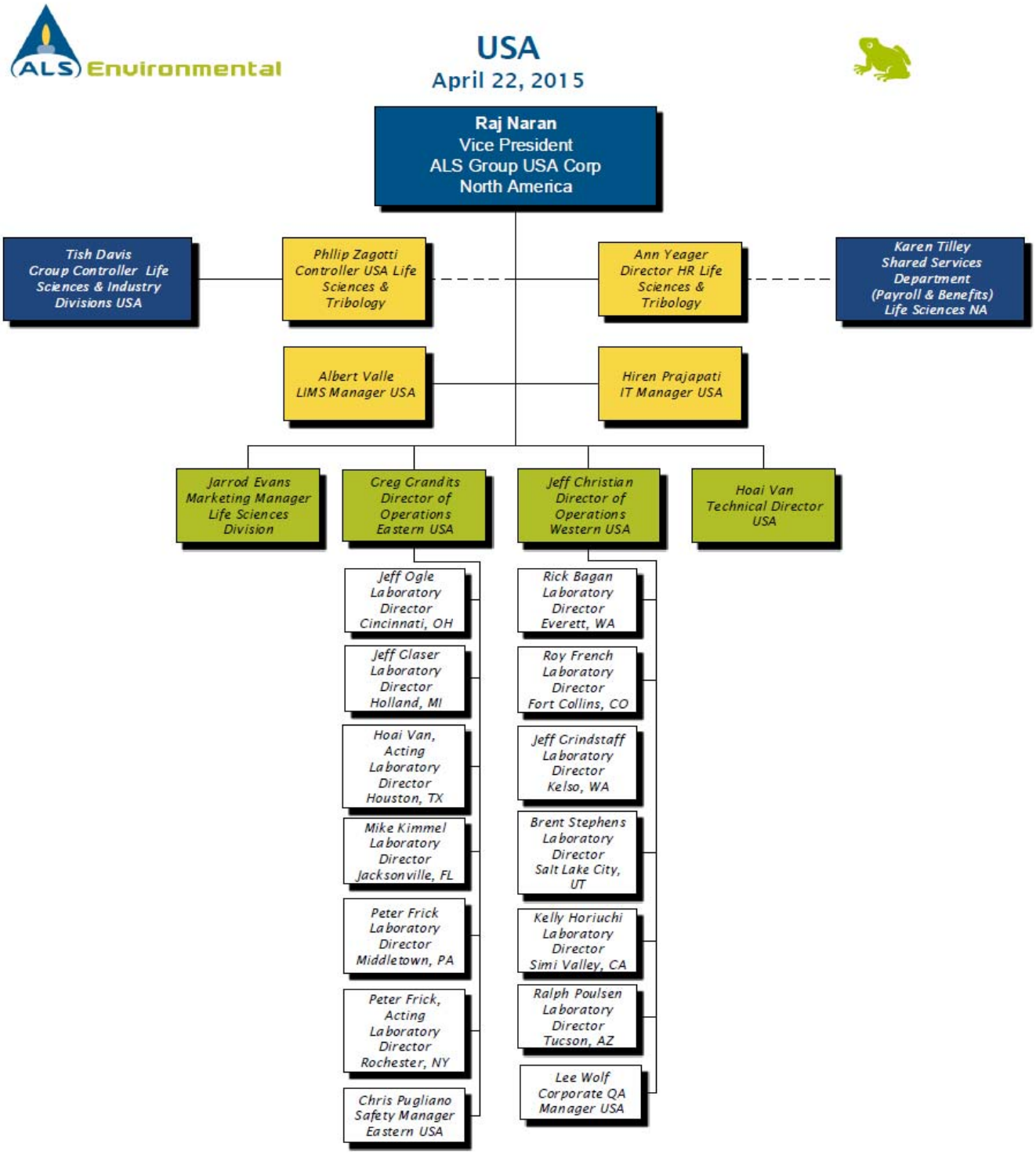
HPLC	High Performance Liquid Chromatography
IC	Ion Chromatography
ICAL	Initial Calibration
ICB	Initial Calibration Blank sample
IDC	Initial Demonstration of Capability
ICV	Initial Calibration Verification sample
IFB	Invitation for Bid
ISO/IEC	International Organization for Standardization/International Electrochemical Commission
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management System
LUFT	Leaking Underground Fuel Tank
MB	Method Blank
MDL	Method Detection Limit
MRL	Method Reporting Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	Not Applicable
NAS	National Academy of Sciences
NELAP	National Environmental Laboratory Accreditation Program
NCASI	National Council for Air and Stream Improvement (for the Paper Industry)
NCI	National Cancer Institute
ND	Not Detected
NIH	National Institute of Health
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NPD	Nitrogen Phosphorus Detector
NPDES	National Pollutant Discharge Elimination System
NSF	National Science Foundation
NTIS	National Technical Information System
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
PCBs	Polychlorinated Biphenyls
PE	Performance Evaluation sample
PID	Photoionization Detector

PQL	Practical Quantitation Limit
PT	Proficiency Test
QA	Quality Assurance
QAM	Quality Assurance Manual
QC	Quality Control
RAS	Routine Analytical Services (Contracts through USEPA)
RCRA	Resource Conservation and Recovery Act
RFP	Requests for Proposal
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SAS	Special Analytical Services (contracts through USEPA)
SIE	Selective Ion Electrode
SIM	Selected Ion Monitoring
SMO	Sample Management Office (aka Sample Receiving)
SOC	Semi-Volatile Organic Compounds
SOP	Standard Operating Procedure
SOQ	Statement of Qualifications
SOW	Statement of Work
SVOAs	Semi-Volatile Organic Analytes
SVOCs	Semi-Volatile Organic Compounds
SW-846	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
TNI	The NELAC Institute
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act
UST	Underground Storage Tank
UV	Ultraviolet Spectrophotometer
VOA	Volatile Organic Analyte
VOC	Volatile Organic Compounds
WP	Water Pollution
WS	Water Supply

Units	Definition
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
mg/m3	Milligrams per Cubic Meter
ng/L	Nanograms per Liter
ppb	Parts Per Billion
ppbV	Parts Per Billion Volume
ppm	Parts Per Million
ppmV	Parts Per Million Volume
ug/L	Micrograms per Liter
ug/m3	Micrograms per Cubic Meter

APPENDIX B – Organization Charts and Key Personnel Qualifications





Kathleen 'Kate' Aguilera

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ALS Environmental

Education

California State University - Northridge, CA
BA, Chemistry, 1989

Affiliations

American Chemical Society

Client Services Manager / Project Manager

2011 – Present

Responsibilities include interfacing with clients to provide technical project management and customer service, including project scheduling, tracking and consulting to determine appropriate sampling and analytical protocols. Coordinates with the laboratory and administration to ensure that analyses are properly executed and meets the clients' needs.

Previous Experience

Columbia Analytical Services, Inc. — **Project Manager, '97 – '11**
Simi Valley, CA

Responsibilities: Responsibilities include interfacing with clients to provide technical project management and customer service, including project scheduling, tracking and consulting to determine appropriate sampling and analytical protocols. Coordinates with the laboratory and administration to ensure that analyses are properly executed and meets the client's needs.

Columbia Analytical Services, Inc. — **GC/MS Analytical Chemist, '94 – '97**
(DBA Performance Analytical, Inc.)
Los Angeles, CA

Responsibilities: Analysis of air samples using EPA compendium methods TO-1, TO-2 and TO-14 using cryogenic concentration and thermal desorption techniques on whole air samples collected in summa canisters, Tedlar bags, and solid sorbent air samples. Proficient in the interpretation of mass spectra. Responsible for the preparation and quality control verification of solid sorbent sampling media for EPA Compendium methods TO-1 and TO-2.

Performance Analytical, Inc. — **GC/MS Analytical Chemist, '92 – '94**
Canoga Park, CA

Responsibilities: Analysis of air samples using EPA compendium methods TO-1, TO-2 and TO-14 using cryogenic concentration and thermal desorption techniques on whole air samples collected in summa canisters, Tedlar bags, and solid sorbent air samples. Proficient in the interpretation of mass spectra. Responsible for the preparation and quality control verification of solid sorbent sampling media for EPA Compendium methods TO-1 and TO-2.

Performance Analytical, Inc. — **GC Analytical Chemist, '89 – '92**
Canoga Park, CA

Responsibilities: Performed analyses of air samples for reduced sulfur compounds, hydrocarbon distribution and speciation, fixed atmospheric gases and total gaseous non-Methane organics. Performed analyses of soil and water samples for TPHg (mod. 8015) and BTEX. Performed extractions and analyses of CARB, NIOSH, OSHA and EPA 8000 series methods. Also performed metals analysis using flame and graphite furnace atomic absorption spectrophotometry (AA, GFAA).

Susan 'Sue' Anderson

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ALS Environmental

Education

University of Illinois - Urbana-Champaign, IL
BS, Biochemistry, 1989

Project Manager/Technical Manager (General Chemistry)

2011 – Present

Responsibilities include interfacing with clients to provide technical project management and customer service, including project scheduling, tracking and consulting to determine appropriate sampling and analytical protocols. Coordinates with the laboratory and administration to ensure that analyses are properly executed and meets the clients' needs. Also responsible for the training of general chemistry staff, maintenance of MDL studies, and standard operating procedures, data evaluation and report responsibility.

Previous Experience

Columbia Analytical Services, Inc. — **Project Manager/Technical Manager (General Chemistry), '06 – '11**
Simi Valley, CA

Responsibilities: Responsibilities include interfacing with clients to provide technical project management and customer service, including project scheduling, tracking and consulting to determine appropriate sampling and analytical protocols. Coordinates with the laboratory and administration to ensure that analyses are properly executed and meets the client's needs. Also responsible for the training of general chemistry staff, maintenance of MDL studies, and standard operating procedures, data evaluation and report responsibility.

Columbia Analytical Services, Inc. — **Project Manager/Technical Manager (General Chemistry), '02 – '06**
Canoga Park, CA

Responsibilities: In addition to the Project Manager duties listed below, also responsible for the management of General Chemistry laboratory operations, including the financial aspects. This includes supervision and coordination of work load and training personnel as necessary as well as supervision of method development and certification, maintenance of MDL studies and SOPs, data evaluation and report responsibility. Other duties include participation in the formulation of project strategy and meetings involving major technical issues, working with regional senior management in short and long-range planning, and other duties as assigned.

Columbia Analytical Services, Inc. — **Project Manager II, '00 – '02**
Canoga Park, CA

Responsibilities: Responsibilities include interfacing with clients to provide technical project management and customer service, including project scheduling and tracking from the delivery of sample bottles to client site to the delivery of the completed analytical report. Ensures that the client receives timely, appropriate, and quality analytical services. Coordinates with the CAS laboratory and administration to ensure that analyses are properly executed and meet the clients' needs. Coordinates sub-contracting with internal and external laboratories. Acts as a liaison for all client-related activities within Columbia Analytical Services, Inc. Interfaces with work processing staff to answer technical questions that arise during EDD completion. Has high level role in data evaluation and report responsibility. High level client and regulatory agency contact.

Columbia Analytical Services, Inc. — **Scientist I-III, '92 – '00**
Canoga Park, CA

Responsibilities: Responsible for performing inorganic analyses such as: alkalinity, ammonia, BOD, COD, cyanide, sulfide, reactivity, fluoride, pH, hardness, hexavalent chromium, phenols, surfactants, total-dissolved-suspended solid, conductivity, turbidity, nitrate, chloride by titration, turbidimetric sulfate, color, odor, organic lead, residual chlorine, settleable solids, specific gravity, carbon dioxide, TCLP/STLC metals and semi-volatile extraction. Also perform analyses for TRPH and oil and grease and occasionally perform metals digestion. Also ran the Graphite furnace for all furnace metals and was responsible for standard prep and maintenance.

National Environmental Testing — **Wet Chemistry, '90 – '91**
Bartlett, IL

Responsibilities: Responsible for the analyses for wastewater parameters and some inorganic analytes.

Widayati 'Wida' Ang

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ALS Environmental

Education

Technical University of West Berlin -
West Berlin, Germany
BS, Chemistry 1982

Technical University of West Berlin -
West Berlin, Germany
MS, Chemistry 1984

Volatile GC/MS Team Leader

2011 – Present

Team leader for the Volatile Gas Chromatography Mass Spectrometry Air group responsibilities are but are not limited to training of chemists, peer review of analytical data, mentoring of junior analysts, standard operating procedure review and streamlining of methods. Duties also require performance reviews and development of her direct reports.

Previous Experience

Columbia Analytical Services, Inc. — **Volatile GC/MS Team Leader, '08 – '11**
Simi Valley, CA
Duties as above.

Columbia Analytical Services, Inc. — **GC/MS Chemist, '07 – '08**
Simi Valley, CA
Analyzing indoor air, ambient air and source emission samples by GC/MS methods, standard preparation, perform maintenance on instruments when required, real time data reduction, participate in peer review process, and good practice of all QA/QC requirements.

Columbia Analytical Services, Inc. — **Technical Manager, Organic Chemistry, '99 – '07**
Canoga Park, CA
Responsible for managing the organics department with regards to State and Federal regulatory requirements. Supervises and coordinates work load and trained personnel. Supervised method development and certification, as well as method troubleshooting and instrument maintenance. Responsible for mobile laboratory operations.

Laboratory Data Consultants, Inc. — **Data Validator, '98 – '99**
Carlsbad, CA
Responsible for retrieving analytical data from closed down laboratory operations, review and validation of data packages. Supervised other employees for data package assembly

VOC Laboratories, Inc. — **Assistant QC Manager and Data Package Specialist, '96 – '98**
Glendale, CA
Responsible for overseeing data quality of final data validation packages. Managed production of data packages to meet various State and Federal analytical programs as well as customized client formats. Oversaw enforcement of the laboratory for implementation of corrective action measure. Interacted with chemists and project managers to ensure accuracy and completeness of data deliverables.

Thermo Analytical — **Technical Director/Department Manager, '92 – '96; Department Supervisor and Chemist, '88 - '92**
Monrovia, CA
Responsible for daily operations of the organic chemistry department. Developed standard operating procedures for various methods. Reviewed analytical data generated for completeness and contractual requirements according to Contract Laboratory Program (CLP) and SW-846 methods. Organized and scheduled reports for project managers. Responsible for upgrading and purchasing new instrumentation. Provided technical support to QC coordinator and laboratory personnel. Assisted with proposal preparation and audits. Responsible for training chemists and technicians in proper performance of various analytical methods. Responsible for sample analysis of water, soil, and air for volatile organics by GC and GC/MS. Assisted chemists in the analysis and interpretation of pesticides and PCBs.

Shankman Laboratories — **Analytical Chemist, '86-'88**
Los Angeles, CA
Prepared and analyzed soil and water samples using GC, GC/MS, HPLC, IR, IC and UV spectrophotometic techniques

Ku-Jih Chen

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ALS Environmental

Education

National Chung-Hsing University - Taipei, Taiwan
BS, Botany, 1975

Principle Chemist

2011 – Present

Responsible for the development and validation of sampling and analysis methods, new technology and laboratory automation.

Previous Experience

Columbia Analytical Services, Inc.
Simi Valley, CA
Principle Chemist, '00 - '11
Responsibilities: Responsibilities listed above.

Columbia Analytical Services, Inc.
(dba Performance Analytical, Inc.)
Los Angeles, CA
Scientist VII, '94 - '00
Responsibilities: Responsibilities included operating the gas chromatography and sample preparation laboratories, developing methods (previously developed the Total Combustion Analyzer for the measurement of reactive organic gases in stationary source samples, and the Determination of Reduced Sulfur Compounds and fixed atmospheric gases in POTW emissions, refinery and landfill gases), and serving as the laboratory's primary Industrial Hygiene Chemist.

Performance Analytical, Inc.
Canoga Park, CA
Principle Chemist, '89-'94
Responsibilities: Responsibilities listed above.

C-E Environmental, Inc.
Camarillo, CA
Extraction Laboratory Supervisor, '84 – '89
Responsibilities: Responsibilities included supervising chemists, associate chemists, and technicians, preparing SOPs, analytical standards, and spiking solutions, serving as Primary Extraction Chemist for the Love Canal Habitability Study, and previously responsible for instrumental analysis using GC, LC, GC/MS, and AA.

Paolyta Company
Taipei, Taiwan
Research and Development Chemist, '80 – '84

Panlabs Taiwan Ltd.
Taipei, Taiwan
Research Chemist, '75 – '80

Madeleine Dangazyan

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ALS Environmental

Education

California State University at Northridge - Northridge, CA
BS, Chemistry 1995

Semi-Volatiles Technical Manager and EH&S Manager

2011 – Present

As EH&S Manager, is responsible for the implementation of the Environmental Health and Safety program of ALS North America to this facility. Duties include accident investigation and incident review, maintenance of all safety-related equipment and documents, and performing safety audits and reporting results to management. Semi-Volatiles/Industrial Hygiene Technical Manager responsibilities are but not limited to training of junior chemists, data reduction and peer review of analytical data, mentoring of junior analysts, writing and reviewing of standard operating procedures. Development and implementation of new methods. Duties also require performance reviews and development of direct reports. Additional responsibilities are analyzing ambient air, source emissions, and industrial hygiene samples using GC and HPLC utilizing OSHA, NIOSH and EPA mandated methodologies. Preparation and analysis of air samples taken on various sorbent tubes for semi-volatile organic compounds. Determination of Carbonyls, Phenols and Cresols in ambient air and source emission samples using HPLC. Determination of Polynuclear Aromatic Hydrocarbons using EPA Method TO-13A. Analysis of Pesticides and PCBs using EPA Methods TO-4A and TO-10A. Routine and necessary instrument maintenance.

Previous Experience

Columbia Analytical Services, Inc. — **Semi-Volatiles Technical Manager, '02- '11; EH&S Manager '10-11**
Simi Valley, CA

Responsibilities: Responsibilities listed above.

Columbia Analytical Services, Inc. — **Scientist, '00- '02**
Simi Valley, CA

Responsibilities: Responsibilities include training of chemists, peer review of analytical data, mentoring or junior analyst, standard operating procedure review, and streamlining of methods. Additional responsibilities are analyzing ambient air, source emissions, and industrial hygiene samples using GC and HPLC utilizing OSHA, NIOSH and EPA mandated methodologies. Preparation and analysis of air samples taken on various sorbent tubes for semi-volatile organic compounds. Determination of Carbonyls, Phenols and Cresols in Aromatic Hydrocarbons using EPA Method TO-13A. Analysis of Pesticides and PCBs using EPA Methods TO-4A and TO-10A. Routine and necessary instrument maintenance.

Columbia Analytical Services, Inc. — **Scientist, '99- '00**
(dba Performance Analytical, Inc.)
Simi Valley, CA

Responsibilities: Responsibilities include analyzing indoor and ambient air, source emission, and industrial hygiene samples by GC methods.

Air Products and Chemicals, Inc. — **Analytical Chemist, '95 – '99**
Long Beach, CA

Responsibilities: Quality assurance analysis of EPA protocol gases utilizing GC, FTIR and NDIR. Preparation of personnel schedules, lead laboratory contact.

California State University at Northridge — **Undergraduate Researcher, '93 – 94**
Northridge, CA

Responsibilities: Assisted professor with improving and implementing student laboratory experiments to better utilize a GC/MS.

Wade Henton

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ALS Environmental

Education

University of California at Santa Barbara – Santa Barbara, CA
BS, Chemistry 1985

Volatile GC Team Leader

2011 – Present

Team leader for the Volatile Gas Chromatography department where responsibilities include but are not limited to training of chemists, peer review of analytical data, mentoring of junior analysts, standard operating procedure review, and streamlining of methods. Duties also require performance reviews and development of direct reports.

Previous Experience

Columbia Analytical Services, Inc. — **Volatile GC Team Leader, '00 – '11**
Simi Valley, CA
Responsibilities listed above.

Columbia Analytical Services, Inc. — **Scientist V, '95 – '00**
(dba Performance Analytical, Inc.)
Los Angeles, CA
Responsibilities include analyzing indoor and ambient air, source emission, and industrial hygiene samples by GC and GC/MS methods.

Columbia Analytical Services, Inc. — **Scientist IV, '94 – '95**
(dba Performance Analytical, Inc.)
Los Angeles, CA
Responsibilities listed above.

Coast-to-Coast Analytical Services — **Analytical Chemist, '92 – '94**
Camarillo, CA
Responsibilities included analyzing samples using EPA methods 625, 525 and 1625 as well as developing new methods for GC/MS testing.

Coast-to-Coast Analytical Services — **Analytical Chemist, '91 – '92**
Goleta, CA
Responsibilities included analyzing samples using EPA methods 624 and 524.2 by GC/MS. Used GC/MS methods to perform fuel fingerprinting

Combustion Engineering Environmental — **Analytical Chemist, '86 – '91**
Camarillo, CA
Responsibilities included method development for GC and HPLC. Analysis of samples using EPA methods 608, 615, 631, 632 and SW846. Other methods used include 8080, 8010, 8020, 8150 and 8030. Oversaw data integrity for the GC Laboratory instrument data network. Data review.

Fortin Industries — **Chemist, '86**
Sylmar, CA
Research and Development and Quality Assurance/Quality Control on polymer products and metal coatings using differential scanning calorimeters, scanning electron microscope, AA, GC, and HPLC.

Kelly M. Horiuchi

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ALS Environmental

Education

California State University, Northridge,CA
BA, Biology, 1998

Laboratory Director

2011 - Present

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

Previous Experience

Columbia Analytical Services, Inc.
Simi Valley, CA
Laboratory Director, '09-'11

Responsible for all phases of laboratory operations, including project planning, budgeting, and quality assurance.

Columbia Analytical Services, Inc.
Simi Valley, CA
Project Manager, '05-'09

Responsibilities: Interfacing with clients to provide technical project management and customer service, including project scheduling, tracking and consulting to determine appropriate sampling and analytical protocols. Coordinated with the laboratory and administration to ensure that analyses were properly executed and meets the client's needs.

Columbia Analytical Services, Inc.
Simi Valley, CA
Data Validation Coordinator,'03-'05

Responsibilities: Validation of analytical results produced by the laboratory. Verification of client analytical requests, sample information, and reporting formats. Interacts with project managers and Quality Assurance Program Manager to ensure that all reports fulfill client requirements as well as QA/QC needs. Compiled quality control summary, and calibration data upon client request for data packages. Assist the Quality Assurance Program Manager with standard operating procedures, control charting, and audit preparation.

Cure Autism Now
Los Angeles, CA
Database Analyst, '02-'03

Responsibilities: Performed analysis of test date through data audits and queries, maintained extensive database, and coordinated data audits between Northern and Southern California locations. Additional duties included assisting in the creation of new databases, as needed, creation of SOP for phenotypic and genotypic data collecting, and process improvements for subject flow through the research project.

Columbia Analytical Services, Inc.
(dba Performance Analytical, Inc.)
Simi Valley, CA
Scientist II, Data Validation Coordinator, '00-'02

Responsibilities: Validation of all analytical results produced by the laboratory. Verification of client analyses, sample information, and reporting format. Compiled quality control summary, and calibration data upon client request for data packages. Assisted the Quality Assurance Program Manager with standard operating procedures, control charting, and audit preparation.

Specialty Laboratories
Santa Monica, CA
Administrative Assistant, Data Analyst, '99-'00

Responsibilities: Performed retrieval, quality control, and organization of data. Compiled data for reporting of HIV, lead, urinalysis, kidney stones, and communicable diseases. Also communicated with the state DOH and clients regarding reporting requirements and demographic information.

Chaney Humphrey

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ALS Environmental

Education

Oregon State University,
Corvallis, OR
BS, Biology, 2004

Quality Assurance Manager

2011 - Present

Responsibilities include facilitate ethics and QA training, maintain all training documentation, perform QA orientation for new employees, review data (both hardcopy and electronic), perform internal QA audits and prepare written reports, review, approve, and control Standard Operating Procedures, maintain QA Manual, maintain QA records (including archived logbooks, archived certificates of analysis, nonconformity and corrective action reports, MDL studies results, SOP revision and distribution, statistical control limits, PE sample results), serve as document control officer, and PC for all PE sample analyses, prepare corrective action report for any unacceptable PE sample results, maintain laboratory's certifications and approvals, facilitator for external QA audits and prepare written response to deficiencies, prepare activity report to management.

Previous Experience

Columbia Analytical Services, Inc. — **Quality Assurance Manager, -09 -11**
Simi Valley, CA

Duties same as above.

Columbia Analytical Services, Inc. — **Data Validation Coordinator, '07-'09**
Simi Valley, CA

Responsibilities include validation of analytical results produced by the laboratory. Verification of client analytical requests, sample information, and reporting formats. Interacts with project managers and Quality Assurance Program Manager to ensure that all reports fulfill client requirements as well as QA/QC needs. Compiled quality control summary, and calibration data upon client request for data packages.

Columbia Analytical Services, Inc. — **GC/MS Chemist,'05-'07**
Simi Valley, CA

Responsibilities: Analyzing indoor air, ambient air and source emission samples by GC/MS methods, standard preparation, perform maintenance on instruments when required, real time data reduction, participate in peer review process, and good practice of all QA/QC requirements.

Columbia Analytical Services, Inc. — **Analyst, '04-'05**
Kelso, WA

Responsibilities: Performed a variety of analytical tests within the General Chemistry laboratory according to EPA Methodologies including Ion Chromatography, total sulfur, and solids. Saturday crew member responsible for performance of all short hold time methods including microbiology methodologies.

Columbia Analytical Services, Inc. — **Temporary Employee, Summers '02-'04**
Kelso, WA

Responsibilities: Temporary employee (summers) performing a variety of analytical tests including grain size, total organic carbon, total suspended solids, total dissolved solids, alkalinity, acidity, and chemical oxygen demand. Additionally, performed colorimetric methods including ortho-phosphorous, total-phosphorous, hexavalent chromium, and nitrite as nitrogen.

Christopher Parnell

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ALS Environmental

Education

University of California
at Santa Barbara
Santa Barbara, CA
BS, Chemistry 1986

Operations Manager/Technical Advisor (Volatile GC/MS Air)

2012 – Present

Operation Managers responsibilities include planning, directing, and coordinating the operations of the laboratory departments. Duties and responsibilities include formulating policies, managing daily operations, and planning the use of materials and human resources. Reviews performance data to measure productivity and goal achievement and to determine areas needing cost reduction and program improvement to increase efficiency.

Technical Advisor for the Volatile Gas Chromatography Mass Spectrometry department. Has the responsibility of oversight of training of chemists, peer review of analytical data, mentoring of junior analysts, standard operating procedure review and streamlining of methods. Duties also require performance reviews and development of direct reports.

Previous Experience

ALS Environmental
Simi Valley, CA
Technical Advisor (Volatile GC/MS Air), '11 – '12
Responsibilities: Technical Advisor responsibilities listed above.

Columbia Analytical Services, Inc.
Simi Valley, CA
Technical Advisor (Volatile GC/MS Air, '08 – '11
Responsibilities: Technical Advisor responsibilities listed above.

Columbia Analytical Services, Inc.
Simi Valley, CA
GC/MS Team Leader, '00 – '08
Responsibilities: Team leader for the Volatile Gas Chromatography Mass Spectrometry group. Responsibilities include training of chemists, peer review of analytical data, mentoring of junior analysts, standard operating procedure review, and streamlining of methods. Duties also require performance reviews and development of direct reports.

Columbia Analytical Services, Inc.
(dba Performance Analytical, Inc.)
Los Angeles, CA
Scientist VI, '94 – '00
Responsibilities: Responsibilities include analyzing indoor air, ambient air and source emission samples by GC/MS methods, standards preparation, perform maintenance on instruments when required, real time data reduction, participation in peer review process, and good practice of all QA/QC requirements.

Performance Analytical, Inc.
Canoga Park, CA
Scientist VI, '91 – '94
Responsibilities: Responsibilities listed above.

ABB Environmental Inc.
Camarillo, CA
Air Toxics Laboratory Supervisor, '90 – '91
Responsibilities: Responsibilities included scheduling client analyses and developing methods for non-routine analyses, and operating the Air Toxics laboratory.

C-E Environmental Inc., EMSI
Camarillo, CA
Analytical Chemist, '87 – '90
Responsibilities: Responsibilities included overseeing the Pesticide/PCB analysis of samples under the EPA Contract Laboratory Program, and interfacing with the EPA and regional offices to respond to inquiries, and performing GC analyses and extractions.

Damon Reference Laboratory
Newbury Park, CA
Chemist, '86 – '87
Responsibilities: Responsibilities included performing Enzyme-linked immunosorbent assays, Western-Blot assays, and Protein Electrophoresis.

APPENDIX C – Ethics and Data Integrity Policy

ETHICS AND DATA INTEGRITY AGREEMENT

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

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

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

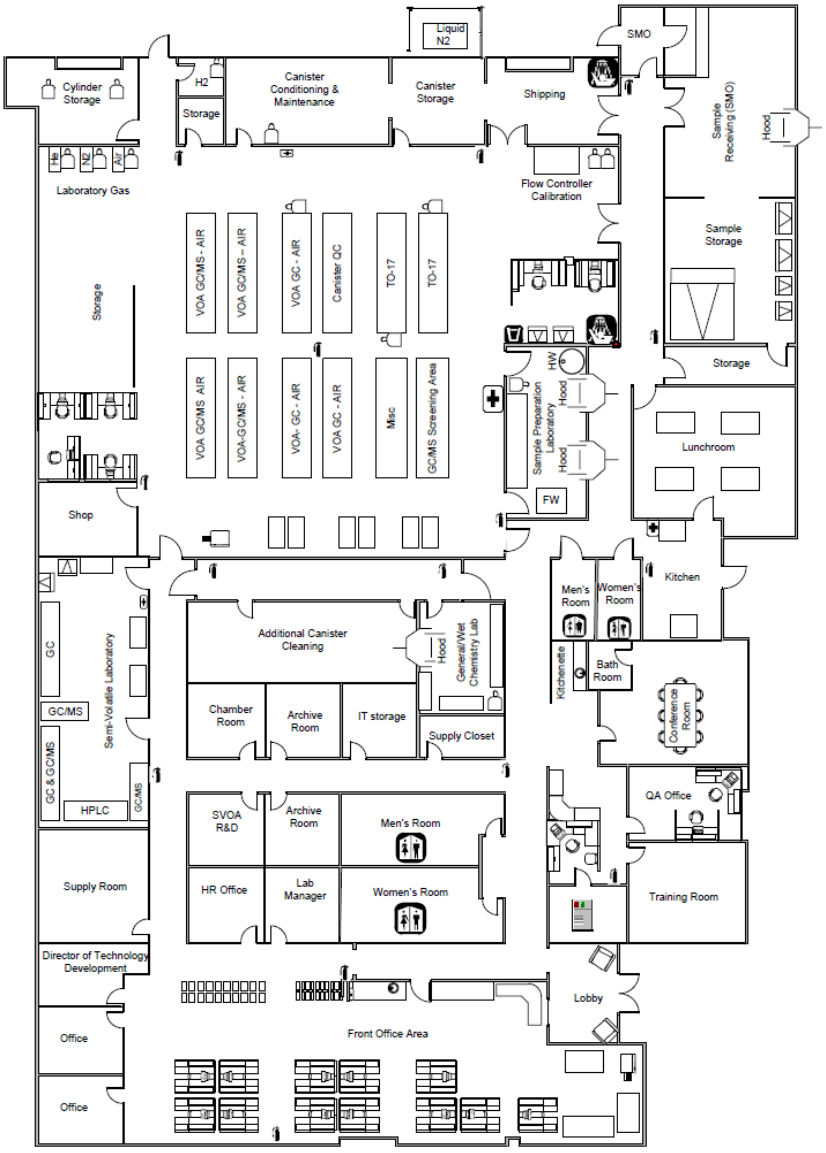
I have read, and understand the above policy and realize that failure to adhere to it may result in disciplinary action, up to and including termination. Compliance with this policy will be strictly enforced with all personnel employed by the company.

Employee Name _____ Signature _____

ALS Location_____ Date _____

APPENDIX D – Laboratory Floor Plan

ALS Environmental-Simi Valley Laboratory Floor Plan

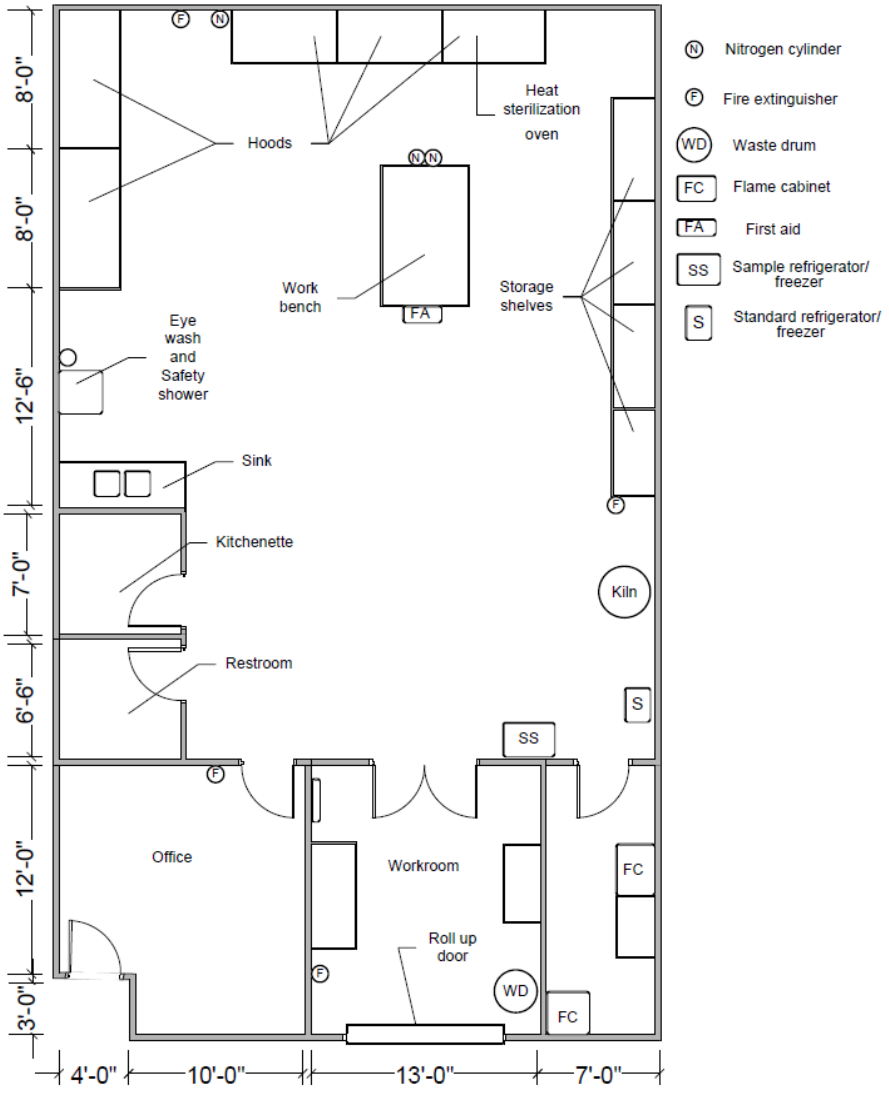


ALS ENVIRONMENTAL - SIMI VALLEY FLOOR PLAN		
2655 Park Center Drive, Suite A, Simi Valley, California 93065		
-First Aid	HW -Hazardous Waste Cabinet	
-Network Server Room	-Emergency Shower	FW -Flammable Waste Cabinet
-Fire Extinguisher	-Gas Cylinder(s)	
-Refrigerator/Freezer	-Deionized Water	

ALS Environmental-Simi Valley Extraction Laboratory Floor Plan

Extraction Laboratory for
ALS Environmental

2360 Shasta Way, Unit G
Simi Valley, CA. 93065



APPENDIX E – Analytical Equipment

Equipment Description - Gas Chromatography	Purchased / Acquired	Location
Screen 02: Hewlett-Packard 5890 with FID Detector	-	VOA GC/MS Screen
Screen 03: Hewlett-Packard 5890 with FID Detector	-	VOA GC/MS Screen
GC01: Hewlett-Packard 5890 with FID/TCD Detectors *Fixed Gas Analyzer/Total Combustion Analyzer (TCA)*	1995	VOA GC
GC03: Hewlett-Packard 5890 with ECD/FID Detectors *Hewlett-Packard 7673 Autosampler*	1995	SVOA
GC05: Hewlett-Packard 5890 Series II Combined with Sievers 355 (SCD 1)	1996	SVOA
GC06: Hewlett-Packard 6890 with ECD/ECD Detectors *Hewlett-Packard 6890 Autosampler*	1995	SVOA
GC07: Hewlett-Packard 6890 with FID/FID Detectors	1995	VOA GC
GC08: Hewlett-Packard 5890 Series II with TCD/FID Detectors	1998	VOA GC
GC09: Hewlett-Packard 5890 Series II with FID Detector	1999	VOA GC/MS Screen
GC10: Hewlett-Packard 5890A with FID/TCD Detectors	1999	VOA GC
GC11: Hewlett-Packard 5890 Series II+ with FID Detector (Combined with MS01)	1999	SVOA
GC12: Hewlett-Packard 5890 Series II+ with FID Detector (Combined with MS02)	2004	SVOA
GC13: Agilent 6890A Combined with Sievers 355 (SCD 2)	2001	VOA GC
GC14: Agilent 6890N with NPD/FID Detectors *Agilent 7683B Autosampler*	2005	SVOA
GC15: Agilent 6890N with NPD/FID Detectors *Agilent 7683 Autosampler*	2005	SVOA
GC16: Agilent 6890N with PFPD Detector and *OI Detector Controller* *Agilent 7683 Autosampler*	2005	SVOA
GC19: Hewlett-Packard 5890 with FID Detector	2007	VOA GC
GC20: Agilent 7890A with FID/TCD Detectors	2008	VOA GC
GC21:Hewlett-Packard 5890 Series II with ECD/FID Detectors	2009	SVOA
GC22: Agilent 7890A Combined with Agilent 355 (SCD 3)	2009	VOA GC
GC23: Hewlett-Packard 6890+ with ECD Detector (Combined with MS14)	2007	SVOA
GC24: Hewlett-Packard 5890 Series II (Combined with MS04)	2011	VOA GC
GC25: Hewlett-Packard 5890 Series II (Combined with MS12)	2006	SVOA
GC26: Agilent 7890A (Combined with MS19)	2011	VOA GC/MS
GC27: Agilent 7890A (Combined with MS20)	2011	VOA GC/MS

Equipment Description - GC/MS Systems	Purchased / Acquired	Location
MS01: HP 5890 Series II+ with FID Detector (GC11) & HP 5971A MSD *Hewlett-Packard 7673 Autosampler*	1991	SVOA
MS02: HP 5890 Series II+ with FID Detector (GC12) & HP 5972 MSD *Hewlett-Packard 7673 Autosampler*	1994	SVOA
MS04: HP 5890 Series II (GC24) & HP 5970 MSD	2004	VOA GC
MS05: Agilent 6890+/5973N MSD *Perkin Elmer TurboMatrix ATD-50 Thermal Desorber*	1999	VOA GC/MS
MS07: HP 6890A/ Agilent 5973N MSD	2001	SVOA
MS08: Agilent 6890N/5973inert MSD Tekmar AUTOCAN Autosampler	2004	VOA GC/MS
MS09: Agilent 6890N/5973inert MSD Tekmar AUTOCAN Autosampler	2005	VOA GC/MS
MS10: HP 6890A/5973 MSD	2006	SVOA
MS11: HP 5890 Series II/5972 MSD	2006	SVOA
MS12: HP 5890 Series II (GC25)/5971 MSD HP 7673 Autosampler	2006	SVOA
MS13: Agilent 6890N/5975B inert MSD Tekmar AUTOCAN Autosampler	2006	VOA GC/MS
MS14: HP 6890+ with ECD Detector (GC23) & HP 5973 MSD HP 6890 Injector	2007	SVOA
MS15: HP 5890 Series II/5972 MSD HP 7673 Autosampler	2007	SVOA
MS16: Agilent 6890N/5975C inert MSD Tekmar AUTOCAN Autosampler	2007	VOA GC/MS
MS17: Shimadzu GCMS QP-2010 Plus	2008	VOA GC/MS
MS18: Agilent 7890A /5975C inert XL MSD Markes Series 2 Unity Thermal Desorber Markes Series 2 Ultra TD Autosampler	2010	VOA GC/MS
MS19: Agilent 7890A (GC26) & 5975C inert XL MSD Tekmar AUTOCAN Autosampler	2011	VOA GC/MS
MS20: Agilent 7890A (GC27) & /5975C inert XL MSD Markes Series 2 Unity Thermal Desorber Markes Series 2 Ultra TD Autosampler	2011	VOA GC/MS
MS21: Agilent 7890A (GC28) & 5975C inert XL MSD Tekmar AUTOCAN Autosampler	2012	VOA GC/MS
MS22: Agilent 7890B (GC29) & 5977A MSD Markes CIA Advantage Autosampler	2015	VOA GC/MS

Liquid Chromatography	Purchased / Acquired	Location
LC03: Agilent Infinity LC 1220 (Combined with LCMS01)	2011	SVOA
LCMS01: Agilent 6120 Quadrupole MS (Combined with LC03)	2011	SVOA
Ion Chromatography	**Purchased / Acquired**	**Location**
IC03: Dionex ICS 2000 with Self-regenerating suppressor AS40 Autosampler	2008	GENCHEM
Spectrophotometer	**Purchased / Acquired**	**Location**
SPM01: Spectronic Instrument 20+ from SC	2001	GENCHEM
pH and Specific Ion Meters	**Purchased / Acquired**	**Location**
pH01: Thermo Orion 920 Selective Ion Meter	2001	GENCHEM
pH02: Orion 720A	1992	GENCHEM
Miscellaneous Equipment	**Purchased / Acquired**	**Location**
US Filter Water Purification System	2006	Main Lab
US Filter Water Purification System	2008	Extraction facility

Note: Purchase / Acquired year may represent when instrument was first maintained by ALS Environmental-Simi Valley or other in-network ALS Laboratory and does not reflect age of instrument.

Air sampling containers / Flow Controllers / Critical Orifices

Six-liter Summa passivated stainless steel canisters

- 1049 Ambient
- 1234 Source
- 191 Standard

Six-liter Silonite passivated stainless steel canisters

- 791 Ambient
- 334 Source

Three-liter Silco passivated stainless steel canisters (71)

One-liter Summa passivated stainless steel canisters (1112)

One-liter Silonite passivated stainless steel canisters (189)

400-millilter mini passivated stainless steel canisters (18)

Low volume flow controllers for time integrated sampling

- 863 Ambient
- 125 Source

Low-flow flow controllers for multi-day sampling (61)

Mini-canister flow controllers for time integrated sampling (16)

Critical orifices (2102)

Critical orifices – Sulfur (171)

Automated Summa Canister Conditioning Units

- Twenty-four position, microprocessor controlled conditioners with heater controller, vacuum gauge, humidified nitrogen fill capability and large-capacity vacuum pump (2)
- Ten position, microprocessor controlled conditioners with heater controller, vacuum gauge, humidified nitrogen fill capability and large-capacity vacuum pump (2)
- Fourteen position, microprocessor controlled conditioners with heater controller, vacuum gauge, humidified nitrogen fill capability and large-capacity vacuum pump (1)
- Sixteen position, microprocessor controlled conditioner with heater controller, vacuum gauge, humidified nitrogen fill capability and large-capacity vacuum pump (2)
- Six position, microprocessor controlled conditioner with heater controller, vacuum gauge, humidified nitrogen fill capability and large-capacity vacuum pump (1)

APPENDIX F – Containers, Preservation and Holding Times

Sample Preservation and Holding Times for Performed Methods

Determination (Method)	Matrix	Container	Preservation	Maximum Holding Time
Solid / Water Sample Analysis				
Bromide (EPA 9056)	S,W	P, FP, G	Cool, 4˚C	28 Days
Chloride (EPA 9056)	S,W	P, FP, G	None Required	28 Days
Fluoride (9056)	S,W	P	Cool, 4˚C	28 days
Hydrogen Ion - pH (EPA 9040B/9045C)	S,W	P, FP, G	None Required	Analyze immediately
Nitrate, Nitrite (EPA 9056)	S,W	P, FP, G	Cool, 4˚C	48 hours
Orthophosphate (EPA 9056)	S	P,G	Cool, 4˚C	48 hours
Formaldehyde, Acetaldehyde (EPA 8315A Procedure 1 Modified)	S,W	Glass w/Teflon-Lined Lid	Cool, 4˚C	Aqueous – prep. - 72 hours, analysis – 30 days; Soil – prep. minimum, analysis – 30 days
Copper Corrosion (In-House Method)	Solid Wallboard	Ziploc Bag, G	None Required	-
H2S/Sulfur Emission (In-House Method)	Solid Wallboard	Ziploc Bag, G	None Required	-
Orthorhombic Cyclooctasulfur (In-House Method)	Solid Wallboard	Ziploc Bag, G	None Required	-

* W = Water or Aqueous solution; S = Soil or Sediment; P = Polyethylene, G = Glass, FP = fluoropolymer

Sample Preservation and Holding Times for Performed Methods

Determination (Method)	Matrix	Container	Preservation	Maximum Holding Time	Sample Vol.[c]
Air Corrosivity	Air	Air Corrosivity Probes	Include 3 small dessicant bags (or equivalent) to each probe vial during shipment.	N/A[d]	3 Day Minimum Exposure
Amines (In-House Method)	Air	Treated Alumina Tubes	Sample Receipt-NA; Storage 4˚C±2˚C	30 days	100L
Ammonia (OSHA ID-188/ID-164)	Air	H_2SO_4 Treated Carbon Bead Tubes	Sample Receipt-NA; Storage 4˚C±2˚C	28 days	TWA: 24L STEL: 7.5L
BTU by ASTM D 3588 (SULFUR, ASTM D 5504; C1-C6+, EPA TO-3M; FIXED GASES, 3C)	Gaseous Fuels	Tedlar Bag Mylar Bag Summa Canister Bottle Vac	N/A	<u>Sulfur</u> Bag – 24 hours Canister – 7 days[b] Bottle Vac[a] – 7 days[b] <u>C1-C6+</u> Bag – 72 hours Canister[a] – 30 days[b] Bottle Vac[a] – 30 days[b] <u>3C</u> Bag – 72 hours Canister[a] – 30 days[b] Bottle Vac[a] – 30 days[b]	Bags 500mL Canisters and Bottle Vacs ≥1.0L
Carboxylic Acids (In-House Method)	Air	Treated Silica Gel Tubes	Sample Receipt-NA Storage 4˚C±2˚C	30 days until extraction; 14 days for analysis	100L
Total Gaseous Non-methane Organics (TGNMO) (EPA 25C)	Air	Tedlar Bag Mylar Bag Summa Canister Bottle Vac	N/A	Bag – 72 hours Canister[a] – 30 days[b] Bottle Vac[a] – 30 days[b]	Bags 500mL Canisters and Bottle Vacs ≥1.0L
Fixed Gases (EPA 3C & ASTM D 1946)	Air	Tedlar Bag Mylar Bag Summa Canister Bottle Vac	N/A	Bag – 72 hours Canister[a] – 30 days[b] Bottle Vac[a] – 30 days[b]	Bags 500mL Canisters and Bottle Vacs ≥1.0L
Helium & Hydrogen (EPA 3C Modified)	Air	Summa Canister Bottle Vac	N/A	Canister[a] – 30 days[b] Bottle Vac[a] – 30 days[b]	Bags 500mL Canisters and Bottle Vacs ≥1.0L

Sample Preservation and Holding Times for Performed Methods

Determination (Method)	Matrix	Container	Preservation	Maximum Holding Time	Sample Vol.[c]
Argon (EPA 3C Modified)	Air	Tedlar Bag Mylar Bag Summa Canister Bottle Vac	N/A	Bag – 72 hours[b] Canister[a] – 30 days[b] Bottle Vac[a] – 30 days[b]	Bags 500mL Canisters and Bottle Vacs ≥1.0L
Methane, Ethane, Ethene, Propane, Propene (RSK 175)	Aqueous	Glass w/Teflon- Lined Lid	No Headspace HCl to pH<2 4˚C±2˚C	14 days when preserved	(3) 40mL Vials
Carbon Dioxide (RSK 175)	Aqueous	Glass w/Teflon Lined Lid	No Headspace neutral pH (5-8) 4˚C±2˚C	N/A[d]	(3) 40mL Vials
Sulfur Compounds (In-House Method)	Aqueous	Glass w/Teflon Lined Lid	No Headspace; pH>4; 4˚C±2˚C	Following pH adjustment – 24 hours	(2) 40mL Vials
Sulfur Compounds (ASTM D 5504; SCAQMD 307-91; Modified SCAQMD 307-91)	Air	Tedlar Bag Fused Silica Lined Stainless Steel Canister Bottle Vac	No direct sunlight	Bag – 24 hours Canister – 7 days[b] Bottle Vac[a] – 30 days[b]	Bags 500mL Canisters and Bottle Vacs ≥1.0L
C_1-C_6+ (EPA TO-3 Modified)	Air	Tedlar Bag Mylar Bag Summa Canister Bottle Vac	N/A	Bag – 72 hours Canister[a] – 30 days[b] Bottle Vac[a] – 30 days[b]	Bags 500mL Canisters and Bottle Vacs ≥1.0L
Methanol, Ethanol, Isopropyl alcohol, Freon, and Methylene Chloride (EPA TO-3 Modified)	Air	Tedlar Bag Mylar Bag Summa Canister Bottle Vac	N/A	Bag – 72 hours Canister[a] – 30 days[b] Bottle Vac[a] – 30 days[b]	Bags 500mL Canisters and Bottle Vacs ≥1.0L
Total Petroleum Hydrocarbons (TPHG) (EPA TO-3 Modified)	Air	Tedlar Bag Mylar Bag Summa Canister Bottle Vac	N/A	Bag – 72 hours Canister[a] – 30 days[b] Bottle Vac[a] – 30 days[b]	Bags 500mL Canisters and Bottle Vacs ≥1.0L
Pesticides and Polychlorinated Biphenyls (PCBs) (EPA TO-4A & TO-10A)	Air	Glass PUF Cartridge; TO-4A (High Volume); TO-10A (Low Volume)	Sample Receipt, <4˚C; Store sample and extract at <4˚C	7 days until extraction; extract – 40 days	2 m^3

Sample Preservation and Holding Times for Performed Methods

Determination (Method)	Matrix	Container	Preservation	Maximum Holding Time	Sample Vol.[c]
Formaldehyde & Other Carbonyl Compounds (EPA TO-11A)	Air	DNPH-Coated Silica Gel Cartridge w/ Polypropylene Cap; SKC UME[x] and Bacharach GMD 570 Passive Monitors (formaldehyde only)	Sample Receipt, 4˚C±2˚C; Laboratory Preservation, 4˚C±2	14 days until extraction; 30 days for analysis	100 – 150L
Polycyclic Aromatic Hydrocarbons (PAHs) (EPA TO-13A)	Air	Polyurethane Foam (PUF) plugs, XAD Tube, PUF / XAD-2	Sample Receipt, <4˚C; Laboratory Preservation, <4˚C	7 days until extraction; 40 days after	130 – 400 m³
Volatile Organic Compounds (EPA TO-14A & TO-15)	Air	Tedlar Bag, Summa Canister (1L, 6L) Bottle Vac	N/A	Bag – 72 hours Canister – 30 days Bottle Vac[a] – 30 days[b]	Bags 500mL Canisters 1.0L/6.0 Bottle Vacs 1.0L
Volatile Organic Compounds (EPA TO-17)	Air	Sorbent Tubes w/Swagelock Caps & PTFE Ferrules	<4˚C; organic solvent free environment; Laboratory Storage, 4˚C±2˚C	30 days	1-4L
Air-Phase Petroleum Hydrocarbons (MADEP APH)	Air	Summa Canister Bottle Vac	N/A	28 days Bottle Vac[a] – 30days[b]	Canisters 1.0L/6.0 Bottle Vacs 1.0L
Halogenated Volatile Organic Compounds (CARB 422)	Air	Tedlar Ba Summa Canister (1L, 6L) Bottle Vac	N/A	Bag – 72 hours Canister[a] – 30 days[b] Bottle Vac[a] – 30 days[b]	Bags 500mL Canisters 1.0L/6.0L Bottle Vacs 1.0L
Organic Vapors / NAPHTHAS (Diesel; etc.) (NIOSH 1550 / OSHA 7)	Air	Charcoal Tube; 3M 3500 or 3520 Badge; Silica Gel Tube w/ plastic caps	Sample Receipt-NA; Storage 4˚C±2˚C	14 days	Various
Sulfur Hexafluoride (NIOSH 6602 Modified)	Air	Tedlar Bag Summa Canister (1L, 6L)	N/A	Bag[b] – 72 hours Canister[a] – 30 days[b]	Bags 500mL Canisters 1.0L/6.0L
Siloxanes (In-House Method)	Air	SPE Cartidges Tedlar Bags	N/A	14 days until extraction; Tedlar Bags – transfer onto sorbent tube within 72 hours. 30 days for analysis	30L Cartridges Bags 500ml

Sample Preservation and Holding Times for Performed Methods

Determination (Method)	Matrix	Container	Preservation	Holding Time	Sample Vol.[c]
Methanol, Acetaldehyde, Methyl Ethyl Ketone, Propionaldehyde (NCASI – DI/MeOH 94.03 /NCASI – DI/HAPS 99.01)	Aqueous - Effluent	Glass w/Teflon Lined Lid	No Headspace; 4˚C±2˚C; HCl to pH 2-3 (Effluent only)	30 days	(1) 40mL Vial
Reduced Sulfur Compounds (NCASI Method RSC-02.02)	Aqueous	40ml amber, borosilicate glass vials with Teflon faced silicone backed caps.	MeSH, DMS, and DMTS (RSCs non-H2S) addition of ascorbic acid and pH adjustment to <2.5 with 1:2 phosphoric acid solution upon collection. Laboratory Preservation, 4˚C±2	14 days	(2) 40ml VOA Vials
Total Sulfide (NCASI Method RSC-02.02)	Aqueous	40ml amber, borosilicate glass vials with Teflon faced silicone backed caps.	Addition of Zinc acetate solution and pH adjustment to >10 with 1 N NaOH solution upon collection. Laboratory Preservation, 4˚C±2	14 days	(2) 40ml VOA Vials
Hydrofluoric Acid (In-House Method)	Air	Radiello Samplers	Laboratory Preservation, 4˚C±2	4 months	15 minutes to 14 days exposure (dependent on sampling environment)
Hydrogen Sulfide (In-House Method)	Air	Radiello Samplers	N/A	6 months	1 hour to 15 days exposure (dependent on sampling environment)
Nitrogen Dioxide (In-House Method)	Air	Radiello samplers	Laboratory Preservation, store in dark at 4˚C±2	4 months	7 to 15 days exposure (dependent on sampling environment)

Sample Preservation and Holding Times for Performed Methods

Determination (Method)	Matrix	Container	Preservation	Holding Time	Sample Vol.[c]
Ozone (In-House Method)	Air	Radiello Samplers	Protect from light	7 days	24 hours to 14 days exposure (dependent on sampling environment)
Sulfur Dioxide (In-House Method)	Air	Radiello Samplers	Laboratory Preservation, store in dark at 4˚C±2	4 months	7 to 15 days exposure (dependent on sampling environment)

Footnotes:

a.	Some methods do not specify the utilization of canisters; therefore, there is no required hold time and this will be noted in the case narrative.
b.	Laboratory recommended hold time; therefore, samples analyzed outside this hold time will be noted in the case narrative accordingly.
c.	Sample volumes are the minimum, which should be received by the laboratory; however, canister volumes should match the canister size utilized.
d.	There is no holding time requirement available and laboratory studies are not available indicating the validity of data prior to or following a specified length of time. Therefore, no holding time notation or qualifier will be adhered to results.

APPENDIX G – Standard Operating Procedures

Corporate SOP Titles	SOP ID
Laboratory Ethics and Data Integrity	CE-GEN001
(Proprietary – Client Specific)	CE-GEN002
Records Management Policy	CE-GEN003
Preventive Action	CE-GEN004
Document Control	CE-GEN005
Data Recall	CE-GEN006
Procurement and Control of Laboratory Services and Supplies	CE-GEN007
Method Development	CE-GEN008
Establishing Standard Operating Procedures	CE-GEN009
Handling Customer Feedback	CE-GEN010
Assigning a TSR to a Project	CE-GEN011
Policy for the use of Accreditation Organization Names, Symbols, and Logos	CE-GEN012
(Proprietary – Client Specific)	CE-GEN013
Internal Audits	CE-QA001
Manual Integration Policy	CE-QA002
Training Policy	CE-QA003
Qualification of Subcontract Laboratories	CE-QA004
Laboratory Management Review	CE-QA005
Proficiency Testing	CE-QA006
Making Entries onto Analytical Records	CE-QA007
Nonconformance and Corrective Action	CE-QA008
Control Limits	CE-QA009
Estimation of Uncertainty of Analytical Measurements	CE-QA010
Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation	CE-QA011
Quality of Reagents and Standards	CE-QA012

Local Administrative SOP Titles	SOP Code
Data and Record Archiving	ADM-ARC
Batches and Sequences	ADM-BATCH_SEQ
Handling Consumable Materials	ADM-CONSUM
Electronic Data Backup, Archiving, and Restoration	ADM-DATA_BU
Data Review and Reporting	ADM-DATA_REV
Glassware Cleaning	ADM-GLASS
Analytical Instrument Acquisition, Reassignment, Maintenance and Documentation	ADM-INSTRUM
Laboratory Storage, Analysis, and Tracking	ADM-LabSAT
Media Request Fulfillment	ADM-Media_Req
Project Management	ADM-PMgmt
Software and Data Quality Assurance	ADM-SftwreQA
Significant Figures	ADM-SIG_FIG
Calibration and Use of Laboratory Support Equipment	ADM-SupEQ
Waste Disposal	ADM-WASTE
Cleaning and Certification of Summa Canisters and Other Specially Prepared Canisters	SMO-Can_Cert
Evaluation and Pressurization of Specially Prepared Stainless Steel Canisters	SMO-Can_Press
Flow Controllers and Critical Orifices	SMO-Flow_Cntrl
Sample Receiving, Acceptance and Log-In	SMO-SMPL_REC

Semi-Volatile SOP Titles	SOP Code
Determination of Formaldehyde and Other Carbonyl Compounds in Ambient Air Using Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPLC) EPA Compendium Method T0-11A	SVO-11A
Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS)	SVO-13A
Determination of Volatile Amines in Ambient Air Using Gas Chromatography Equipped with a Nitrogen Phosphorus Detector (NPD)	SVO-AMINES
Determination of Carboxylic Acids in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS)	SVO-CACIDS
Analysis of Halogenated Volatile Organic Compounds in Emissions from Stationary Sources using GC/ECD in Accordance with a Modification of CARB Method 422	SVO-CARB422
NCASI Method RSC-02.02 Reduced Sulfur Compounds by Direct Injection GC/PFPD	SVO-NCASI_RSC
Determination of Methanol, Acetaldehyde, Methyl Ethyl Ketone, and Propionaldehyde in Pulp and Paper Process Liquids by GC/FID	SVO-NCASI_MeOH
Preparation and Analysis of 2-Butoxyethanol on Coconut Shell Charcoal Tubes and Analyzed using GC/FID	SVO-NIOSH1403
Determination of Organic Vapors Using GC/FID in Accordance with OSHA Method 07	SVO-OSHA_07
Determination of P-9290 Target Compounds from a Chamber and Specific P-9290 Quality Control Parameters	SVO-P9290
Preparation and Analysis of Orthorhombic Cyclooctasulfur by Gas Chromatography/Electron Capture Detector (GC/ECD)	SVO-S8_ECD
Analysis of Sulfur Hexafluoride in Accordance with a Modification of NIOSH 6602	SVO-SF6
Determination of Siloxanes in Biogas using Gas Chromatography/Mass Spectrometry (GC/MS)	SVO-SILOXANES
Determination of Pesticides and Polychlorinated Biphenyls (PCBs) in Ambient Air by GC/ECD per EPA Compendium Methods TO-4 and TO-10A	SVO-TO4A
Sample and Media Preparation per EPA Compendium Method TO-13A	SVP-TO13A
Sample Extraction and Preparation of Pesticide and PCB Samples According to EPA Compendium Methods TO-4A and TO-10A	SVP-TO4A

Volatile SOP Titles	SOP Code
Analysis of Air Corrosivity by Checkmate Meter	VOA-AIRCORR
Analysis of Argon Using Gas Chromatography with Thermal Conductivity Detection (TCD)	VOA-ARGON
Calculating Heat Value, Compressibility Factor, and Relative Density of Gaseous Fuels in Accordance with ASTM D 3588	VOA-BTU
Samples Preparation in Glass Chambers	VOA-CHAMBER
Dissolved Gas Analysis in Aqueous Samples Using a GC Headspace Equilibration Technique	VOA-DISGAS
Sample Preparation of Drywall for Sulfur Analysis and the Determination of Copper Corrosion	VOA-DRYWALL
Determination of Total Gaseous Nonmethane Organic (TGNMO) Emissions as Carbon in Landfill Gases in Accordance with EPA Method 25C	VOA-EPA25C
Determination of Methane, Carbon Monoxide, Carbon Dioxide, and Total Gaseous Nonmethane Organic (TGNMO) Emissions as Carbon in Landfill Gases According to Modified EPA Method 25C	VOA-EPA25CM
Determination of Hydrogen, Carbon Monoxide, Carbon Dioxide, Nitrogen, Methane, and Oxygen using Gas Chromatography with Thermal Conductivity Detection (TCD) in Accordance with EPA 3C or ASTM D 1946	VOA-EPA3C
Analysis of Hydrogen and Helium using Gas Chromatography with Thermal Conductivity Detection (TCD)	VOA-HHe
Analysis of Sulfur Compounds in a Gaseous Matrix by Gas Chromatography with Sulfur Chemiluminescence Detection per ASTM D 5504 and Modified SCAQMD Method 307	VOA-S307M_SCD
Analysis of Sulfur Compounds in Liquid Samples by Gas Chromatography with Sulfur Chemiluminescence Detection	VOA-SH_2O_SCD
Analysis of C1-C6+ using Gas Chromatography with Flame Ionization Detection (FID) in Accordance with a Modification of EPA Compendium Method TO-3	VOA-TO3C1C6
Analysis of Various Compounds using Gas Chromatography with Flame Ionization Detection (FID) in Accordance with a Modification of EPA Compendium Method TO-3	VOA-TO3MeOH
Analysis of Total Petroleum Hydrocarbons as Gasoline in Air by Gas Chromatography with Flame Ionization Detection	VOA-TPHG_TO3
Determination of Air-Phase Petroleum Hydrocarbons by Gas Chromatography/Mass Spectrometry (GC/MS)	VOA-MAPH
Determination of Volatile Organic Compounds in Air Samples Collected in Specially Prepared Canisters and Gas Collection Bags and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)	VOA-TO15
Determination of Volatile Organic Compounds in Ambient Air Using Active or Passive Sampling Onto Sorbent Tubes	VOA-TO17

General Chemistry (WET) SOP Titles	SOP Code
Determination of Inorganic Anions by Ion Chromatography	WET-Anions_IC
Colorimetric Determination of Hydrogen Sulfide (H_2S) in Air	WET-H_2SAir
Analysis of Hydrofluoric (HF) Acid in Air by Ion Selective Electrode	WET-HFAir
Ammonia in Air by Ion Selective Electrode	WET-NH_3Air
Colorimetric Determination of Nitrogen Dioxide (NO_2) in Air	WET-NO_2Air
Colorimetric Determination of Ozone (O_3) in Air	WET-O_3Air
pH Electrometric Measurement for Liquids by Ion Selective Electrodes	WET-pHL
pH Electrometric Measurement for Solids by Ion Selective Electrodes	WET-pHS

APPENDIX H – Data Qualifiers

CODE	CATEGORY	DESCRIPTION
BC	AIHA	Reported results are not blank corrected.
BH	AIHA	Results indicate breakthrough; back section of tube greater than front section.
BT	AIHA	Results indicated possible breakthrough; back section ≥10% front section.
DE	AIHA	Reported results are corrected for desorption efficiency.
RA	AIHA	Result not available.
G	GENERAL	Improper container.
G1	GENERAL	Unpreserved or improperly preserved sample.
X	GENERAL	See case narrative.
H1	HOLD TIME	Sample analysis performed past holding time. See case narrative.
H2	HOLD TIME	Initial analysis within holding time. Reanalysis for the required dilution was past holding time.
H3	HOLD TIME	Sample was received and analyzed past holding time.
H4	HOLD TIME	Sample was extracted past required extraction holding time, but analyzed within analysis holding time. See case narrative.
i	MATRIX	The MDL/MRL has been elevated due to matrix interference.
M	MATRIX	Matrix interference; results may be biased (high/low).
M1	MATRIX	Matrix interference due to coelution with a non-target compound. (TO-15 only)
Q	PETROLEUM	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter/heavier molecular weight constituents than the calibration standard.
Y	PETROLEUM	The chromatogram resembles a petroleum product but does not match the calibration standard.
Z	PETROLEUM	The chromatogram does not resemble a petroleum product.
#	QC	The control limit criterion is not applicable. See case narrative.
*	QC	The result is an outlier. See case narrative.
B	QC	Analyte detected in both the sample and associated method blank.
I	QC	Internal standard not within the specified limits. See case narrative.
L	QC	Laboratory control sample recovery outside the specified limits; results may be biased (high/low).
N	QC	The matrix spike sample recovery is not within control limits. See case narrative.
R	QC	Duplicate precision not met.

CODE	CATEGORY	DESCRIPTION
R1	QC	Duplicate precision not within the specified limits; however, the results are below the MRL and considered estimated.
S	QC	Surrogate recovery not within specified limits.
V	QC	The continuing calibration verification standard was outside (biased high/low) the specified limits for this compound.
C	RESULT	Result identification confirmed.
CE	RESULT	Co-elution.
D	RESULT	The reported result is from a dilution.
E	RESULT	Estimated; concentration exceeded calibration range.
J	RESULT	The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
J1	RESULT	The analyte was positively identified below the method reporting limit prior to utilizing the dilution factor; the associated numerical value is considered estimated.
K	RESULT	Analyte was detected above the method reporting limit prior to normalization.
ND	RESULT	Compound was analyzed for, but not detected above the laboratory reporting/detection limit.
P	RESULT	The confirmation criterion was exceeded. The relative percent difference was greater than 40/25% between the two analytical results.
U	RESULT	Compound was analyzed for, but not detected (ND) at or above the MRL/MDL.
W	RESULT	Result quantified, but the corresponding peak was detected outside the generated retention time window.
UJ	RESULT	The analyte was not detected; however, the result is estimated due to discrepancies in meeting certain analyte-specific quality control criteria.
Ui	RESULT	The compound was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL; however, the MRL/MDL has been elevated due to matrix interference.
T	TIC	Analyte is a tentatively identified compound, result is estimated.

APPENDIX I – Master List of Controlled Documents

Controlled Documents*	Document Code
Health and Safety Manual	ADM-SAFETY
Quality Assurance Manual	ALSMV-QAM

*Refer to Appendix G for a list of the laboratory's controlled standard operating procedures.

QA Program Files	
Item	**Location / Name**
Approved Signatories List	QA Manual Appendix I
Approved Subcontract Laboratories	Q:\Approved Sub-Contract Labs\Subcontract Lab List
Control Limit\Chart Status	Q:\Control Charts\CntrlChrt(status1).xls
Job Descriptions	HR Department
Master List of Controlled Documents (Logbooks, SOPs, etc.)	Q:\Master List of Controlled Documents\Master List of Controlled Documents.xls
MDL,LOD,LOQ Status	Q:\MDL Status\MDL Status Table (EACH DEPT).xls
Personnel Resumes, Transcripts	HR and QA Departments
Simi Valley Certification Status	Q:\Certifications\Cert Status.xls
Simi Valley Data Quality Objectives	Q:\MDL_MRL\DQO Spreadsheet.xls
Technical Training Status	Q:\Training\TRAINING STATUS\TRAINING STATUS.xls

Approved Signatories	
Name	**Title**
Kelly Horiuchi, B.A.	Laboratory Director / Project Manager
Chaney Humphrey, B.S.	Quality Assurance Manager
Wade Henton, B.S.	Volatiles (GC) Technical Manager
Chris Parnell, B.S.	Operations Manager; Technical Manager (VOA GC/MS – Air)
Madeleine Dangazyan, B.S.	Semi-Volatiles/ Industrial Hygiene Technical Manager; Environmental Health & Safety Coordinator
Wida Ang, B.S., M.S.	Team Leader (Volatiles GC/MS – Air)
Sue Anderson, B.S.	Project Manager / Technical Manager (General Chemistry)
Samantha Henningsen, B.S.	Project Manager
Kathleen Aguilera, B.A.	Client Services Manager / Project Manager

APPENDIX J – Laboratory Accreditations

American Industrial Hygiene Association (AIHA)

Industrial Hygiene Laboratory Accreditation Program Laboratory
Laboratory # 101661
Approved Method(s):

- NIOSH 1450
- NIOSH 1457
- NIOSH 1500
- NIOSH 1501
- NIOSH 1550
- OSHA 07

State of Arizona, Department of Health Services

License No. AZ0694
Approved Method(s):

- EPA TO-15
- EPA 3C

Department of Defense, Environmental Laboratory Accreditation Program (DoD-ELAP)

Perry Johnson Laboratory Accreditation, Inc. Accreditation No. 65818
Approved Method(s):

- EPA TO-15
- RSK 175
- EPA 3C
- ASTM D 1946-90
- SOP VOA-EPA3C (EPA 3C Modified)
- SOP VOA-TPHG_TO3 (TPHG by Modified EPA TO-3)
- SOP VOA-TO3C1C6 (Hydrocarbons and ranges by Modified EPA TO-3)
- SOP VOA-TO15 (EPA TO-15 Modified)

State of Florida, Department of Health (NELAP-Secondary)

Laboratory ID No.: E871020
Approved Method(s):

- EPA TO-15
- EPA TO-17

State of Maine, Department of Health and Human Services

Certificate No.: 2014025
Approved Methods

- EPA TO-15
- MADEP APH

State of Minnesota, Department of Health, Environmental Laboratory Certification Program (NELAP-Secondary)
Laboratory ID: 006-999-456
Approved Method(s):
- EPA TO-15

State of New York, Department of Health (NELAP –Secondary)
Environmental Analyses/Air and Emissions
Laboratory ID No. 11221
Approved Method(s):
- EPA TO-13A
- EPA TO-15
- EPA TO-17

State of New Jersey, Department of Environmental Protection (NELAP-Secondary)
Laboratory ID: CA009
Approved Method(s):
- EPA TO-15
- EPA TO-13A

State of Oregon, Environmental Laboratory Accreditation Program (NELAP-Primary)
Laboratory ID: 4068
Approved Method(s):
- EPA TO-4A
- EPA TO-10A
- EPA TO13A
- EPA TO-15
- EPA TO-17
- MADEP APH

Commonwealth of Pennsylvania, Department of Environmental Protection Bureau of Laboratories
Registration Number: 68-03307

State of Texas, Texas Commission on Environmental Quality (NELAP-Secondary)
Certificate # T104704413-14-5
Approved Method(s):
- EPA TO-15

State of Utah, Department of Health, Environmental Laboratory Certification Program (NELAP-Secondary)
Certificate # CA016272014-4
Approved Method(s):
- EPA TO-15

State of Washington, Department of Ecology
Laboratory ID: C946
Approved Method(s):
- EPA TO-15
- EPA RSK-175

Note 1: This Quality Assurance Manual is revised annually with AIHA, DoD and NELAP-Primary Certificates, and the Scope of Accreditations/Parameters are revised annually (where necessary). During this interim period Certificates may expire and the Scope of Accreditations/Parameters may change; therefore, these may not be updated until the next revision.

Note 2: Current Certificates and Scope of Accreditations/Parameters are on file and displayed in the front hallway. Updated or Specific Certificates and Scope of Accreditations/Parameters are available upon request.

AIHA Laboratory Accreditation Programs, LLC

acknowledges that

ALS Environmental – Simi Valley
2655 Park Center Drive, Suite A, Simi Valley, CA 93065-6200
Laboratory ID: 101661

along with all premises from which key activities are performed, as listed above, has fulfilled the requirements of the AIHA Laboratory Accreditation Programs (AIHA-LAP), LLC accreditation to the ISO/IEC 17025:2005 international standard, *General Requirements for the Competence of Testing and Calibration Laboratories* in the following:

LABORATORY ACCREDITATION PROGRAMS

✓	**INDUSTRIAL HYGIENE**	Accreditation Expires: 11/01/2016
☐	**ENVIRONMENTAL LEAD**	Accreditation Expires:
☐	**ENVIRONMENTAL MICROBIOLOGY**	Accreditation Expires:
☐	**FOOD**	Accreditation Expires:
☐	**UNIQUE SCOPES**	Accreditation Expires:

Specific Field(s) of Testing (FoT)/Method(s) within each Accred
itation Program for which the above named laboratory maintains accreditation is outlined on the attached **Scope of Accreditation**. Continued accreditation is contingent upon successful on-going compliance with ISO/IEC 17025:2005 and AIHA-LAP, LLC requirements. This certificate is not valid without the attached **Scope of Accreditation**. Please review the AIHA-LAP, LLC website (www.aihaaccreditedlabs.org) for the most current Scope.

Gerald Schultz, CIH
Chairperson, Analytical Accreditation Board

Cheryl O. Morton
Managing Director, AIHA Laboratory Accreditation Programs, LLC

Revision 14: 03/26/2014

Date Issued: 09/30/2014

AIHA Laboratory Accreditation Programs, LLC
SCOPE OF ACCREDITATION

ALS Environmental – Simi Valley
2655 Park Center Drive Suite A, Simi Valley, CA 93065-6200

Laboratory ID: **101661**
Issue Date: 09/30/2014

The laboratory is approved for those specific field(s) of testing/methods listed in the table below. Clients are urged to verify the laboratory's current accreditation status for the particular field(s) of testing/Methods, since these can change due to proficiency status, suspension and/or withdrawal of accreditation.

Industrial Hygiene Laboratory Accreditation Program (IHLAP)

Initial Accreditation Date: 09/01/1994

IHLAP Scope Category	Field of Testing (FoT)	Technology sub-type/ Detector	Published Reference Method/Title of In-house Method	Method Description or Analyte *(for internal methods only)*
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1450	
			NIOSH 1457	
			NIOSH 1500	
			NIOSH 1501	
			NIOSH 1550	
			OSHA 07	
	Gas Chromatography (Diffusive Samplers)		OSHA 07	

A complete listing of currently accredited Industrial Hygiene laboratories is available on the AIHA-LAP, LLC website at: http://www.aihaaccreditedlabs.org

Effective: 03/12/2013
101661_Scope_IHLAP_2014_09_30.docx
Page 1 of 1

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

ALS Environmental
2655 Park Center Drive, Suite A, Simi Valley, CA 93065

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the DoD Quality Systems Manual for Environmental Laboratories Version 4.2 10/26/2010 and is accredited is accordance with the:

United States Department of Defense
Environmental Laboratory Accreditation Program
(DoD-ELAP)

This accreditation demonstrates technical competence for the defined scope:
Environmental Testing
(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Tracy Szerszen
President/Operations Manager

Initial Accreditation Date:	*Issue Date:*	*Expiration Date:*
January 11, 2010	January 2, 2014	January 31, 2016

Accreditation No.:	*Certificate No.:*
65818	L14-2

Perry Johnson Laboratory
Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com

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Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental

2655 Park Center Drive, Suite A, Simi Valley, CA 93065
Chaney Humphrey Phone: 805-526-7161

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard Method	Technology	Analyte
Aqueous	RSK 175	GC/FID	Methane
Aqueous	RSK 175	GC/FID	Ethane
Aqueous	RSK 175	GC/FID	Ethene
Aqueous	RSK 175	GC/TCD	Carbon Dioxide
Air	(ALS SOP) VOA-EPA3C	GC/TCD	Hydrogen
Air	(ALS SOP) VOA-EPA3C	GC/TCD	Oxygen
Air	(ALS SOP) VOA-EPA3C	GC/TCD	Nitrogen
Air	(ALS SOP) VOA-EPA3C	GC/TCD	Methane
Air	(ALS SOP) VOA-EPA3C	GC/TCD	Carbon Dioxide
Air	(ALS SOP) VOA-EPA3C	GC/TCD	Carbon Monoxide
Air	(ALS SOP) VOA-TPHG_TO3	GC/FID	Total Petroleum Hydrocarbons Gasoline (TPHG)
Air	(ALS SOP) VOA-TPHG_TO3	GC/FID	JP-4
Air	(ALS SOP) VOA-TO3C1C6	GC/FID	C1 - C6+
Air	(ALS SOP) VOA-TO3C1C6	GC/FID	Ethane
Air	(ALS SOP) VOA-TO3C1C6	GC/FID	Ethene
Air	(ALS SOP) VOA-TO3C1C6	GC/FID	Methane
Air	(ALS SOP) VOA-TO3C1C6	GC/FID	n-Butane
Air	(ALS SOP) VOA-TO3C1C6	GC/FID	n-Hexane
Air	(ALS SOP) VOA-TO3C1C6	GC/FID	n-Pentane
Air	(ALS SOP) VOA-TO3C1C6	GC/FID	Propane
Air	(ALS SOP) VOA-TO3C1C6	GC/FID	Propene
Air	(ALS SOP) VOA-TO3C1C6	GC/FID	Total Volatile Petroleum Hydrocarbons (TVPH) as Hexane
Air	EPA TO-15	GC/MS	1,1,1-Trichloroethane
Air	EPA TO-15	GC/MS	1,1,2,2-Tetrachloroethane
Air	EPA TO-15	GC/MS	1,1,2-Trichloroethane
Air	EPA TO-15	GC/MS	1,1-Dichloroethane
Air	EPA TO-15	GC/MS	1,1-Dichloroethene
Air	EPA TO-15	GC/MS	1,2,3-Trimethylbenzene
Air	EPA TO-15	GC/MS	1,2,4-Trichlorobenzene

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Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental

2655 Park Center Drive, Suite A, Simi Valley, CA 93065
Chaney Humphrey Phone: 805-526-7161

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard Method	Technology	Analyte
Air	EPA TO-15	GC/MS	1,2,4-Trimethylbenzene
Air	EPA TO-15	GC/MS	1,2,Dibromo-3-Chloropropane
Air	EPA TO-15	GC/MS	1,2-Dibromoethane
Air	EPA TO-15	GC/MS	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)
Air	EPA TO-15	GC/MS	1,2-Dichlorobenzene
Air	EPA TO-15	GC/MS	1,2-Dichloroethane
Air	EPA TO-15	GC/MS	1,2-Dichloropropane
Air	EPA TO-15	GC/MS	1,3,5-Trimethylbenzene
Air	EPA TO-15	GC/MS	1,3-Butadiene
Air	EPA TO-15	GC/MS	1,3-Dichlorobenzene
Air	EPA TO-15	GC/MS	1,4-Dichlorobenzene
Air	EPA TO-15	GC/MS	1,4-Dioxane
Air	EPA TO-15	GC/MS	1-Butanol
Air	EPA TO-15	GC/MS	2-Butanone (MEK)
Air	EPA TO-15	GC/MS	2-Ethyltoluene
Air	EPA TO-15	GC/MS	2-Hexanone
Air	EPA TO-15	GC/MS	3-Ethyltoluene
Air	EPA TO-15	GC/MS	4-Ethyltoluene
Air	EPA TO-15	GC/MS	4-Methyl-2-Pentanone
Air	EPA TO-15	GC/MS	Acetone
Air	EPA TO-15	GC/MS	Acetonitrile
Air	EPA TO-15	GC/MS	Acrolein
Air	EPA TO-15	GC/MS	Acrylonitrile
Air	EPA TO-15	GC/MS	Allyl Chloride
Air	EPA TO-15	GC/MS	alpha-Methylstyrene
Air	EPA TO-15	GC/MS	alpha-Pinene
Air	EPA TO-15	GC/MS	Benzene
Air	EPA TO-15	GC/MS	Benzyl Chloride
Air	EPA TO-15	GC/MS	Bromodichloromethane
Air	EPA TO-15	GC/MS	Bromoform
Air	EPA TO-15	GC/MS	Bromomethane
Air	EPA TO-15	GC/MS	Carbon Disulfide
Air	EPA TO-15	GC/MS	Carbon Tetrachloride
Air	EPA TO-15	GC/MS	Chlorobenzene
Air	EPA TO-15	GC/MS	Chloroethane

Issue: 1/14 *This supplement is in conjunction with certificate #L14-2* *Page 3 of 8*

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental

2655 Park Center Drive, Suite A, Simi Valley, CA 93065
Chaney Humphrey Phone: 805-526-7161

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard Method	Technology	Analyte
Air	EPA TO-15	GC/MS	Chloroform
Air	EPA TO-15	GC/MS	Chloromethane
Air	EPA TO-15	GC/MS	cis-1,2-Dichloroethene
Air	EPA TO-15	GC/MS	cis-1,3-Dichloropropene
Air	EPA TO-15	GC/MS	Cumene
Air	EPA TO-15	GC/MS	Cyclohexane
Air	EPA TO-15	GC/MS	Cyclohexanone
Air	EPA TO-15	GC/MS	Dibromochloromethane
Air	EPA TO-15	GC/MS	Dichlorodifluoromethane (CFC 12)
Air	EPA TO-15	GC/MS	Diisopropyl Ether
Air	EPA TO-15	GC/MS	d-Limonene
Air	EPA TO-15	GC/MS	Ethanol
Air	EPA TO-15	GC/MS	Ethyl Acetate
Air	EPA TO-15	GC/MS	Ethyl tert-Butyl Ether
Air	EPA TO-15	GC/MS	Ethylbenzene
Air	EPA TO-15	GC/MS	Hexachlorobutadiene
Air	EPA TO-15	GC/MS	Isooctane
Air	EPA TO-15	GC/MS	Isopropyl acetate
Air	EPA TO-15	GC/MS	Isopropyl Alcohol
Air	EPA TO-15	GC/MS	m-&, p-Xylenes
Air	EPA TO-15	GC/MS	Methyl Methacrylate
Air	EPA TO-15	GC/MS	Methyl tert-Butyl Ether
Air	EPA TO-15	GC/MS	Methylene Chloride
Air	EPA TO-15	GC/MS	Naphthalene
Air	EPA TO-15	GC/MS	n-Butyl Acetate
Air	EPA TO-15	GC/MS	n-Butylbenzene
Air	EPA TO-15	GC/MS	n-Decane
Air	EPA TO-15	GC/MS	n-Dodecane
Air	EPA TO-15	GC/MS	n-Heptane
Air	EPA TO-15	GC/MS	n-Hexane
Air	EPA TO-15	GC/MS	n-Nonane

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Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental

2655 Park Center Drive, Suite A, Simi Valley, CA 93065
Chaney Humphrey Phone: 805-526-7161

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard Method	Technology	Analyte
Air	EPA TO-15	GC/MS	n-Octane
Air	EPA TO-15	GC/MS	n-Propylbenzene
Air	EPA TO-15	GC/MS	n-Undecane
Air	EPA TO-15	GC/MS	o-Xylene
Air	EPA TO-15	GC/MS	p-Isopropyltoluene
Air	EPA TO-15	GC/MS	Propene
Air	EPA TO-15	GC/MS	sec-Butylbenzene
Air	EPA TO-15	GC/MS	Styrene
Air	EPA TO-15	GC/MS	tert-Amyl Methyl Ether
Air	EPA TO-15	GC/MS	tert-Butanol
Air	EPA TO-15	GC/MS	tert-Butylbenzene
Air	EPA TO-15	GC/MS	Tetrachloroethene
Air	EPA TO-15	GC/MS	Tetrahydrofuran
Air	EPA TO-15	GC/MS	Toluene
Air	EPA TO-15	GC/MS	trans-1,2-Dichloroethene
Air	EPA TO-15	GC/MS	trans-1,3-Dichloropropene
Air	EPA TO-15	GC/MS	Trichloroethene
Air	EPA TO-15	GC/MS	Trichlorofluoromethane
Air	EPA TO-15	GC/MS	Trichlorotrifluoroethane
Air	EPA TO-15	GC/MS	Vinyl Acetate
Air	EPA TO-15	GC/MS	Vinyl Chloride
Air	ASTM D 1946-90	GC/TCD	Hydrogen
Air	ASTM D 1946-90	GC/TCD	Oxygen
Air	ASTM D 1946-90	GC/TCD	Nitrogen
Air	ASTM D 1946-90	GC/TCD	Methane
Air	ASTM D 1946-90	GC/TCD	Carbon Dioxide
Air	ASTM D 1946-90	GC/TCD	Carbon Monoxide
Air	EPA 3C	GC/TCD	Oxygen
Air	EPA 3C	GC/TCD	Nitrogen
Air	EPA 3C	GC/TCD	Methane
Air	EPA 3C	GC/TCD	Carbon Dioxide
Air	(ALS SOP) VOA-TO15	GC/MS	1,1,1-Trichloroethane
Air	(ALS SOP) VOA-TO15	GC/MS	1,1,2,2-Tetrachloroethane
Air	(ALS SOP) VOA-TO15	GC/MS	1,1,2-Trichloroethane
Air	(ALS SOP) VOA-TO15	GC/MS	1,1-Dichloroethane

Issue: 1/14 *This supplement is in conjunction with certificate #L14-2* *Page 5 of 8*

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental

2655 Park Center Drive, Suite A, Simi Valley, CA 93065
Chaney Humphrey Phone: 805-526-7161

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard Method	Technology	Analyte
Air	(ALS SOP) VOA-TO15	GC/MS	1,1-Dichloroethene
Air	(ALS SOP) VOA-TO15	GC/MS	1,2,3-Trimethylbenzene
Air	(ALS SOP) VOA-TO15	GC/MS	1,2,4-Trichlorobenzene
Air	(ALS SOP) VOA-TO15	GC/MS	1,2,4-Trimethylbenzene
Air	(ALS SOP) VOA-TO15	GC/MS	1,2-Dibromo-3-Chloropropane
Air	(ALS SOP) VOA-TO15	GC/MS	1,2-Dibromoethane
Air	(ALS SOP) VOA-TO15	GC/MS	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)
Air	(ALS SOP) VOA-TO15	GC/MS	1,2-Dichlorobenzene
Air	(ALS SOP) VOA-TO15	GC/MS	1,2-Dichloroethane
Air	(ALS SOP) VOA-TO15	GC/MS	1,2-Dichloropropane
Air	(ALS SOP) VOA-TO15	GC/MS	1,3,5-Trimethylbenzene
Air	(ALS SOP) VOA-TO15	GC/MS	1,3-Butadiene
Air	(ALS SOP) VOA-TO15	GC/MS	1,3-Dichlorobenzene
Air	(ALS SOP) VOA-TO15	GC/MS	1,4-Dichlorobenzene
Air	(ALS SOP) VOA-TO15	GC/MS	1,4-Dioxane
Air	(ALS SOP) VOA-TO15	GC/MS	1-Butanol
Air	(ALS SOP) VOA-TO15	GC/MS	2-Butanone (MEK)
Air	(ALS SOP) VOA-TO15	GC/MS	2-Ethyltoluene
Air	(ALS SOP) VOA-TO15	GC/MS	2-Hexanone
Air	(ALS SOP) VOA-TO15	GC/MS	3-Ethyltoluene
Air	(ALS SOP) VOA-TO15	GC/MS	4-Ethyltoluene
Air	(ALS SOP) VOA-TO15	GC/MS	4-Methyl-2-Pentanone
Air	(ALS SOP) VOA-TO15	GC/MS	Acetone
Air	(ALS SOP) VOA-TO15	GC/MS	Acetonitrile
Air	(ALS SOP) VOA-TO15	GC/MS	Acrolein
Air	(ALS SOP) VOA-TO15	GC/MS	Acrylonitrile
Air	(ALS SOP) VOA-TO15	GC/MS	Allyl Chloride
Air	(ALS SOP) VOA-TO15	GC/MS	alpha-Methylstyrene
Air	(ALS SOP) VOA-TO15	GC/MS	alpha-Pinene
Air	(ALS SOP) VOA-TO15	GC/MS	Benzene
Air	(ALS SOP) VOA-TO15	GC/MS	Benzyl Chloride
Air	(ALS SOP) VOA-TO15	GC/MS	Bromodichloromethane
Air	(ALS SOP) VOA-TO15	GC/MS	Bromoform
Air	(ALS SOP) VOA-TO15	GC/MS	Bromomethane

Issue: 1/14 *This supplement is in conjunction with certificate #L14-2* *Page 6 of 8*

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental

2655 Park Center Drive, Suite A, Simi Valley, CA 93065
Chaney Humphrey Phone: 805-526-7161

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard Method	Technology	Analyte
Air	(ALS SOP) VOA-TO15	GC/MS	Carbon Disulfide
Air	(ALS SOP) VOA-TO15	GC/MS	Carbon Tetrachloride
Air	(ALS SOP) VOA-TO15	GC/MS	Chlorobenzene
Air	(ALS SOP) VOA-TO15	GC/MS	Chloroethane
Air	(ALS SOP) VOA-TO15	GC/MS	Chloroform
Air	(ALS SOP) VOA-TO15	GC/MS	Chloromethane
Air	(ALS SOP) VOA-TO15	GC/MS	cis-1,2-Dichloroethene
Air	(ALS SOP) VOA-TO15	GC/MS	cis-1,3-Dichloropropene
Air	(ALS SOP) VOA-TO15	GC/MS	Cumene
Air	(ALS SOP) VOA-TO15	GC/MS	Cyclohexane
Air	(ALS SOP) VOA-TO15	GC/MS	Cyclohexanone
Air	(ALS SOP) VOA-TO15	GC/MS	Dibromochloromethane
Air	(ALS SOP) VOA-TO15	GC/MS	Dichlorodifluoromethane (CFC 12)
Air	(ALS SOP) VOA-TO15	GC/MS	Diisopropyl Ether
Air	(ALS SOP) VOA-TO15	GC/MS	d-Limonene
Air	(ALS SOP) VOA-TO15	GC/MS	Ethanol
Air	(ALS SOP) VOA-TO15	GC/MS	Ethyl Acetate
Air	(ALS SOP) VOA-TO15	GC/MS	Ethyl tert-Butyl Ether
Air	(ALS SOP) VOA-TO15	GC/MS	Ethylbenzene
Air	(ALS SOP) VOA-TO15	GC/MS	Hexachlorobutadiene
Air	(ALS SOP) VOA-TO15	GC/MS	Isooctane
Air	(ALS SOP) VOA-TO15	GC/MS	Isopropyl acetate
Air	(ALS SOP) VOA-TO15	GC/MS	Isopropyl Alcohol
Air	(ALS SOP) VOA-TO15	GC/MS	m-&,p-Xylenes
Air	(ALS SOP) VOA-TO15	GC/MS	Methyl Methacrylate
Air	(ALS SOP) VOA-TO15	GC/MS	Methyl tert-Butyl Ether
Air	(ALS SOP) VOA-TO15	GC/MS	Methylene Chloride
Air	(ALS SOP) VOA-TO15	GC/MS	Naphthalene
Air	(ALS SOP) VOA-TO15	GC/MS	n-Butyl Acetate
Air	(ALS SOP) VOA-TO15	GC/MS	n-Butylbenzene
Air	(ALS SOP) VOA-TO15	GC/MS	n-Decane
Air	(ALS SOP) VOA-TO15	GC/MS	n-Dodecane
Air	(ALS SOP) VOA-TO15	GC/MS	n-Heptane
Air	(ALS SOP) VOA-TO15	GC/MS	n-Hexane
Air	(ALS SOP) VOA-TO15	GC/MS	n-Nonane

Issue: 1/14 *This supplement is in conjunction with certificate #L14-2* *Page 7 of 8*

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental

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Chaney Humphrey Phone: 805-526-7161

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard Method	Technology	Analyte
Air	(ALS SOP) VOA-TO15	GC/MS	n-Octane
Air	(ALS SOP) VOA-TO15	GC/MS	n-Propylbenzene
Air	(ALS SOP) VOA-TO15	GC/MS	n-Undecane
Air	(ALS SOP) VOA-TO15	GC/MS	o-Xylene
Air	(ALS SOP) VOA-TO15	GC/MS	p-Isopropyltoluene
Air	(ALS SOP) VOA-TO15	GC/MS	Propene
Air	(ALS SOP) VOA-TO15	GC/MS	sec-Butylbenzene
Air	(ALS SOP) VOA-TO15	GC/MS	Styrene
Air	(ALS SOP) VOA-TO15	GC/MS	tert-Amyl Methyl Ether
Air	(ALS SOP) VOA-TO15	GC/MS	t-Butanol
Air	(ALS SOP) VOA-TO15	GC/MS	tert-Butylbenzene
Air	(ALS SOP) VOA-TO15	GC/MS	Tetrachloroethene
Air	(ALS SOP) VOA-TO15	GC/MS	Tetrahydrofuran
Air	(ALS SOP) VOA-TO15	GC/MS	Toluene
Air	(ALS SOP) VOA-TO15	GC/MS	trans-1,2-Dichloroethene
Air	(ALS SOP) VOA-TO15	GC/MS	trans-1,3-Dichloropropene
Air	(ALS SOP) VOA-TO15	GC/MS	Trichloroethene
Air	(ALS SOP) VOA-TO15	GC/MS	Trichlorofluoromethane
Air	(ALS SOP) VOA-TO15	GC/MS	Trichlorotrifluoroethane
Air	(ALS SOP) VOA-TO15	GC/MS	Vinyl Acetate
Air	(ALS SOP) VOA-TO15	GC/MS	Vinyl Chloride

Issue: 1/14 *This supplement is in conjunction with certificate #L14-2* *Page 8 of 8*

OREGON

Environmental Laboratory Accreditation Program

NELAP Recognized

ALS Environmental - Simi Valley

4068

2655 Park Center Drive, Suite A

Simi Valley,CA 93065

IS GRANTED APPROVAL BY ORELAP UNDER THE 2009 TNI STANDARDS, TO PERFORM ANALYSES ON ENVIRONMENTAL SAMPLES IN MATRICES AS LISTED BELOW :

Air	*Drinking Water*	*Non Potable Water*	*Solids and Chem. Waste*	*Tissue*
Chemistry		Chemistry		

AND AS RECORDED IN THE LIST OF APPROVED ANALYTES, METHODS, ANALYTICAL TECHNIQUES, AND FIELDS OF TESTING ISSUED CONCURRENTLY WITH THIS CERTIFICATE AND REVISED AS NECESSARY.

ACCREDITED STATUS DEPENDS ON SUCCESSFUL ONGOING PARTICIPATION IN THE PROGRAM AND CONTINUED COMPLIANCE WITH THE STANDARDS.

CUSTOMERS ARE URGED TO VERIFY THE LABORATORY'S CURRENT ACCREDITATION STATUS IN OREGON.

Gary K. Ward, MS
Oregon State Public Health Laboratory
ORELAP Administrator
3150 NW. 229th Ave, Suite 100
Hillsboro, OR 97124

ISSUE DATE: 02/16/2015
EXPIRATION DATE: 02/15/2016
Certificate No: 4068 - 001

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Oregon

Environmental Laboratory Accreditation Program

Department of Agriculture, Laboratory Division
Department of Environmental Quality, Laboratory Division
Oregon Health Authority, Public Health Division

NELAP Recognized

ORELAP Fields of Accreditation

ORELAP ID: 4068
EPA CODE: CA01627
Certificate: 4068 - 001

ALS Environmental - Simi Valley
2655 Park Center Drive, Suite A
Simi Valley CA 93065

Issue Date: 02/16/2015 ***Expiration Date:*** 02/15/2016

As of 02/16/2015 ***this list supercedes all previous lists for this certificate number. Customers. Please verify the current accreditation standing with ORELAP.***

MATRIX : Air

Reference	Code	Description
EPA TO-10A (GC/ECD)	**10247504**	**Pesticides and PCBs with LV PUF by GC/ECD**

Analyte Code	*Analyte*
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
8880	Aroclor-1016 (PCB-1016)
8910	Aroclor-1260 (PCB-1260)
7115	beta-BHC (beta-Hexachlorocyclohexane)
7105	delta-BHC
7470	Dieldrin
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
7810	Methoxychlor

EPA TO-13A	**10248405**	**Polycyclic Aromatic Hydrocarbons in Ambient Air by GC/MS**

Analyte Code	*Analyte*
5500	Acenaphthene
5505	Acenaphthylene
5555	Anthracene
5575	Benzo(a)anthracene
5580	Benzo(a)pyrene
5590	Benzo(g,h,i)perylene
5600	Benzo(k)fluoranthene
5585	Benzo[b]fluoranthene
5855	Chrysene
5895	Dibenz(a,h) anthracene
6265	Fluoranthene
6270	Fluorene
6315	Indeno(1,2,3-cd) pyrene

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Analyte Code	*Analyte*
5005	Naphthalene
6615	Phenanthrene
6665	Pyrene

EPA TO-15 **10248803** **VOCs collected in Canisters by GC/MS**

Analyte Code	*Analyte*
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
5182	1,2,3-Trimethylbenzene
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4570	1,2-Dibromo-3-chloropropane (DBCP)
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
5215	1,3,5-Trimethylbenzene
9318	1,3-Butadiene
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
4836	1-Propene
5220	2,2,4-Trimethylpentane
4410	2-Butanone (Methyl ethyl ketone, MEK)
4538	2-Ethyltoluene
4860	2-Hexanone
4531	3-Ethyltoluene
4542	4-Ethyltoluene
4910	4-Isopropyltoluene (p-Cymene)
4995	4-Methyl-2-pentanone (MIBK)
4315	Acetone
4320	Acetonitrile
4325	Acrolein (Propenal)
4340	Acrylonitrile
4355	Allyl chloride (3-Chloropropene)
4357	alpha-Methylstyrene
6698	alpha-Pinene
4375	Benzene
5635	Benzyl chloride
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4555	Cyclohexane
4560	Cyclohexanone
4625	Dichlorodifluoromethane (Freon-12)
9375	Di-isopropylether (DIPE)
6208	d-Limonene
4750	Ethanol

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Analyte Code	*Analyte*
4755	Ethyl acetate
4765	Ethylbenzene
4770	Ethyl-t-butylether (ETBE) (2-Ethoxy-2-methylpropane)
4835	Hexachlorobutadiene
4890	Isopropyl acetate
4895	Isopropyl alcohol (2-Propanol, Isopropanol)
4900	Isopropylbenzene
5240	m+p-xylene
4950	Methyl bromide (Bromomethane)
4960	Methyl chloride (Chloromethane)
4990	Methyl methacrylate
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4425	n-Butyl alcohol (1-Butanol, n-Butanol)
4415	n-Butyl-acetate
4435	n-Butylbenzene
5875	n-Decane
6235	n-Dodecane
4825	n-Heptane
4855	n-Hexane
5026	n-Nonane
5027	n-Octane
5090	n-Propylbenzene
6747	n-Undecane
5250	o-Xylene
4440	sec-Butylbenzene
5100	Styrene
4370	T-amylmethylether (TAME)
4420	tert-Butyl alcohol
4445	tert-Butylbenzene
5115	Tetrachloroethylene (Perchloroethylene)
5120	Tetrahydrofuran (THF)
5140	Toluene
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5225	Vinyl acetate
5235	Vinyl chloride
5260	Xylene (total)

EPA TO-17 **10312206** **Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes**

Analyte Code	*Analyte*
5160	1,1,1-Trichloroethane
5110	1,1,2,2-Tetrachloroethane
5195	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
5165	1,1,2-Trichloroethane
4630	1,1-Dichloroethane
4640	1,1-Dichloroethylene
5155	1,2,4-Trichlorobenzene
5210	1,2,4-Trimethylbenzene
4570	1,2-Dibromo-3-chloropropane (DBCP)
4585	1,2-Dibromoethane (EDB, Ethylene dibromide)
4695	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)
4610	1,2-Dichlorobenzene
4635	1,2-Dichloroethane (Ethylene dichloride)
4655	1,2-Dichloropropane
5215	1,3,5-Trimethylbenzene
9318	1,3-Butadiene

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Analyte Code	*Analyte*
4615	1,3-Dichlorobenzene
4620	1,4-Dichlorobenzene
4735	1,4-Dioxane (1,4- Diethyleneoxide)
5220	2,2,4-Trimethylpentane
4410	2-Butanone (Methyl ethyl ketone, MEK)
4860	2-Hexanone (MBK)
4995	4-Methyl-2-pentanone (MIBK)
4315	Acetone
4320	Acetonitrile
4375	Benzene
4395	Bromodichloromethane
4400	Bromoform
4450	Carbon disulfide
4455	Carbon tetrachloride
4475	Chlorobenzene
4575	Chlorodibromomethane
4485	Chloroethane (Ethyl chloride)
4505	Chloroform
4645	cis-1,2-Dichloroethylene
4680	cis-1,3-Dichloropropene
4555	Cyclohexane
4625	Dichlorodifluoromethane (Freon-12)
4750	Ethanol
4765	Ethylbenzene
4835	Hexachlorobutadiene
4895	Isopropyl alcohol (2-Propanol, Isopropanol)
4900	Isopropylbenzene
5240	m+p-xylene
4960	Methyl chloride (Chloromethane)
5000	Methyl tert-butyl ether (MTBE)
4975	Methylene chloride (Dichloromethane)
5005	Naphthalene
4825	n-Heptane
4855	n-Hexane
5027	n-Octane
5250	o-Xylene
5100	Styrene
5115	Tetrachloroethylene (Perchloroethylene)
5120	Tetrahydrofuran (THF)
5140	Toluene
4700	trans-1,2-Dichloroethylene
4685	trans-1,3-Dichloropropylene
5170	Trichloroethene (Trichloroethylene)
5175	Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)
5235	Vinyl chloride
5260	Xylene (total)

EPA TO-4A **10249204** **Pesticides and PCBs by HV PUF GC**

Analyte Code	*Analyte*
7355	4,4'-DDD
7360	4,4'-DDE
7365	4,4'-DDT
7025	Aldrin
7110	alpha-BHC (alpha-Hexachlorocyclohexane)
7240	alpha-Chlordane
8880	Aroclor-1016 (PCB-1016)
8910	Aroclor-1260 (PCB-1260)
7115	beta-BHC (beta-Hexachlorocyclohexane)
7105	delta-BHC
7470	Dieldrin

ORELAP Fields of Accreditation

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ALS Environmental - Simi Valley
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Simi Valley CA 93065

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Analyte Code	Analyte
7510	Endosulfan I
7515	Endosulfan II
7520	Endosulfan sulfate
7540	Endrin
7530	Endrin aldehyde
7535	Endrin ketone
7120	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)
7245	gamma-Chlordane
7685	Heptachlor
7690	Heptachlor epoxide
7810	Methoxychlor

MADEP APH **90017188** **Air-Phase Petroleum Hydrocarbons**

Analyte Code	Analyte
9318	1,3-Butadiene
3792	APH Aliphatics C5-C8
3793	APH Aliphatics C9-C12
3794	APH Aromatics C9-C10
4375	Benzene
4765	Ethylbenzene
5240	m+p-xylene
5000	Methyl tert-butyl ether (MTBE)
5005	Naphthalene
5250	o-Xylene
5140	Toluene

ALS Standard Operating Procedure

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DOCUMENT TITLE:	ANALYSIS OF HALOGENATED VOLATILE ORGANIC COMPOUNDS IN EMISSIONS FROM STATIONARY SOURCES USING GAS CHROMATOGRAPHY WITH ELECTRON CAPTURE DETECTION (ECD) IN ACCORDANCE WITH A MODIFICATION OF CARB METHOD 422
REFERENCED METHOD:	CARB 422 MODIFIED
SOP ID:	SVO-CARB422
REV. NUMBER:	05.0
EFFECTIVE DATE:	04/25/2015

STANDARD OPERATING PROCEDURE

ANALYSIS OF HALOGENATED VOLATILE ORGANIC COMPOUNDS IN EMISSIONS FROM STATIONARY SOURCES USING GAS CHROMATOGRAPHY WITH ELECTRON CAPTURE DETECTION (ECD) IN ACCORDANCE WITH A MODIFICATION OF CARB METHOD 422

CARB 422 MODIFIED

SOP ID:	SVO-CARB422	Rev. Number:	05.0	Effective Date:	04/25/2015

Approved By: _____ Date: 4/14/15
SVOC Team Leader – Madeleine Dangazyan

Approved By: _____ Date: 4/20/15
QA Manager – Chaney Humphrey

Approved By: _____ Date: 4/15/15
Laboratory Director – Kelly Horiuchi

Archival Date:	_____	Doc Control ID#:	Non-Controlled	Editor:	_____

TABLE OF CONTENTS

ANALYSIS OF HALOGENATED VOLATILE ORGANIC COMPOUNDS IN EMISSIONS FROM STATIONARY SOURCES USING GAS CHROMATOGRAPHY WITH ELECTRON CAPTURE DETECTION (ECD) IN ACCORDANCE WITH A MODIFICATION OF CARB METHOD 422

1) Scope and Applicability

1.1 This gas chromatograph method is used in the analysis of chloroform, trichloroethene, and tetrachloroethene by a modification of CARB Method 422. Other compounds that maybe reported provided that the requirements of this document are followed are: carbon tetrachloride, 1,2-dichloroethane, 1,2-dibromoethane, trichlorofluoromethane, 1,3-butadiene and dichloromethane. This method cannot be used to determine compounds of high molecular weight, compounds that may polymerize before analysis or compounds that have very low vapor pressures at stack or instrument conditions.

1.2 This method applies to but is not limited to the following sample matrices: ambient air, source emissions, landfill gases, digester gases, and vehicular exhaust. The range of this method for quantifying target analyte gases, depending on the concentration of the samples, is approximately 0.0010 to 200ppm. The upper limit may be extended by diluting the sample with an inert gas or by using a smaller injection volume. Approximately twenty samples may be analyzed in one eight hour day.

2) Summary of Procedure

2.1 Samples are collected in Tedlar bags, and delivered to the laboratory for analysis. A modification of the method may be used for the collection of samples in Summa canisters or glass bottles. An aliquot is drawn from the sampling container using a gastight syringe and injected onto a chromatographic column where the analytes are separated and measured using an electron capture detector (ECD). Analytes are identified and quantified based on their retention time, which is compared with that of a known standard under identical conditions. The Tedlar bag sampling and analysis is not suitable for monitoring 1,3-butadiene in combustion source emissions. Refer to CARB Method 422.102 for the analysis of 1,3-butadiene.

3) Definitions

3.1 Relative Standard Deviation (RSD) The RSD is the coefficient of variation (CV; ratio of the standard deviation to the mean) multiplied by 100 to convert the CV to a percentage of the mean.

3.2 Analytical Sequence The analytical sequence describes exactly how the field and QC samples in an analytical batch are to be analyzed.

3.3 Field Sample A sample collected and delivered to the laboratory for analysis.

3.4 Batch QC Batch QC refers to the QC samples that are analyzed in an analytical batch of field samples and includes the Method Blank (MB), Laboratory Control Sample (LCS) and Laboratory Duplicate (LD), etc.

3.5 Calibration Standard (Initial Calibration – ICAL) A calibration standard is a known concentration of desired analyte(s) prepared from a primary standard, which is, in turn, prepared from a stock standard material. A calibration standard is analyzed at varying concentrations and used to calibrate the response of the measurement system with respect to analyte concentration.

3.6 Initial Calibration Verification (ICV) Standard An initial calibration verification standard (ICV) is a standard that is prepared from materials obtained from a source other than

the source for the calibration standards and is analyzed after the measurement system is calibrated, but prior to sample analysis in order to verify the calibration of the measurement system.

3.7 Continuing Calibration Verification (CCV) Standard A continuing calibration verification standard (CCV) is a midrange calibration standard that is analyzed periodically to verify the continuing calibration of the measurement system.

3.8 Method Blank (MB) The method blank (MB) for this method is ultra-pure nitrogen that is analyzed to verify the zero point of the analytical system and to verify freedom from carryover.

3.9 Method Reporting Limit (MRL) The minimum reliably quantifiable concentration of a compound.

3.10 Laboratory Control Sample (LCS) For the purposes of this document, a laboratory control sample (LCS) shall be a calibration standard of known concentration. The percent recovery of the analyte(s) in the LCS is used to assess method performance.

3.11 Laboratory Duplicate Aliquots of a sample taken from the same container under laboratory conditions which are processed and analyzed independently.

3.12 Precision Precision of a method is how close results are to one another, and is usually expressed by measures such as standard deviation, which describe the spread of results.

3.13 Bias The bias of a method is an expression of how close the mean of a set of results (produced by the method) is to the true value.

3.14 Manual Integration This term applies to a data file in which setpoints have been changed and reintegration has occurred under the changed setpoints; baselines have been adjusted; peak integration start and stop “ticks” have been changed; peak area, or peak height, are changed after the time of data collection and data file generation.

4) Health and Safety Warnings

4.1 Pollution Prevention and Waste Management All waste management must be carried out in accordance with the most recent version of the *SOP for Waste Disposal*.

4.2 This procedure may include CHEMICAL, OPERATIONAL and/or EQUIPMENT hazards. Employees must review and understand the following hazards and their preventive measures prior to proceeding with this activity. Hazard information related to this activity which is not included or referenced in this document should be immediately brought to the attention of the Department Supervisor.

HAZARD ASSESSMENT		
Job Task #1:	**Hazards**	**Preventative Measures**
Standard and sample preparation.	Exposure to potential health hazards through absorption through skin. Inhalation hazards.	Reduce exposure through the use of gloves and fume hoods. Safety glasses must be worn when working in the prep lab. Care should be taken when handling standard material in a neat or highly concentrated form. Personal protective clothing (safety glasses, gloves, and lab coat) are required when handling standard material in neat form. Consult Safety Data Sheets (SDS) for compounds being handled in this procedure, and be familiar with proper safety precautions. SDS shall be reviewed as part of employee training. Refer to the laboratory's *Environmental Health and Safety Manual* for additional information regarding safety in the workplace.
Job Task #2:	**Hazards**	**Preventative Measures**
Using and moving compressed gas cylinders.	Gas leak, fire, and explosion. Personal injury due to falling during transport.	All cylinders must be secured in an upright position to a wall or immovable counter with a chain or a cylinder clamp when not in use. Keep safety caps on when cylinders are not in use. A handcart must be used when transporting cylinders. The cylinder must be secured to the handcart with a chain or belt. Full cylinders must be kept separate from empty cylinders. Flammable gases (i.e. pressurized hydrogen) must be clearly labeled. Flammables and oxidizers must be separated by a ½-hour fire wall or by at least twenty feet.
Job Task #3:	**Hazards**	**Preventative Measures**
Glass syringe use	Skin lacerations and punctures.	The proper use of syringes should be part of employee training for this SOP. Care should be taken to avoid personal injury as a result or improper handling techniques.
Job Task #4:	**Hazards**	**Preventative Measures**
Working with and Pressurization of glass bottles	Personal injury from breakage or shattering.	Wear safety glasses when working with glass bottles. Gloves may be worn to help maintain grip. Bottle Vacs must not be pressurized higher than 7 psig.

5) Cautions

5.1 An instrument maintenance log shall be kept documenting maintenance performed on each analytical system. This log must be kept current. The serial numbers of each instrument shall be recorded in the front of the logbook. An entry shall be made in the appropriate log every time maintenance is performed. The extent of the maintenance is not important, however, it is important that a notation be included for each maintenance activity such as changing a column, tuning the instrument, or cleaning the source. The entry in the log must include:

(a) the date of maintenance
(b) who did the maintenance
(c) description of the maintenance
(d) proof that the maintenance activity was successful

A notation of a successful continuing calibration or initial calibration shall serve as proof that the maintenance is complete and the instrument is in working order.

5.2 Carrier Gas Purifier

If in-line purifiers or scrubbers are in place, these purifiers must be changed as recommended by the supplier.

5.3 GC System

5.3.1 Column Performance should be monitored by observing peak shapes and column bleed. Over time, the column may exhibit a poor overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur depends on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column.

Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and “clean” (uniform, without fragmentation) by using the proper column-cutting tool. When removing any major portion of the column, which will affect the retention times and elution characteristics, a change in instrument conditions may be required to facilitate nominal analytical activity.

Poor performance can also be due to ineffective column ferrules, which should be replaced when a tight seal around the column is no longer possible. This can be detected with the use of a leak detector.

5.3.2 Injection Port Injection port maintenance includes changing the injection port liner and column ferrule as needed. Liners should be changed when recent sample analyses predict a problem in chromatographic performance.

5.3.3 Injector Septa Septa should be changed monthly or whenever there is a noticeable change in peak definition. For best results with air analyses, two septa are placed into the injector in order to eliminate loss during manual injections.

5.3.4 Electron Capture Detector The ECD contains Nickel-63 and must undergo a radioactive leak or “wipe” test every 6 months. The radioactive leak test records are to be maintained for a minimum of 3 years. If a leak test fails, the ECD must be immediately taken out of use and the following must occur:

- Send detector to an authorized repair or disposal facility.
- Prepare and submit a report within 30 days to the California department of radiological health including a complete description of the device (manufacturer, type, serial number) and a brief description of the event and the remedial action taken (*California Code of Regulations).*

Under no circumstances is the ECD unit to be opened, cleaned, repaired or modified by laboratory personnel, as this would be a direct violation of the General License requirement.

6) Interferences

6.1 Contaminated Sample

Care must be taken to prevent ambient air intrusion into the sample container during canister pressurization and laboratory analysis. When using adapters and fittings the dead volume must be evacuated and replaced with the sample gas prior to sampling from the container. The sampling syringe shall then be flushed with the sample gas to remove residual ambient air. An aliquot greater than is needed is drawn, and the syringe plunger is adjusted to the appropriate volume *immediately* before injecting.

6.2 Carrier Gas Contamination

To prevent system contamination, UHP/ZERO grade helium (99.999% purity) is used as the carrier gas. Additionally, a purifier is incorporated into the analytical system as another precaution in preventing contamination.

7) Personnel Qualifications and Responsibilities

7.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review and reporting. Personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP must perform analysis and interpretation of the results. This demonstration shall be in accordance with the training program of the laboratory. The department supervisor/manager or designee shall perform final review and sign-off on the data.

7.2 Training shall be conducted in accordance with the *SOP for Training Policy.* An initial demonstration of proficiency shall be performed prior to independent analyses of samples. In addition, a continuing demonstration must be performed annually or prior to the analysis of samples. Both demonstrations consist of spiking Tedlar bags with the LCS standard and evaluating for both precision and accuracy. The criteria for approval are the same as the acceptance criteria for the LCS as specified in this document. See Attachment 1.

8) Sample Collection, Handling, and Preservation

8.1 The samples are collected and delivered to the laboratory for analysis in either Tedlar bags or specially prepared canisters, or glass sampling bottles (Bottle Vac. Entech Instruments). Samples collected in bags must be analyzed within 72 hours after sample collection unless otherwise specified by the client. Samples delivered in cleaned, evacuated summa or other specially prepared canisters do not have specified holding times for atmospheric gases but should be analyzed within 30 days from the date of collection.

9) Equipment and Supplies

9.1 Gas Chromatograph

HP 5890 or equivalent equipped with an electron capture detector, and having a temperature programmable oven. The column shall be 60m, 0.53mm ID RT_x-1 or equivalent with a 5µm film thickness.

Conditioning of the chromatographic column is required prior to use of the system. The column should be conditioned with a continuous flow of chromatographic grade helium and temperature programmed from 35°C to 200°C at a rate of five degrees per minute. The column should be held at 200°C for at least four hours.

9.2 Regulators

Regulators are used on the gas cylinders supplying the GC and for preparing cylinder standards.

9.3 Data System

A data system with the ability to collect data from the GC detector, integrate the peaks and perform the appropriate quantification calculations shall be used. This laboratory currently uses HP Chemstation/Enviroquant GC software.

9.4 Syringes

Gas tight syringes of the following volumes: 10mL, 1.0mL, and 0.5mL.

9.5 Tedlar Bags

New Tedlar bags are used for preparing standards and diluting very concentrated samples, which fall outside of the initial calibration range.

10) Standards and Reagents

10.1 All samples and standards must be stored separately. The concentration, preparation and expiration date as well as analyst's initials must be identified on the standard label. Each standard must also be uniquely identified with a laboratory ID number.

All certificates shall be noted with the standard identification number, date received and initials of the receiving analyst and retained by the quality assurance department.

10.2 Carrier and Calibration Standard Balance Gas

10.2.1 Helium - UHP/ZERO (99.999%) or higher in purity

10.2.2 Nitrogen - UHP/ZERO (99.999%) or higher in purity

10.3 Neat Standards

These standards must be stored in accordance with the requirements described in the *SOP for Handling Consumable Materials*. These standards may be stored for a period of 5 years for neat standards, 2 years for air standards or as recommended by the manufacturer.

Compound	Purity	MW	Density
Chloroform	99+%	119.4	1.4832
Trichloroethene	99+%	131.4	1.4642
Tetrachloroethene	99+%	165.8	1.6227
Carbon tetrachloride	99+%	153.8	1.5940
1,2-Dichloroethane	99+%	98.96	1.2351
1,2-Dibromoethane	99+%	187.9	2.17
Trichlorofluoromethane	99+%	137.4	1.494
1,3-Butadiene	99+%	54.09	0.6149
Dichloromethane (Methylene Chloride)	99+%	84.94	1.3266

10.4 Initial Calibration Standard / Working Standard

Prepare a neat cocktail standard from the above stated compounds by adding the appropriate volume of the neat compounds into a clean 2mL vial.

The current cocktail concentration recommendation is 200ppm for tetrachloroethene and 1000ppm for all other compounds. Determine the spike volume and add this amount to 1L of high purity nitrogen in a Tedlar bag. Record the calibration standard in accordance with the requirements described in the *SOP for Handling Consumable Materials.* Depending on the desired dynamic range of the initial calibration, various dilutions shall be made from this standard bag. A serial dilution may also be prepared from this standard bag.

The intermediate standard, along with all dilutions, must be stored at room temperature and expires 3 days after preparation.

10.4.1 *Equi-mass "soup"* (contains compounds in equal mass amounts) or *cocktail* prepared from neat compounds.

Cocktail Preparation:

Step 1: This cocktail is prepared by combining a calculated amount of each neat compound into a small glass vial based on the desired Tedlar bag standard concentration of 200ppm for tetrachloroethene and 1000ppm for other compounds. Use a microliter syringe to transfer each compound, cleaning with solvents in between. Put the vial in the freezer between aliquots to minimize volatilization. Take the density and molecular weight of each compound into account to determine the actual amount of each compound to spike into the cocktail by using the following equation.

$$S = \frac{\frac{S_A * MW * 1L * \frac{m^3}{1000L}}{24.46}}{D} \qquad \text{(Equation 1)}$$

Where:

S Calculated volume, per compound (uL)
MW Molecular weight for each compound, g/mole
S_A Desired concentration for each compound (ppm= mg/m³)
D Density (g/mL); refer to the density references

Example: The actual volume of chloroform to add to the cocktail is calculated by the following.

$$\text{S(Chloroform)} = \frac{\dfrac{1000mg/m^3 * 119.4 * 1L * \dfrac{m^3}{1000L}}{24.46}}{1.4832} = 3.29\text{uL}$$

Hint: To obtain a larger cocktail volume, multiply each compound volume by a multiplier (i.e., 40 or 50). This procedure prevents from having to prepare cocktail more often.

Tabulate all of the calculated spike amounts and spike the total into a 1L Tedlar bag filled with nitrogen. Place in an oven at approximately 60ºC for about 10 minutes. Allow the Tedlar bag to sit for about 15-20 minutes for an equilibrium period.

11) Method Calibration

11.1 Initial Calibration

The instrument must be calibrated initially and whenever the laboratory takes corrective action (maintenance), which may change or affect the initial calibration criteria, or if the continuing calibration acceptance criteria have not been met. Introduce each initial calibration concentration standard (at least five levels, analyzed from low concentration to high concentration) by direct injection using a gas tight syringe. Perform all calibration runs according to the analytical portion of the sample analysis described in Section 12.1

Note: The concentrations of the initial calibration may change as long as the low standard analyzed is the same as the reporting limit for each analyte.

11.1.1 Initial Calibration Requirements

Once a set of ICAL standards is analyzed, the previous ICAL may no longer be used to analyze new samples and it must be archived. The only time an archived ICAL can be used thereafter is to review or re-evaluate samples(s) previously processed using that ICAL.

1. A minimum of 5 concentrations must be used to calculate the calibration curve.
2. Highest concentration, together with the lowest concentration, defines the calibration curve.
3. Lowest concentration must be at method reporting limit.
4. A blank should be analyzed prior to beginning the analysis of the calibration standards.
5. The initial calibration event may not be interrupted by maintenance.
6. Only one value per concentration may be used.
7. Analyze calibration standards from low to high concentration.
8. All ICAL analyses must be completed within 48 hours.
9. If 5 calibration standards are in the ICAL, one standard may be re-analyzed. If 6 to 10 calibration standards are in the ICAL, two calibration standards may be re-analyzed.
10. Point dropping policy
    - Minimum of 5 consecutive concentrations must be used to calculate the calibration curve.

- Lowest concentration must be at the MRL and may not be dropped unless the MRL is changed to the concentration of the remaining lowest standard.
- Points at high end may be dropped, but doing so lowers the calibration curve range.
- Points may not be dropped from the interior of the curve unless an assignable cause (i.e., gross dilution or standard preparation error, or instrument malfunction) is accounted for and documented in a nonconformity and corrective action report (NCAR). In these instances, all the analytes in that calibration standard must be dropped from the calibration curve as the corrective action.
- If a point or a calibration standard is dropped, the reason must be documented (and the results maintained with the documentation for the final ICAL).
- A calibration standard may be re-analyzed if the first analysis of the standard has been dropped and other requirements in this policy are met (i.e., still within 48 hours).
- Once the ICAL has been used to calculate and report sample results, it is not to be changed.

11.1.2 Initial Calibration Review

Analyst's calculations and assessment along with a peer review of all ICAL data and documentation as stated in Attachment 2 is required before the ICAL may be used to analyze samples. Sample results may only be reported if the ICAL is reviewed and found to be acceptable.

11.1.3 Initial Calibration File

An ICAL file is to be created for each initial calibration performed per instrument into which is placed the following ICAL documents. The file shall remain in the laboratory and be filed by instrument and date.

- ICAL Checklist filled out, reviewed and approved
- Blank analysis quantitation report
- Calibration status report (a.k.a. Calibration History)
- Relative Response Factor Report / Percent Relative Standard Deviation
- Quantitation report for each calibration standard (including manual integration documentation – before and after manual integration)
- ICV quantitation report and evaluate continuing calibration report (a.k.a. Percent Difference Report)

11.1.4 Initial Calibration Verification

Verify the initial calibration by analyzing an independent calibration verification standard (ICV).

12) Sample Preparation/Analysis

12.1 Analytical Sequence and Data System Setup

12.1.1 Data System Load the appropriate acquisition method file for the gas chromatograph temperature program. Load the appropriate analytical sequence. Enter the analytical sequence information in the table window, including standard name, sample name and injection volume. Run the sequence and inject the standards and samples per the guidelines in Section 12.1.2.

12.1.2 Analytical Sequence The analytical batch must be completed for the analysis of ≤20 field samples. Laboratory duplicates (LD), duplicate field samples and sample dilutions are considered samples. Batch QC samples may be analyzed anywhere in the analytical sequence, with the exception of the method blank which must be analyzed prior to sample analysis in order to demonstrate a contamination free system.

Analytical Sequence Guideline[1]

Sample Description(w/ICAL)	*Sample Description*
Calibration Stds.[2]	CCV[3]
ICV[4]	MB[5]
MB[5]	LCS[6]
LCS[6]	Samples 1-10
Samples 1-10	CCV[3]
CCV[3]	Samples 11-19
Samples 11-19	LD[7]
LD[7]	CCV[3]
CCV[3]	

[1] The batch QC may be analyzed in an order other than the one listed in this document; the analytical sequence specified below is a guideline.
[2] The initial calibration must be generated in accordance with the guidelines detailed in Section 11.1 of this document.
[3] In cases, where the ICAL is not performed the analytical sequence must begin with the analysis of a CCV standard. In addition, the analytical sequence shall end with an acceptable CCV.
[4] Every ICAL must be followed by a second source standard (ICV) which contains all of the target analytes.
[5] The method blank must be analyzed prior to any samples within the sequence.
[6] Every analytical sequence must include a laboratory control sample. A LCS shall be analyzed at a rate of one per twenty samples or fewer for each analyte.
[7] A laboratory duplicate must be analyzed at a frequency of 1 in 20 or fewer samples.

12.2 GC Configuration

12.2.1 Temperature Program The GC oven temperature programming must be set to completely elute all of the target analytes. The temperature program ramps up to a high temperature, not exceeding the maximum temperature rating of the column in use, and holds there to allow all heavier compounds to elute, in order to prevent carryover to the next injection. The settings and system parameters are as follows.

Instrument Control Parameters – GC21	
Sample Inlet	GC
Injection Source	Manual
Run Time	12 minutes
Injector	
Mode	Packed
Temperature	150˚C
Pressure	18psi at 100˚C oven temperature
Isothermal Oven	
Initial Temperature	100˚C
Initial Time	12 minutes
Column	
Model Number	RTx-1
Nominal Length	60m
Nominal Diameter	0.53mm ID
Film Thickness	5µm
ECD	
N2	50mL/min
Temperature	280˚C

12.3 Continuing Calibration

A continuing calibration check shall be performed at the beginning, after every 10 samples and at the end of an analytical sequence, or every twenty field samples, not to exceed a 24-hour period. The concentration of the calibration verification may be varied within the established calibration range.

12.4 Method Blank

The method blank shall be obtained using ultra high purity nitrogen directly injected in the same manner as the standards and samples. A method blank must be analyzed prior to analysis of samples. A method blank must also be analyzed if carryover contamination is suspected.

12.5 Laboratory Control Sample

The laboratory control sample shall be an injection of the continuing calibration or initial calibration verification standard. Make sure that all of the pertinent information is included on the quantitation report including the sample identification (LCS), concentration, standard used, and analyst.

12.6 Analysis

12.6.1 Canister and Glass Bottle Pressurization Sample analysis must be made using the same instrument parameters as that of the calibration standards. Refer to the *SOP for Evaluation and Pressurization of Specially Prepared Stainless Steel Canisters* for the procedure of how canisters and glass bottles are to be pressurized prior to analysis. The analyst shall record the appropriate pressures on the Service Request form. This includes noting any anomalies for which the appropriate corrective actions have been detailed and must be followed accordingly.

12.6.2 Sample Analysis Sample analysis shall be performed by a direct injection technique using gas tight syringes. Insert the syringe through the Tedlar bag septum or summa can fit with an adapter. When using adapters and fittings the dead volume must be evacuated and replaced with the sample gas prior to

sampling from the container. The sampling syringe shall then be flushed with the sample gas to remove residual ambient air and vented into a waste bag. This procedure entails drawing an aliquot greater than is needed, and adjusting the syringe plunger to the appropriate volume *immediately* before injecting.

Note: The maximum allowed injection volume is 500uL

Bottle Vacs use a proprietary quick connect fitting (Micro-QT, Entech Instruments). Each female Micro-QT fitting must be purged after use to remove any remaining sample residue and prevent contamination from subsequent usage. Connect a male Micro-QT fitting to a source of ultrapure or carbon-filtered gas. Adjust the pressure to about 10 psig using an inline regulator. Connect the female fitting for several seconds, then remove and place in an oven kept at 60ºC until the next use. Do not heat the fittings higher than 80ºC.

12.6.3 Sample Dilution If any target analyte results are above the highest level of the initial calibration, a smaller sample aliquot or a dilution in a Tedlar bag must be analyzed. Guidance in performing dilutions and exceptions to this requirement are given below.

- Use results of the original analysis to determine the approximate dilution factor required getting the largest analyte peak within the initial calibration range.
- The dilution factor chosen should keep the response of the analyte peak for a reported target compound in the upper half of the initial calibration range of the instrument. Additional compounds may be reported as long as they are within the calibration range.
- Analysis involving dilution should be made with high purity nitrogen and must be reported with a dilution factor.

Tedlar bag dilution:

- Calculate the sample amount and volume of balance gas needed to obtain the required dilution.
- Fill a new 1.0L Tedlar bag with nitrogen using the appropriate gas tight syringe.
- Remove the difference in the balance gas using the appropriate gas tight syringe.
- Add the calculated sample amount using a gas tight syringe.

12.7 Laboratory Duplicate

Analyze two separate aliquots from the same sample container. A laboratory duplicate must be analyzed a frequency of 1 in 20 field samples. The laboratory duplicate should be rotated among clients, whenever possible

12.8 Manual Integration

The integration(s) for each sample is checked to ensure that it has been integrated properly. Assuming an incorrect automatic integration the analyst shall conduct the manual integration in accordance with the *SOP for Manual Integration Policy* including all documentation and reviews associated with the process. The review should include the analyst and peer reviewer initialing and dating the manual integration as an indication of acceptability and approval.

12.9 Method Detection and Quantitation Limits

The MDL must be performed in accordance with the procedure outlined in the *SOP for the Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation.* Method detection limits must be determined annually and whenever

there is a change in the test method that affects how the test is performed, or when a change in instrumentation is such that it affects the sensitivity of the analysis. The MDL study shall be performed on each instrument for which this method is performed. All supporting data must be approved and retained.

12.10 Cleaning Tedlar Bags

Fill with nitrogen and evacuate several times. In the final cleaning step partially fill the bags with nitrogen and evacuate using a pump.

13) Troubleshooting

13.1 Prepare new standards, check instrument maintenance, prepare a new curve as needed, etc. Refer to the corrective actions listed in Section 16 of this SOP for additional troubleshooting details.

14) Data Acquisition

14.1 Storing Electronic Data

The initial calibration data must be stored in a quantitation method (on the server) using a unique filename and may not be overwritten at any time in order to maintain an accurate audit trail. Files should be named with a character notation indicating the compound list and the date of the corresponding initial calibration. In addition, all data files including method blanks, continuing calibration verification, laboratory control samples and client submitted samples files shall be saved in a unique sub-directory on the server. An example of how the analyst should store analytical data is as follows:

Instrument Number/Data/Method ID/yr_month/.d*

The initial calibration curve may be saved with an identification such as CARB followed by the date of the analysis (mm,yy). This file should be saved in the following directory: J:\"instrument ID"\Method\. No curve may be overwritten at any time to ensure a complete audit trail.

14.2 Sufficient raw data records must be retained of the analysis, instrument calibrations and method detection limit studies including: analysis/calibration date and time, test method, instrument, sample identification, each analyte name, analyst's initials, concentration and response, and standards used for the analysis and calibrations, any manual calculations including sample dilutions and manual integrations. Information entered and reported on the quantitation report and instrument run log must be complete and accurate.

14.3 The essential information to be associated with analysis, such as computer data files, run logs, etc. shall include: Sample ID code, date of analysis, time of analysis, instrument operating conditions/parameters (or reference to such data), analysis type, any manual calculations including dilutions and manual integrations, analyst's initials, sample preparation (pressure readings), standard and reagent origin, sample receipt, calibration criteria, frequency and acceptance criteria, data and statistical calculations, review, confirmation, interpretation, and assessment and reporting conventions.

15) Calculation and Data Reduction Requirements

15.1 Initial Calibration

- Tabulate the linear relationship using Equation 1

15.2 Initial Calibration Verification

- Calculate the concentration for each analyte using equation number 1.
- Calculate the percent difference (%D) between the calculated concentration (equation number 1) and the actual concentration using equation number 2.

15.3 Continuing Calibration Verification

- Calculate the concentration of each analyte using equation number 1.
- Calculate the percent difference (%D) between the calculated concentration (equation number 1) and the actual concentration using equation number 2.

15.4 Laboratory Control Sample

- Calculate the concentration of each analyte using equation number 1.
- Calculate the percent recovery (%R) for each analyte using equation number 4.

15.5 Sample Analysis

- Calculate the concentration of each analyte using equation number 1.
- Calculate the dilution factor if necessary using equation number 5.

15.6 Laboratory Duplicate

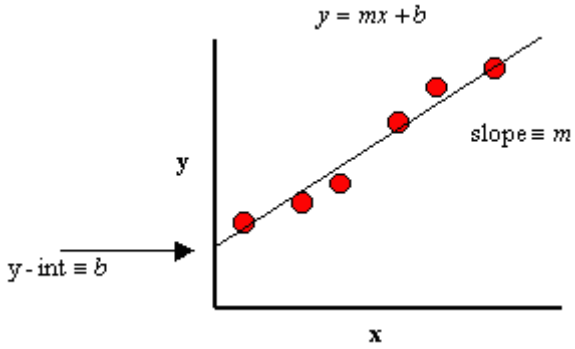
- Calculate the concentration of each analyte using equation number 1.
- Calculate the relative percent difference (RPD) using equation number 3.

15.7 Calculations

15.7.1 Equation Number 1

Linear Relationship

Say we have a set of data, (x_i, y_i), shown at the left. If we have reason to believe that there exists a **linear relationship** between the variables **x** and **y**, we can plot the data and draw a "best-fit" *straight line* through the data. Of course, this relationship is governed by the familiar equation $y = mx + b$. We can then find the **slope, *m*,** and **y-intercept, *b*,** for the data, which are shown in the figure below.



Linear Regression Equations

If we expect a set of data to have a linear correlation, **it is not necessary for us to plot the data** in order to determine the constants *m* (slope) and *b* (y-

intercept) of the equation $y = mx + b$. Instead, we can apply a statistical treatment known as **linear regression** to the data and determine these constants.

Given a set of data (x_i, y_i) with *n* data points, the slope, y-intercept and correlation coefficient, *r*, can be determined using the following: (Note that the limits of the summation, which are *i* to *n*, and the summation indices on *x* and *y* have been omitted.)

$$m = \frac{n\sum(xy) - \sum x \sum y}{n\sum(x^2) - (\sum x)^2}$$

$$b = \frac{\sum y - m\sum x}{n}$$

$$r = \frac{n\sum(xy) - \sum x \sum y}{\sqrt{\left[n\sum(x^2) - (\sum x)^2\right]\left[n\sum(y^2) - (\sum y)^2\right]}}$$

Casio fx-300W Calculation Instruction for Linear Regression:

The regression formula for linear regression is: y = A+Bx
Enter REG Mode (Linear Regression)
Hit Mode, 3 Reg, 1 Lin shift Scl = (memory clear)
Enter data points - concentration vs absorbance: [ex: 0,0 'M+', 0.1, 0.099 'M+', 0.2, 0.198 'M+' & 0.4, 0.402 'M+']
For correlation coefficient – hit 'Shift' then 'r' then '=' 0.999965116
For unknown concentrations enter absorbance (ex: 0.175 from spectrophotometer) - hit shift '+' key = 0.17524865

15.7.2 Equation Number 2

Percent Difference, %D,

The %D is used for evaluating ICV and CCV vs. the initial calibration

$$\%D = \frac{C_{CCVorICV} - C_{std}}{C_{std}}(100)$$

where, for any given analyte:

$C_{CCVorICV}$	is the concentration being evaluated
C_{std}	is the concentration from the current calibration curve

15.7.3 Equation Number 3

Relative Percent Difference (RPD)

$$\frac{|R_1 - R_2|}{\left(\frac{R_1 + R_2}{2}\right)} x100$$

where:

R_1 First measurement value
R_2 Second measurement value

15.7.4 Equation Number 4

Percent Recovery (%R):

$$\%R = \frac{C}{S} x100$$

Where:

C = Concentration of the analyte recovered
S = Spiked amount

15.7.5 Equation Number 5

Dilution Factor

$$DF = \frac{V_T}{V_S}$$

Where:

DF = dilution factor
V_S = volume of sample (mL) used
V_T = total volume of dilution (mL)

15.7.6 Equation Number 6

Results

In order to obtain the final reported value, the result must be adjusted with the canister dilution factor, any sample dilution and injection volume and converted to ug/m^3.

Example:

- R = Result = 22.079ppb (on column)
- DF = Dilution Factor = 1.58 (canister dilution factor)
- IV_N = Normal Injection Volume = 0.5mL (see method blank injection volume)
- IV_A = Actual Injection Volume = 0.1mL
- AD = Additional Dilution = 1000

$$ppbV = \frac{R * DF * IV_N * AD}{IV_A} = \frac{22.079 * 1.58 * 0.5 * 1000}{0.1} = \frac{17442}{0.1} = 174424 =$$

170,000ppbV

- MW is the molecular weight of PCE
- 24.46 is the molar volume of gas at lab conditions (constant)
- All results are reported with two significant figures

$$ug/m^3 = \frac{ppbV * MW}{24.46} = \frac{174424 * 165.8}{24.46} = 1{,}182{,}318 = 1{,}200{,}000 ug/m^3$$

15.8 Data Review

The analyst must review data on a real time basis for all calibration and QC data. The QC data must be evaluated following the data review checklist in Attachment 3. The data shall be reviewed and the sample results calculated and assessed by one analyst and reviewed by a second qualified analyst. The data review checklist shall be used to document the review process. Once it has been completed, the checklist must be initialed, dated and filed with each job file.

Initial calibrations must be reviewed in the same manner as QC data with all ICAL documentation retained in a separate file. Refer to the initial calibration checklist in Attachment 2 for the review guideline. The ICAL file must contain all the pertinent information stated in Section 11.1.3.

15.9 Reporting

The results of each test shall be reported clearly, unambiguously and objectively, and shall include all the information necessary for the interpretation of the test results. The analyst shall ensure that all of the requirements specified in this document and the *SOP for Data Review and Reporting* are followed.

15.10 Sample Preparation and Analysis Observations / Case Narrative Summary Form

The case narrative summary form, which is included in the *SOP for Laboratory Storage, Analysis, and Tracking*, must be generated when there are any specific sample composition information, sample preparation, analysis issues and/or observations. In addition, during the analysis, specific identification information or problems, interferences, calibration issues, flags, and additional/expanded explanation of flags should be added to the form. This form may be modified as long as the sections and basic concepts are reserved.

This form is necessary for documentation purposes and shall be reviewed when compiling the final report and case narrative. All information regarding the job shall remain in the file, in order that sufficient documentation is available to recreate the job from sample receipt through preparation, analysis, data reduction, and reporting.

16) Quality Control, Acceptance Criteria, and Corrective Action

16.1 This section contains technical acceptance criteria. To the extent possible, samples shall be reported only if all of the quality control measures are acceptable.

16.2 It must be determined if there are any instrumentation problems contributing to the occurrence of any out-of-control data. If it is decided that problems do exist, then the analyst must determine if the effects have caused any modification in the data from

client submitted samples. This being the case, all samples (including QC) that are affected by instrumentation problems must be re-analyzed following any necessary maintenance activity. All corrective actions shall follow the procedures outlined in the *SOP for Nonconformance and Corrective Action*, where appropriate.

16.3 Initial Calibration

16.3.1 Acceptance Criteria

- The correlation coefficient must be at least 0.98 from the least squares fit for the calibration to be considered acceptable.
- The retention time of each analyte at each calibration level must be within 0.1 minute of the midpoint standard in the calibration curve.

16.3.2 Corrective Action Inspect the system for possible sources. It may be necessary to change the column or take other corrective actions. Also, check standards for a bad injection and re-analyze standard. If a bad injection is not evident, perform maintenance and attempt another initial calibration (make notation in maintenance logbook regarding any steps taken). A demonstration of an in-control system is required before proceeding with the analysis.

Note: No ICAL may be interrupted by any maintenance procedure. Therefore, all standards incorporated in a curve must be reanalyzed.

16.4 Initial Calibration Verification Standard (ICV)

16.4.1 Acceptance Criteria

- The percent difference (%D) for each calculated target analyte must be within ±30% of the actual concentration of the standard.
- The retention time of each target analyte must be within 0.1 minute of the midpoint standard in the calibration curve.

16.4.2 Corrective Action The initial calibration verification should be re-analyzed. A second failed ICV must initiate corrective action and two consecutive ICVs must pass in order for the ICAL to be deemed acceptable. It may be necessary to prepare either new ICAL or ICV standards or both, perform maintenance and reanalyze the initial calibration.

16.5 Continuing Calibration Verification (CCV)

16.5.1 Acceptance Criteria

- The percent difference (%D) for each calculated target analyte must be within ±30% of the actual concentration.

16.5.2 Corrective Action If the criteria are not met, reanalyze (no more than two injections may be made before corrective action is initiated) or prepare a fresh CCV standard and reanalyze. If routine corrective action procedures fail to produce an acceptable calibration verification, a new initial calibration must be performed. However, sample data associated with an unacceptable calibration verification may be reported as qualified data only under the following special condition:

When the acceptance criteria for the continuing calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise the sample affected by the unacceptable CCV shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

16.6 Method Blank

16.6.1 Acceptance Criteria

- The method blank result for any target analyte must not be greater than the method reporting limit or contribute more than 10% of the sample concentration.

16.6.2 Corrective Action The source of the problem must be investigated and measures taken to eliminate the cause. Determine whether the contamination is from the instrument or due to contamination in the nitrogen, syringe or other source. Regardless, appropriate corrective measures must be taken and documented before further sample analysis proceeds. If the results are the same, the blank along with all associated samples must be reported to the client with the appropriate qualifier.

16.7 Laboratory Control Sample (LCS)

16.7.1 Acceptance Criteria

- The percent recovery for all compounds must be within 70% and 130%.

16.7.2 Corrective Action Determine whether the cause is instrumentation or the result of a poor injection. If the problem is instrumentation, perform maintenance and reanalyze the associated sample(s). If the problem is with the injection, reanalyze the LCS. If the results are still unacceptable and there does not appear to be any instrumentation problems refer to the appropriate reporting information.

16.8 Sample Analysis

16.8.1 Acceptance Criteria

- Sample results must be quantitated from the current instrument initial calibration and may not be quantitated from any continuing calibration verification standard.
- The field samples must be analyzed along with a laboratory method blank that has met the method blank criteria.
- All target analyte peaks must be within the initial calibration range.
- The retention time of each target analyte must be within 0.1 minute of the CCV.

16.8.2 Corrective Action To the extent possible, samples shall be reported only if all of the quality control measures are acceptable. If a quality control measure is found to be out-of-control, and the data must be reported, all samples associated with the out-of-control quality control measures shall be reported with the appropriate data qualifier(s).

- When corrective actions are made, samples analyzed while the system was not functioning properly must be reanalyzed.
- Results not bracketed by initial instrument calibration standards (within calibration range) must be reported as having less certainty, e.g., defined qualifiers or flags.

16.9 Laboratory Duplicate

16.9.1 Acceptance Criteria

- The selected samples must be rotated among client samples so that various matrix problems may be noted and/or addressed.

- The results must meet all of the criteria for sample analysis as well as be <15% relative percent difference for all analytes of interest, provided that the concentration is greater than 10x the RL.

16.9.2 Corrective Action The sample(s) should be re-analyzed whenever the duplicate results are outside the technical acceptance window. If the results are still unacceptable and there does not appear to be any matrix effects, interfering peaks, or instrument problems, the results for both injections shall be reported to the client with the appropriate qualifier.

16.10 Samples Holding Time Expired The client is to be notified (best attempt) that the sample's holding time was missed and the client is to decide if the sample analysis shall continue. The documentation of missed holding time and the client's decision to proceed must be included in the corresponding job file. A statement dictating all holding time occurrences must accompany the sample results in the final report.

17) Data Records Management

17.1 All data resubmittal forms and job documentation including Service Requests, Chain of Custody forms, Sample Acceptance Check forms and hardcopy electronic mail messages must be filed in the project file. Final reports, revised reports, and final invoices are stored electronically.

17.2 All laboratory and client documentation must be retained for a minimum of five years.

18) Contingencies for Handling Out of Control Data

18.1 If a quality control measure if found to be out-of-control and the data must be reported, all samples associated with the out-of-control quality control measure shall be reported with the appropriate data qualifier(s).

18.2 Analysis quality control results (CCV, MB, LD, and LCS recoveries) out-of-control

If the associated samples are within holding time, re-analyze the sample. Alternatively, evaluate the effect on the sample results and report the results with qualifiers and/or discuss in the case narrative as detailed below.

18.2.1 CCV The LCS should be in control in order for any results to be reported with an out-of-control CCV (biased high). Refer to Section 16.5.

18.2.2 Method Blank If an analyte in the blank is found to be out-of-control and the analyte is also found in associated samples, those sample results shall be "flagged" in the report. If the analyte is found in the blank but not in the sample and all other quality control meets acceptance criteria then the results for the sample may be reported without a qualifier. However, if other QC is out-of-control then an evaluation must be made and the results reported accordingly.

18.2.3 Laboratory Control Sample If the samples are analyzed with an out-of-control LCS, then all reported analytical results must be "flagged" with the appropriate data qualifier and/or discussed in the case narrative.

18.2.4 Laboratory Duplicate The appropriate data qualifier must be included for results associated with an out-of-control laboratory duplicate and/or discussed in the case narrative.

18.3 Sample quality control results out-of-control

Examine the sample results for matrix interference and for carryover. Reanalyze the sample(s) and/or reanalyze the sample(s) at a lower aliquot. If the out-of-control

results are due to matrix interference, report the results with a matrix interference qualifier.

Holding time qualifiers must be reported on samples not analyzed within holding time.

19) Method Performance

19.1 An on-going assessment of method performance is conducted in order to ensure that the laboratory is capable of reporting results which are acceptable for its intended use. Validation of the method is confirmed by the examination and provision of objective evidence that these requirements are met.

20) Summary of Changes

Table 20.1

Revision Number	Effective Date	Document Editor	Description of Changes
05.0	04/25/15	C. Humphrey	Section 1.1 – Removed 1,1,1-trichloroethane
			Section 2.1 – Added glass bottles
			Section 4 – Revised
			Section 8.1 – Added glass bottles
			Section 10.3 – Removed 1,1,1-trichloroethane
			Section 12.6.1 – Revised; added glass bottles
			Table 1 – Removed 1,1,1-trichloroethane; updated MDL values

21) References and Related Documents

21.1 State of California Air Resources Board, Method 422 "Determination of Volatile Organic Compounds in Emissions from Stationary Sources", Amended December 13, 1991.

21.2 *SOP for Making Entries onto Analytical Records*, SOP ID CE-QA007

21.3 *SOP for Data Review and Reporting*, SOP ID ADM-DATA_REV

21.4 *SOP for Nonconformance and Corrective Action*, SOP ID CE-QA008

21.5 *SOP for Handling Consumable Materials,* SOP ID ADM-CONSUM

21.6 *SOP for Training Policy,* SOP ID CE-QA007

21.7 *SOP for Laboratory Storage, Analysis, and Tracking,* SOP ID ADM-LabSAT

21.8 *SOP for Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation,* SOP ID CE-QA011

21.9 *SOP for Manual Integration Policy,* SOP ID CE-QA002

21.10 *SOP for Evaluation & Pressurization of specially Prepared Stainless Steel Canisters,* SOP ID SMO-Can_Press

22) Appendix

22.1 Tables

Table 1 – Target Analytes with Corresponding Method Detection and Reporting Limits

22.2 Attachments

Attachment 1 – Training Plan

Attachment 2 – Initial Calibration Checklist

Attachment 3 – Data Review Checklist

TABLE 1

CARB Method 422 (Modified) Target Analytes with Method Reporting Limits

Analyte	MDL (ppb)	MRL (ppb)
Chloroform	0.095	1.0
Trichloroethene	0.042	1.0
Tetrachloroethene	0.061	0.20
1,2-Dibromoethane	0.18	0.50

Note: These values may change with each new MDL study performed. Additional compounds must have a complete MDL study and the MRL must be at or higher than the low standard of the initial calibration.

Attachment 1

Training Plan

Training Plan for Analysis of Various Halogenated Compounds by GC/ECD

Trainee _____ Trainer _____ Completion Date _____ Instrument ____

1. Read SOP — Trainer ____ Trainee ____ Date _____
2. Read Method: CARB 422 — Trainer ____ Trainee ____ Date _____
3. Demonstrated understanding of the scientific basis of the analysis
   Gas chromatography Electron Capture Detector — Trainer ____ Trainee ____ Date _____
4. Demonstrated familiarity with related SOPs — Trainer ____ Trainee ____ Date _____
   SOP for Batches and Sequences; Rev.___
   SOP for Making Entries onto Analytical Records; Rev.___
   SOP for Manual Integration Policy; Rev.___
   SOP for Significant Figures; Rev.___
   SOP for Nonconformance and Corrective Action; Rev.___
   SOP for Performing MDL Studies and Establishing Limits of Detection & Quantitation; Rev.___
5. Observe performance of SOP — Trainer ____ Trainee ____ Date _____
   ___standard preparation (gas-phase dilutions)
   ___sample preparation
   ___analytical sequence setup
   ___initial calibration and initial calibration verification
   ___continuing calibration verification
   ___sample analysis
   ___EnviroQuant introduction
   ___data reduction and reporting
6. Perform SOP with supervision — Trainer ____ Trainee ____ Date _____
   ___standard preparation (gas-phase dilutions)
   ___sample preparation
   ___analytical sequence setup
   ___initial calibration and initial calibration verification
   ___continuing calibration verification
   ___sample analysis
   ___EnviroQuant use
   ___data reduction and reporting
7. Independent performance of the SOP — Trainer ____ Trainee ____ Date _____
   ___standard preparation (gas-phase dilutions)
   ___sample preparation
   ___analytical sequence setup
   ___initial calibration and initial calibration verification
   ___continuing calibration verification
   ___sample analysis
   ___EnviroQuant proficiency
   ___data reduction and reporting
   ___initial demonstration of competency
   ___ four consecutive laboratory control samples
8. Instrument operation and maintenance — Trainer ____ Trainee ____ Date _____
   ___GC and capillary column installation
   ___ECD setup and maintenance
   ___data system

Attachment 2
Initial Calibration Checklist

Initial Calibration Checklist
Analysis of Various Halogenated Compounds by Modified CARB 422

ICAL Date: _____

Instrument: ☐ GC21 ☐ _____

Analyst			Reviewer
☐	1.	Is the required documentation in the ICAL file?	☐
		☐ Sequence report	☐
		☐ Blank analysis Quantitation Report	☐
		☐ Calibration Status Report (aka Calibration History) - Initial	☐
		☐ Coefficient of Determination	☐
		☐ Quantitation Report for each calibration standard (including manual integration documentation – before and after printouts)	☐
		☐ ICV Quant Report and Evaluate Continuing Calibration Report (aka Percent Diff. report)	☐
☐	2.	ICAL performed continuously (i.e., not interrupted for maintenance or sample analysis)?	☐
☐	3.	ICAL performed within 48 hours?	☐
☐	4.	Standards analyzed from low concentration to high concentration?	☐
☐	5.	All analytes in blank analysis <MRL?	☐
☐	6.	Does each analyte's ICAL include a minimum of 5 concentrations?	☐
☐	7.	For each analyte, is there only one value used for each calibration level?	☐
☐	8.	If a point is dropped, is information noted in the ICAL explaining the reason?	☐
☐	9.	Does this follow the point dropping policy (including re-analysis within 48 hrs)?	☐
☐	10.	For each analyte, is the lowest standard's concentration at or below the MRL?	☐
☐	11.	For each analyte, does the ICAL include 5 consecutive levels?	☐
☐	12.	For each analyte, are there no levels skipped?	☐
☐	13.	Does the calibration curve give a correlation coefficient ≥0.98?	☐
☐	14.	For the ICV analysis, is the percent recovery for each analyte 70-130%?	☐
☐	15.	Are all peak integrations including manual integrations (per *SOP for Manual Integration Policy*) acceptable? ***If so, initial and date the appropriate pages***	☐

COMMENTS:

_____

_____

_____

Reviewed By _____ Secondary Reviewer _____

Date _____ Date _____

Attachment 3

Data Review Checklist

Data Review Checklist
Modified CARB 422

(Note exceptions in Comments section and attach Sample Preparation and Analysis Observations / Case Narrative Summary as applicable)

Analysis Date_____ Client _____ QC Level _____

Project # _____ Due Date _____ Instrument ☐ GC21 ☐ _____

Analyst **Reviewer**

Initial Calibration

☐ 1. Is the referenced ICAL the most recent ICAL performed? ☐

☐ 2. Has the referenced ICAL been peer reviewed and all associated documentation including the ICAL review checklist available for review? ☐

☐ 3. Were all associated requirements within the specified limits? ☐

Continuing Calibration

☐ 4. CCV raw data submitted? ☐

☐ 5. Was the %D for the CCV ±30% (first or second injection)? ☐

☐ 6. CCV analyzed at the beginning of the sequence, every 10 samples, and the end of the sequence? ☐

Sample Data

☐ 7. Is all sample data present and correct? ☐

- ☐ Sample raw data?
- ☐ Target analyte responses within calibration range?
- ☐ Peak integrations acceptable?
- ☐ All manual integrations flagged and properly documented? If so, initial and date.
- ☐ Any essential retention time shifts?
- ☐ All calculations correct?
- ☐ First quantitation report initialed and dated by analyst?

QC Data

☐ 8. Duplicate sample analyzed 1 per 20 or fewer samples? ☐

☐ 9. Is the laboratory duplicate within 15% of their average? ☐

☐ 10. Is the LCS/LCSD within ±15% of their average (where applicable)? ☐

☐ 11. Is the recovery for the LCS and/or LCSD within 70-130%? ☐

☐ 12. Are all analytes in the MB < MRL? ☐

Reporting Information

☐ 13. Sample Preparation and Analysis Observations / Case Narrative Summary completed if applicable? ☐

☐ 14. Appropriate flags indicated on a Sample Preparation and Analysis Observations / Case Narrative Summary form when applicable? ☐

☐ 15. Reporting spreadsheet complete and all flags correctly indicated? ☐

COMMENTS: _____

_____

_____

Reviewed By _____ Secondary Reviewer _____

Date _____ Date _____

ALS Standard Operating Procedure

DOCUMENT TITLE:	DETERMINATION OF HYDROGEN, CARBON MONOXIDE, CARBON DIOXIDE, NITROGEN, METHANE, AND OXYGEN USING GAS CHROMATOGRAPHY WITH THERMAL CONDUCTIVITY DETECTION (TCD) IN ACCORDANCE WITH EPA METHOD 3C OR ASTM D 1946
REFERENCED METHOD:	EPA METHOD 3C, ASTM D 1946
SOP ID:	VOA-EPA3C
REV. NUMBER:	13.0
EFFECTIVE DATE:	12/31/2015

Proprietary - Uncontrolled Copy

ALS Environmental

STANDARD OPERATING PROCEDURE

DETERMINATION OF HYDROGEN, CARBON MONOXIDE, CARBON DIOXIDE, NITROGEN, METHANE, AND OXYGEN USING GAS CHROMATOGRAPHY WITH THERMAL CONDUCTIVITY DETECTION (TCD) IN ACCORDANCE WITH EPA METHOD 3C OR ASTM D 1946

EPA METHOD 3C, ASTM D 1946

SOP ID:	VOA-EPA3C	Rev. Number:	13.0	Effective Date:	12/31/2015

Approved By: _____ Date: 12/15/15
Department Supervisor - Wade Henton

Approved By: _____ Date: 12/15/15
QA Manager - Charley Humphrey

Approved By: _____ Date: 12/15/15
Laboratory Director - Kelly Horiuchi

Archival Date: _____ Doc Control ID#: Non-Controlled Editor: _____

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DETERMINATION OF HYDROGEN, CARBON MONOXIDE, CARBON DIOXIDE, NITROGEN, METHANE, AND OXYGEN USING GAS CHROMATOGRAPHY WITH THERMAL CONDUCTIVITY DETECTION (TCD) IN ACCORDANCE WITH EPA METHOD 3C OR ASTM D 1946

1) Scope and Applicability

1.1 The referenced method (EPA Method 3C) was written for the analysis of carbon dioxide, methane, nitrogen and oxygen, in municipal solid-waste landfill gas and other stationary sources but is easily modified for the gas chromatographic method determination of hydrogen and carbon monoxide. In contrast, the practice ASTM D 1946 covers the determination of the chemical composition of reformed gases and similar gaseous mixtures containing each of these six components. Method ASTM D 1945-03 modified which describes the analysis of natural gas may also be referenced.

1.2 This method is appropriate for quantifying target analyte gases depending on the concentration of the samples from approximately 500 ppmv to high percent values. The number of samples, which may be analyzed in one eight hour day, is approximately twenty. The reporting limits for these analytes are listed in Attachment 4 of this standard operating procedure.

2) Summary of Procedure

2.1 The EPA Method 3C was written for use with backfilled summa canisters but is easily modified for samples collected as vapor in Tedlar bags, steel tanks, glass bottles, summa or other specially prepared canisters. In contrast, the ASTM methods do not specify a requirement for the sampling container.

2.2 An aliquot is drawn from the sampling container using a sample loop and injected onto a packed chromatographic column where the analytes are separated and measured using a thermal conductivity detector (TCD). Samples are analyzed in duplicate for EPA Method 3C, but a modification may be made which entails a single injection per submitted field sample. However, results from samples analyzed per ASTM D 1946 are obtained using a single injection technique.

Note: Refer to Sections 12.13 and 15.9 for the list of reporting modifications for these methods.

3) Definitions

3.1 Analytical Sequence The analytical sequence describes exactly how the field and QC samples in an analytical batch are to be analyzed.

3.2 Field Sample A sample collected and delivered to the laboratory for analysis.

3.3 Batch QC The QC samples that are analyzed in an analytical batch of field samples and includes the Method Blank (MB), Laboratory Control Sample (LCS) or Laboratory Duplicate (LD).

3.4 Calibration Standard (Initial Calibration – ICAL) A calibration standard of a known concentration containing desired analyte(s) prepared from a primary standard, which is, in turn, prepared from a stock standard material. A calibration standard is injected at varying volumes and used to calibrate the response of the measurement system with respect to analyte concentration.

3.5 Initial Calibration Verification (ICV) Standard An ICV is a standard that is obtained from a source other than the source for the calibration standards and is analyzed after the

measurement system is calibrated, but prior to sample analysis in order to verify the initial calibration of the measurement system.

3.6 Method Blank (MB) An analyte-free matrix, which is carried through the entire analytical process. It is used to evaluate the process for contamination from the laboratory.

3.7 Laboratory Control Sample (LCS) An LCS is a standard that is obtained from a source other than the source for the continuing calibration verification standard (CCV). The percent recovery of the analyte(s) in the LCS is used to assess method performance.

3.8 External Standard Calibration External standard calibration involves comparison of instrument responses from the sample to the responses from the target compounds in the calibration standards. Sample peak areas or peak heights are compared to peak areas or peak heights of the standards.

3.9 Analytical Batch A group of samples which behave similarly with respect to the sampling or the test procedures being employed and are processed as a unit using the sample lots of reagents and with the manipulations common to each sample within the same time period or in continuous sequential time periods. In an analytical batch of samples, the time period is 24 hours or up to twenty sample injections, whichever comes first of continuous operation without interruption.

3.10 Continuing Calibration Verification (CCV) Standard A continuing calibration verification standard is a midrange calibration standard that is analyzed periodically to verify the continuing calibration of the measurement system.

3.11 Precision Precision of a method is how close results are to one another, and is usually expressed by measures such as standard deviation, which describe the spread of results.

3.12 Bias The bias of a method is an expression of how close the mean of a set of results (produced by the method) is to the true value.

3.13 Manual Integration This term applies to a data file in which setpoints have been changed and reintegration has occurred under the changed setpoints; baselines have been adjusted; peak integration start and stop “ticks” have been changed; peak area, or peak height, are changed after the time of data collection and data file generation.

3.14 Ambient Air Ambient air within the laboratory which is sampled and analyzed once per batch to assess injector performance.

3.15 Limit of Detection (LOD) The smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate (Type II error) is 1%. (DoD Clarification). For consistency purposes, the LOD may be referred to as the MDL once it is reported; however, full verification will be on file in the laboratory per the procedures detailed in this document.

3.16 Limit of Quantitation (LOQ) The lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard. (DoD Clarification). For consistency purposes and since the LOQ and MRL are equivalent with regards to laboratory procedure, the LOQ will be referred to as the MRL in this document and once it is reported. Full verification will be on file in the laboratory per the procedures detailed in the document.

3.17 Detection Limit (DL) / Method Detection Limit (MDL) The smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate (Type 1 error) is 1%. (DoD Clarification). For consistency purposes, the DL may be referred to as MDL. Also, as far as reporting is concerned the MDL will be raised (where necessary) to the verified LOD per the procedures defined in this document and reported accordingly.

4) Health and Safety Warnings

4.1 Each compound, mixture of compounds, standards, as well as samples, should be treated as a potential health hazard. Exposure to these chemicals should be reduced to the lowest level possible through the use of hoods (to minimize inhalation). For proper handling, use, and disposal refer to the laboratory's *Environmental Health and Safety Manual*, Safety Data Sheets (located in the safety cubicle in the front office), as well as the *SOP for Waste Disposal*.

4.2 Safety Data Sheets (SDS) Safety Data Sheets (SDS) are available in the Safety cubicle located in the front office and shall be reviewed as part of employee training.

4.3 Safety Glasses Safety glasses are required when performing maintenance on pressurized systems.

4.4 Pressurized Gases The use of pressurized gases is required for this procedure. Care should be taken when moving cylinders. All gas cylinders must be secured to a wall or an immovable counter with a chain or a cylinder clamp at all times. The regulator should not remain on size "D" cylinders when not in use. Sources of flammable gases (i.e. pressurized hydrogen) should be clearly labeled.

4.5 Pollution Prevention and Waste Management All waste management must be carried out in accordance with the requirements detailed in the *SOP for Waste Disposal* as well as the *Environmental Health and Safety Manual*.

5) Cautions

5.1 A maintenance log shall be kept documenting maintenance performed on each analytical system and the instrument maintenance log must be kept current and reviewed quarterly. The serial numbers of each instrument shall be recorded in the front of the logbook. An entry must be made in the appropriate log each time any maintenance activity is performed (no matter the extent). The entry in the log must include:

(a) The date of maintenance
(b) Who did the maintenance
(c) Description of the maintenance
(d) Proof that the maintenance activity was successful

A notation of a successful continuing calibration or initial calibration shall serve as proof that the maintenance is complete and the instrument is in working order.

5.2 Carrier Gas Purifier If in-line purifiers or scrubbers are in place, these purifiers must be changed as recommended by the supplier.

5.3 GC System

5.3.1 Column Column performance should be monitored by observing peak shapes and column bleed. Over time, the column may exhibit a poor overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur depends on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be changed or the packing replaced (see Section 9.1.1). Care should be taken to minimize the introduction of air or oxygen into the column whenever GC maintenance is performed.

Decreasing performance can also be due to a leak in the system. Leaks can be detected with the use of a leak detector. Fittings may need to be tightened or ineffective column ferrules replaced to eliminate any leak detected.

5.3.2 Detector Replace filament assembly as needed.

5.3.3 Injection Lines Purge with nitrogen to ensure the line is not blocked.

6) Interferences

6.1 Contamination Dry ambient air at sea level contains 78.08% Nitrogen, 20.95% Oxygen, 0.93% Argon, and approximately 0.033% Carbon Dioxide by volume. Precautions must be taken to prevent intrusion of ambient air into the analytical system and the sampling containers.

6.1.1 Contamination in the Sample Care must be taken to prevent ambient air intrusion into the sample container during canister pressurization and laboratory analysis. When using adapters and fittings the dead volume should be evacuated and replaced with the sample gas prior to sampling from the container.

6.1.2 Carrier Gas Contamination To prevent system contamination, UHP/ZERO grade helium (99.999% purity) is used as the carrier gas. Also, a purifier and an oxygen trap are incorporated into the analytical system as additional insurance against possible contamination.

6.2 Peak Separation Since the TCD exhibits universal responses and detects all gas components except the carrier (helium, in this case), the appropriate temperature program, column flow rates and column packing must be used in order to separate all of the permanent gases with an exception of argon

6.3 Argon In this method, argon (0.93% by volume in ambient air) is not chromatographically separated from oxygen; therefore, results are reported as oxygen/argon.

7) Personnel Qualifications and Responsibilities

7.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review and reporting per the corresponding standard operating procedures. Laboratory personnel that have successfully demonstrated the ability to generate acceptable results according to this SOP are approved to perform sample analysis and interpretation of the results.

7.2 The department supervisor/manager or designee shall perform final review and sign-off on the data.

7.3 Demonstration of Capability

Training demonstrations shall be conducted in accordance with the *SOP for Training Policy,* DoD QSM 5.0, and TNI requirements. An initial demonstration of proficiency must be performed prior to independent analyses of samples. In addition, ongoing demonstration must be performed annually.

Once performance is found to be acceptable, a certification statement must be completed by the QA Manager and either the immediate supervisor or Laboratory Director and retained on file as a demonstration of compliance.

7.3.1 Quarterly Demonstration A demonstration of method sensitivity must be performed *quarterly on each instrument* performing this method.

1) A spike at the current LOD must be analyzed if results are to be reported below the MRL.
2) Verification of precision and bias at the LOQ must be performed.

Refer to Section 12.4 (LOQ) and 12.11.1 (LOD) for additional information on how these demonstrations are to be performed as well as the acceptance criteria.

7.3.2 Annual Demonstration Each analyst must perform this demonstration both initially and annually. Analyze four LCS standards at 1-4x the MRL (LOQ) either concurrently or over a period of days as a verification of precision and bias of the quantitation range. The standard deviation (n-1) and average percent

recovery of the four replicates are compared against current laboratory control limits for precision and bias. See Attachment 4.

7.3.3 Change in Personnel, Instruments, Method and/or Matrix The requirements in Sections 7.3.1 and 7.3.2 must be performed per the schedule noted and when there is a change in personnel, instruments, method or matrix. "Change" refers to any change in personnel, instrument, test method, or sample matrix that potentially affects the precision and bias, sensitivity, or selectivity of the output (e.g., a change in the detector, column type, matrix, or other components of the sample analytical system, or a method revision).

All attempts at this demonstration must be completed and turned into the QA department for retention. Once performance is found to be acceptable, a required certification statement will be completed by the QA Manager and either the immediate supervisor or Laboratory Director and retained on file as a demonstration of compliance.

8) Sample Collection, Handling, and Preservation

8.1 The samples are collected and delivered to the laboratory for analysis in either Tedlar bags, specially prepared canisters, or glass sampling bottles (Bottle Vac. Entech Instruments). Samples collected in bags must be analyzed within 72 hours after sample collection unless otherwise specified by the client. Samples delivered in cleaned, evacuated summa or other specially prepared containers do not have a specified holding time for atmospheric gases but this laboratory recommends that samples be analyzed within 30 days from the date of collection.

9) Equipment and Supplies

9.1 Gas Chromatograph The analysis is performed using a Hewlett-Packard model 5890 series II gas chromatograph or equivalent equipped with a thermal conductivity detector.

9.1.1 Column 6' x 1/8" stainless steel column packed with 60/80-mesh carbosphere.

Conditioning of the chromatographic column is required prior to use of the system. The column should be conditioned with a continuous flow of chromatographic grade Helium and temperature programmed from 35˚C to 200˚C at a rate of five degrees per minute. The column should be held at 200˚C for at least four hours.

9.1.2 Sample Loop Stainless steel tubing with a 1/16" diameter (various lengths).

9.1.3 Conditioning System The system is able to maintain the column and sample loop at a constant temperature.

9.2 Adsorption Tubes In addition to a thermal gas purifier incorporated into the system, an oxygen trap shall be utilized to remove any O2 from the carrier gas to help in extending the life of the TCD filaments.

9.3 Sampling Media Tedlar bags, Summa canisters, or glass bottles may be supplied to the client for sampling purposes. These samples are submitted to the laboratory for analysis. Summa canisters must be conditioned and certified in accordance with the *SOP for Cleaning and Certification of Summa Canisters and Other Specially Prepared Canisters*.

10) Standards and Reagents

10.1 All samples, standards, and media must be stored separately. The concentration, preparation and expiration date as well as analyst's initials must be identified on the standard label. Each standard must also be uniquely identified with a laboratory ID number.

All standard certificates shall be noted with the standard identification number, date received and initials of the receiving analyst. They must then be given to the quality assurance department where they will be maintained. For additional information on these and other requirements, refer to the *SOP for Handling Consumable Materials.*

10.2 Carrier and Calibration Standard Balance Gas

10.2.1 Helium UHP/ZERO (99.999%) or higher in purity

10.3 Standards DoD compliance requires that second source standards be obtained from a second manufacturer. The use of a standard from a second lot is acceptable only when one manufacturer of the standard exists.

10.3.1 Purchased Standards These standards must be stored in accordance with the requirements described in the *SOP for Handling Consumable Materials*. These standards must be stored at ambient temperatures for a period of up to 2 years or as recommended by the manufacturer.

10.3.1.1 Scott Specialty Gas or Equivalent

Compound	Concentration
Carbon dioxide	~5.00%
Carbon monoxide	~5.00%
Hydrogen	~4.00%
Methane	~4.00%
Nitrogen	~5.00%
Oxygen	~5.00%
Balance Gas: Helium	

Note: The concentrations of these standards will change with each purchase and the specific concentration of each compound will be denoted on the standard as well as the Certificate of Analysis and used in all calculations.

10.3.1.2 Matheson or Equivalent

Compound	Concentration
Carbon dioxide	~5.00%
Carbon monoxide	~5.00%
Hydrogen	~4.00%
Methane	~4.00%
Nitrogen	~5.00%
Oxygen	~5.00%
Balance Gas: Helium	

Note: The concentrations of these standards will change with each purchase and the specific concentration of each compound will be denoted on the standard as well as the Certificate of Analysis and used in all calculations.

10.3.1.3 AirGas or equivalent (Neat gas standards)

Compound	Concentration
Hydrogen	99.999%
Oxygen	99.999%
Nitrogen	99.999%
Methane	99.999%
Carbon Dioxide	99.999%

10.3.2 Ambient Air Ambient air is analyzed once per batch to assess injector performance.

11) Method Calibration

11.1 Initial Calibration

Record the detector temperatures, GC temperature program, standard concentrations, and sample loop volume. All of the following information must be retained to permit reconstruction of the initial instrument calibration: calibration date, test method, instrument, analysis date, each analyte name, analyst's initials, concentration and response, response factor. Refer to Section 16.4 for the acceptance criteria.

11.1.1 Analysis Guidelines

- Analyze differing concentrations covering the desired calibration range by utilizing different sample loops. The dynamic range may be amended as long as all documentation reflects the correct concentrations.
- An ICAL shall be performed at a minimum annually.

11.1.2 Initial Calibration Requirements

Once a set of ICAL standards is analyzed, the previous ICAL may no longer be used to analyze new samples and it must be archived. The only time an archived ICAL can be used thereafter is to review or re-evaluate samples(s) previously processed using that ICAL.

1. A minimum of 5 concentrations, must be used to calculate the calibration curve.
2. Highest concentration, together with the lowest concentration, defines the calibration curve.
3. Lowest concentration must be at or below the method reporting limit.
4. The initial calibration event may not be interrupted by maintenance.
5. Only one value per concentration may be used.
6. Analyze calibration standards from low to high concentration.
7. All ICAL analyses must be completed within 48 hours.
8. One injection per 5 points (2 per 6) may be re-analyzed to replace "bad" injection(s).
9. Point dropping policy:
    - The following are guidelines to follow if points are to be reviewed to determine the appropriateness of dropping a point or injection.
    - Lowest concentration must be at the MRL and may not be dropped unless another concentration is added to the upper end of the curve. This would in turn raise the MRL.
    - Points at the high end may be dropped but another concentration must be added and used in the calculation. The curve range must be noted.
    - Points must not be dropped from the "interior" of a curve unless there is an assignable cause* for doing so that affects many (if not all) the analytes in the calibration standard. If a calibration standard

is to be dropped from the interior of the curve, all the analytes in the calibration standard must be dropped from all the analytes' calibration curves.

- If a point or a calibration standard is dropped, the reason must be documented (and the results maintained with the documentation for the final ICAL).
- A calibration standard may be re-analyzed if the first analysis of the standard has been dropped and other requirements in this policy are met (i.e., still within 48 hours).
- Once the ICAL has been used to calculate and report sample results, it is not to be changed.

* Assignable causes include

- Standard preparation error
- Instrument malfunction (e.g., it quits acquiring in the middle of the analysis)
- Bad injection or purge

10. A set of concentrations for a calibration curve is in the following table (Attachment 5). However these concentrations might change due to the availability of the standards. Other concentrations can be used as long as all other guidelines for the analysis of initial calibration are followed.

Note: Hydrogen may not be linear; therefore, if an average response factor or linear regression cannot be used, a quadratic curve fit may be employed. A quadratic (second order) model requires a minimum of five calibration points.

11.1.3 ICAL Update Procedure

1. Open most recent method.
2. Save to new ICAL method ID. The date used in method ID is the date files were analyzed.
3. Clear all responses prior to update initiation and/or clear levels if different concentrations are to be used (Initial Calibration → Clear All Calibration Responses; Initial Calibration → Clear All Calibration Levels).
4. Quantitate standard
5. Review all peaks for retention time, integration, etc.
6. Update responses for standard
7. Repeat for all standards
8. If necessary load midpoint standard and update retention times.
9. Save method.
10. Verify Calibration Files listed on Response Factor Report are correct (Both Primary and Secondary Reviewer).
11. Verify responses of Page 3 of Edit Compounds are correct (Both Primary and Secondary Reviewer).
12. Verify file ID, acquisition time, quant time, update time, and last update information is correct on the Calibration Status Report (Both Primary and Secondary Reviewer).
13. Save Method. Confirm that no other copies of the method are open on other computer workstations.

Note: It is also acceptable to quantitate all standards and review all peaks before updating responses but steps 1-2 still must be completed initially. Step 3 also must be done prior to beginning ICAL update.

11.1.4 Initial Calibration Review

The ICAL checklist is used to document the review and approval process. The Analyst's calculation and assessment along with a peer review of all ICAL data

and documentation as stated in Attachment 2 is required before the ICAL may be used to analyze samples.

11.1.5 Initial Calibration File

An ICAL file is to be created for each initial calibration performed per instrument into which is placed the following ICAL documents. The file shall remain in the laboratory and be filed by instrument and date.

- ICAL Checklist filled out, reviewed and approved
- Blank analysis quantitation report
- Calibration status report (aka Calibration History)
- Relative Response Factor Report / Percent Relative Standard Deviation
- Plot for quadratic fit for hydrogen, if necessary
- Quantitation report for each calibration standard (including manual integration documentation – before and after manual integration)
- ICV quantitation report and evaluate continuing calibration report (aka Percent Difference Report)
- Injection log (optional)

11.1.6 Initial Calibration Verification Verify the initial calibration by analyzing an independent calibration verification standard (ICV). Utilize the standard described in Section 10.3.1 for the analysis of a second source standard. Refer to Section 16.5 for acceptance criteria.

12) Sample Preparation/Analysis

12.1 Analytical Sequence The analytical batch must be completed for the analysis of ≤20 field samples.

Analytical Sequence Guideline[1]

Sample Description (w/ICAL)	*Sample Description*
Calibration Stds.[2]	CCV[3]
ICV[4]	MB[5]
MB[5]	Lab Air[6]
Lab Air[6]	Samples 1-10[7]
Samples 1-10[7]	CCV[3]
CCV[3]	Samples 11-19[7]
Samples 11-19[7]	LD[8]
LD[8]	LCS[9]
CCV[3]	CCV[3]

[1]The batch QC may be analyzed in an order other than the one listed in this document; the analytical sequence specified below is a guideline.
[2]The initial calibration must be generated in accordance with the guidelines detailed in Section 11.1.1 of this document.
[3]In cases, where the ICAL is not performed the analytical sequence must begin with the analysis of a CCV standard. In an external standard calibration the CCV is to be analyzed no less frequently than every ten samples or every 12 hours, whichever is more frequent, and the analytical sequence is to end with the analysis of a CCV standard.
[4]Every ICAL must be followed by a second source standard (ICV) which contains all of the target analytes. Same source as LCS; therefore, LCS is not required to be analyzed again.
[5]The method blank must be carried throughout the entire analytical process and be analyzed prior to any samples within the sequence. A method blank (MB) shall be run to monitor for laboratory introduced contamination.
[6]A volume of laboratory ambient air shall be analyzed at a rate of one per twenty sample injections or fewer.

[7]EPA Method 3C requires a duplicate injection for each sample. If the samples are being analyzed per a modified Method 3C, they are to be injected once (refer to note number 8). ASTM D 1946 requires only a single injection.

[8]Every batch must include the analysis of a laboratory duplicate. Samples selected for duplicate analysis shall be rotated among client samples. In addition, if performing EPA Method 3C without modification (duplicate injection), the laboratory duplicate analysis will not be necessary. A laboratory duplicate is considered a sample.

[9] A second source standard similar to 10.3.1.1 shall be analyzed once per twenty sample injections or fewer.

12.2 Conditions

The column and detector temperatures should be adjusted to the recommended levels. The column should be conditioned as instructed in Section 9.1.1. Once the GC/TCD system is optimized for analytical separation and sensitivity, the identical sample operating conditions must be used to analyze all samples, blanks, calibration standards and quality control samples.

The recommended settings and system parameters for GC01 are as follows:

Sample Inlet: GC
Injection Source: Sample Loop
Run Time: ~8 min

OVEN

Initial Temperature: 50˚C *Maximum Temperature*: 250˚C
Initial Time: 2.0 min *Equilibration Time*: 0.0 min

Ramps: Rate: 30˚/min
Final Temp.: 200˚C
Final Time: 1 min

COLUMN

Type: Packed
Model: Carbosphere 60/80
Dimensions: 6’ x 1/8”

DETECTOR

Temperature: 260˚C
Reference Flow: 45mL/min
He Make up: 20mL/min

The recommended settings and system parameters for GC20 are as follows:

Sample Inlet: GC
Injection Source: Sample Loop
Run Time: ~6.5 min

OVEN

Initial Temperature: 50˚C *Maximum Temperature*: 250˚C
Initial Time: 1.0 min *Equilibration Time*: 0.0 min

Ramps: Rate: 30˚/min
Final Temp.: 200˚C
Final Time: 0.5 min

COLUMN

Type: Packed
Model: shin carbon ST 100/120
Dimensions: 2 meters 1mm ID

DETECTOR

Temperature: 300˚C
Reference Flow: 20mL/min
He Make up: 2mL/min

12.3 Retention Time (RT) Windows

Retention time windows for each target analyte must be generated whenever there is a major change in instrument conditions including flow rates or when standard analyses result in analyte retention times outside the established windows. The procedure for determining the retention time windows for this method is as follows. However, other approaches may be employed, providing that the analyst can demonstrate that they provide performance appropriate for the intended application. For example, the analyst may use the corresponding retention times from the initial calibration as they may show shifts in RTs due to the volume injected (higher concentrations lead to wider peaks).

1. Make sure that the system is operating reliably and that the system conditions have been optimized for the target analytes in the sample matrix to be analyzed.
2. Make four injections of all applicable standard mixes over a 72 hour period. Make the injections cover the entire 72-hour period or the end result could be windows, which are too tight.
3. Record the retention time for each single component analyte to three decimal places. Calculate the mean and standard deviation of the four absolute retention times for each single component analyte and surrogate
4. If the standard deviation of the retention times for the target compound is 0.000, then additional injections may be included or the use of a default standard deviation of 0.01 minutes.
5. The width of the retention time window for each analyte is defined as ±3 times the standard deviation of the mean absolute retention time established during the 72 hour period. If the default standard deviation of 0.01 is used, the width of the window will be 0.03 minutes.
6. Establish the center of the retention time window for each analyte by using the absolute retention time for each analyte from the continuing calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.

Retention time windows must be calculated for each analyte on each instrument. New retention time windows must be established when a new column is installed.

12.4 LOQ Establishment, Verification, and Acceptance Criteria

A) The LOQ must be set within the calibration range (≥ low std. of the current passing ICAL) prior to sample analysis.
B) The LOQ for each analyte must be ≥ the analyte's LOD.
C) Initially a passing demonstration of precision and bias must be performed at the LOQ.
D) Run CCV 2 times at LOQ and:
   1) Evaluate the LOQ for precision and bias using current control chart limits.
   2) Check the signal to noise ratio (S/N) using the software. The S/N ratio must be at least 3:1 for each analyte.
E) If anything fails, verify at higher level and notify reporting. Also, make a note in the ICAL documentation.
F) Turn in all LOQ verification data (quant reports and software reports/checks) to QA (regardless of pass/fail).
G) Verify the LOQ on each instrument quarterly by running the CCV at the LOQ and verifying that ongoing precision and bias requirements are met.

12.5 Continuing Calibration Verification

A continuing calibration check shall be performed at the beginning and end of an analytical sequence and every ten field samples, not to exceed a 12 hour period. The concentration of the calibration verification may be varied within the established calibration range. Refer to Section 16.6 for acceptance criteria.

12.6 Laboratory Control Sample

A second source standard similar to Section 10.3.1.1 shall be analyzed once per closed batch. Refer to Section 16.11 for acceptance criteria.

12.7 Method Blank

A method blank must be analyzed by sampling chromatographic grade helium. Refer to Section 16.8 for acceptance criteria.

12.8 Sample Analysis

Refer to Section 16.10 for the acceptance criteria.

12.8.1 Container Pressurization Sample analysis must be made using the same instrument parameters as that of the calibration standards. Refer to the *SOP for Evaluation and Pressurization of Specially Prepared Stainless Steel Canisters* for the procedure of how containers are to be pressurized prior to analysis. The analyst shall record the appropriate pressures on the Service Request form.

12.8.2 Sample Analysis Sample analysis is performed with the utilization of a sample loop equipped with a pump. If the sample container is not equipped with a sampling valve appropriate for this use, the sample container shall be fitted with an adapter. The dead volume within the adapter shall be evacuated and the sample loop flushed then filled with sample gas. Analyze each sample in duplicate (calculate the percent difference of the calculated concentration of each analysis) unless performing a single injection modification or referencing ASTM D 1946 (refer to Section 12.8.3, #2).

Bottle Vacs use a proprietary quick connect fitting (Micro-QT, Entech Instruments). Each female Micro-QT fitting must be purged after use to remove any remaining sample residue and prevent contamination from subsequent usage. Connect a male Micro-QT fitting to a source of ultrapure or carbon-filtered gas. Adjust the pressure to about 10 psig using an inline regulator. Connect the female fitting for several seconds, then remove and place in an oven kept at 60ºC until the next use. Do not heat the fitting higher than 80ºC.

12.8.3 Sample Re-analysis

1. If the response of any permanent gas analyte in a sample is greater than the response of that analyte in the ICAL (outside the ICAL upper calibration range) the sample shall be reanalyzed using a smaller loop.

   Dilution (i.e. Tedlar bags) would compromise sample integrity with the addition of laboratory air. Guidance in performing dilutions and exceptions to this requirement are given below.

   - The dilution factor chosen should keep the response of the analyte peak for a reported target compound in the upper half of the initial calibration range of the instrument. Additional compounds may be reported as long as they are within the calibration range.

2. If the percent difference between the duplicate injection (analysis without modification) is greater than the acceptance criterion of 5%, the sample must be re-analyzed and repeated until acceptable *consecutive* numbers are achieved.

12.9 Laboratory Duplicate (LD)

If the method is being performed with a single injection modification, then the analysis of a LD is required to show precision. The laboratory duplicate should be rotated among clients, whenever possible. Refer to Section 16.9 for acceptance criteria.

12.10 Manual Integration

The integration for each peak is checked to ensure that it has been integrated properly. Assuming an incorrect automatic integration the analyst shall conduct the manual integration in accordance with the *SOP for Manual Integration Policy* including all documentation and reviews associated with the process. The review shall include the analyst and peer reviewer initialing and dating the manual integration as an indication of acceptability and approval.

12.11 Detection Limits and Limits of Detection

If results are to be reported below the MRL, an MDL study must be performed in accordance with the procedure outlined in the *SOP for Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation.* Method detection limits must be determined annually and each time there is a change in the test method that affects how the test is performed, or when a change in instrumentation is such that it affects the sensitivity of the analysis. The MDL study shall be performed on each instrument for which this method is performed. All supporting data must be approved and retained.

The detection limit shall be used to determine the LOD for each analyte. Once determined on each instrument, the highest LOD (for each analyte from all instrument determinations) shall be used as the uniform LOD.

12.11.1 Performance and Acceptance Criteria

1. Perform Limit of Detection (LOD) verification on all instruments (performing this method) immediately following the MDL study. Spike the LOD at 2-4x the MDL; the spike level establishes the LOD.
2. LOD Acceptance
   - Analyte must be detected reliably and identified by the method-specific criteria and produce a signal that is at least 3 times the instrument's noise level (3:1 signal to noise ratio).
   - It is specific to each combination of analyte, matrix, method and instrument configuration.
   - The LOD must be verified quarterly on each instrument (spiked at LOD) using the criteria listed above.
3. If the LOD verification fails (per #2), repeat the detection limit determination and LOD verification at a higher concentration or perform and pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration.
4. The laboratory shall maintain documentation for all detection limit determinations and LOD verifications (regardless of pass or fail).

Note: Per the DoD QSM 5.0 and TNI Standard, it is not necessary to perform a MDL study when results are not to be reported below the LOQ/MRL.

12.12 Ambient Air

An ambient laboratory air sample shall be analyzed once per closed batch (20 or fewer sample injections). Refer to Section 16.7 for the acceptance criteria and corrective action.

12.13 Method Modifications

12.13.1 The following are EPA 3C method modifications:

- Reporting carbon dioxide, methane, nitrogen, and oxygen from a single sample injection.
- Reporting hydrogen and carbon monoxide (these compounds are not included in 3C method).
- Sample results are normalized per ASTM D 1946.
- Use of sample containers other than backfilled Summa canisters.

12.13.2 The modification for ASTM D 1946 is the omission of ethane and ethane.

12.13.3 The column backflush procedure described in method ASTM D 1945-03 is not performed.

12.14 Loop calibration

The loop injection port has a standard loop of approximately 100ul to introduce sample to the instrument. There are other loops that are used to introduce smaller and larger amounts and these are calibrated against the normal loop for a known dilution factor.

12.14.1 Calibration Procedure

A standard of approximately 50000ppm for all analytes is analyzed three times with the normal loop. The area counts for all analytes with the exception of hydrogen are summed for each standard. This summation is averaged of the three standard injections. This procedure is duplicated using another loop. The dilution factor is the ratio of the average area counts of the normal loop divided by the average area counts of the other sampling loop.

For current Loop Ratios see Table 1.

13) Troubleshooting

13.1 Prepare new standards, check instrument maintenance, prepare a new curve as needed, etc. Refer to the corrective actions listed in Section 16 of this SOP for additional troubleshooting details.

14) Data Acquisition

14.1 Data System

Load the appropriate analytical sequence (e.g., J:\GC1\sequence\fxgs_25c.s). Enter the analytical sequence information in the table window, including sample/standard name. Load the appropriate quantitation analytical method (e.g., J:\gc1\methods\"appropriate ICAL"). Run the sequence and analyze the standards and samples in the order specified.

14.2 Storing Electronic Data

The initial calibration data must be stored in a quantitation method (on the server) using a unique filename and may not be overwritten at any time in order to maintain an accurate audit trail. Files shall be named with a two-character notation indicating the compound list and the date of the corresponding initial calibration. In addition, all data files including method blanks, continuing calibration verification, laboratory control samples and client submitted samples files shall be saved in a unique sub-directory on the server. An example of how the analyst must store analytical data is as follows:

Instrument Number/Data/Method ID/yr_month/*.d

* Injection (automatically assigned based on order of injection)

14.3 Sufficient raw data records must be retained of the analysis, instrument calibrations and method detection limit studies. This includes analysis/calibration date, test method, instrument, sample identification, each analyte name, analyst's initials, concentration and response, and standards used for the analysis and calibrations as well as any manual integrations and all manual calculations including sample dilutions. All information entered and reported on the quantitation reports must be complete and accurate.

14.4 The essential information to be associated with analysis, such as computer data files, run logs, etc. shall include: Sample ID code, date and time of analysis (both are required for Tedlar bags since the holding time is 72 hours), instrument operating conditions/parameters (or reference to such data), analysis type, manual integrations, all manual calculations, analyst's initials, sample preparation (pressure readings and balance gas), standard and reagent origin, sample receipt, calibration criteria, frequency and acceptance criteria, data and statistical calculations, review, confirmation, interpretation, and assessment and reporting conventions.

15) Calculation and Data Reduction Requirements

15.1 Initial Calibration

- Response Factor for each injection (equation number 5)
- Mean Response Factor using all injections (equation number 6)
- Percent Relative Standard Deviation (equation numbers 5,6,7, and 8)

Hydrogen (if quadractic is used):

- Coefficient of Determination (equation number 12)

15.2 Initial Calibration Verification

- Response Factor (equation number 5)
- Mean Area Response (equation number 6)
- Percent Difference (equation number 3)

15.3 Continuing Calibration Verification

- Response Factor (equation number 5)
- Mean Area Response, where necessary (equation number 6)
- Percent Difference (equation number 3)

15.4 Laboratory Duplicate and Method 3C without modification

- Relative Percent Difference (equation number 4)

15.5 Sample Analysis

Sample results must be quantitated from the initial instrument calibration and may not be quantitated from any continuing instrument calibration verification.

All permanent gas results are normalized as dry gas to 99.99% proportionately, in order to reflect the true composition of the sample. It is the practice of the laboratory to normalize results of permanent gas analysis, except under special circumstances that occur where the normalization of the results is not utilized or the normalization procedure is modified. For example, samples containing greater than 0.01% by volume of measured constituents other than permanent gases (for instance high hydrocarbon or sulfur levels) are normalized to 99.99% minus the percent contribution from components other than permanent gases.

- Calculate the average area of the two injections, where necessary (equation number 2)
- Calculate the dilution factor, where necessary (equation number 1)
- Analyte concentration (equation number 9)
- Hydrogen concentration (equation number 14)
- Normalization (equation number 11)

When the analysis of a sample produces permanent gas results whereby the total is significantly less than expected, accounting for experimental error, it is the laboratory's practice to reanalyze the sample in question as well as the laboratory air. This will determine if there is a problem with the analytical system. If there is no problem with the system and the results are the same refer to the following example.

If the total of the permanent gas analysis is less than 60.0% by volume and the laboratory is not requested to perform additional analyses, the results would be reported unnormalized. The decisions whether to report the unnormalized results is at the discretion of the analyst and department supervisor.

15.6 Laboratory Control Sample

- Calculate the percent recovery (equation number 10)

15.7 Calculations

15.7.1 Equation Number 1

Dilution Factor

$$DF = \frac{V_{STD}}{V_S}$$

Where:

DF = dilution factor
V_{STD} = volume of standard loop
V_S = volume of sample loop

15.7.2 Equation Number 2

Average

$$\frac{x + y}{n}$$

where:

x = response from the first injection
y = response from the second consecutive injection
n = number being averaged together

15.7.3 Equation Number 3

Percent Difference, %D,

The %D is used for evaluating ICV and CCV vs. the initial calibration

$$\%D = \frac{C_{CCVorICV} - C_{std}}{C_{std}}(100)$$

where, for any given analyte:

$C_{CCVorICV}$ is the calculated concentration being evaluated
C_{std} is the concentration of the standard used

15.7.4 Equation Number 4

Relative Percent Difference (RPD)

$$\frac{|R_1 - R_2|}{\left(\frac{R_1 + R_2}{2}\right)} x100$$

where:

R_1 First measurement value
R_2 Second measurement value

15.7.5 Equation Number 5

Response Factor (RF)

The response factor, for analyte *x* is given by:

$$RF = \frac{A_x}{C_x}$$

where:

A_x = Area of the analyte in the standard
C_x = Concentration of the analyte in the standard

15.7.6 Equation Number 6

Average (or Mean) RF

$$\overline{RF} = \frac{\sum_{i=1}^{N} RF_i}{N}$$

where:
RF_i are the individual RFs from each injection in the initial calibration curve
N is the number of injections

15.7.7 Equation Number 7

Standard Deviation, SD:

$$SD = \sqrt{\sum_{i=1}^{N} \frac{\left(RF_i - \overline{RF}\right)^2}{N-1}}$$

where:

RF_i are the individual RFs from each concentration level in the initial calibration curve

$\overline{RF}$ Average (or Mean) RF of all injections in the initial calibration curve

N total number of injections

15.7.8 Equation Number 8

Percent Relative Standard Deviation, %RSD:

$$\%RSD = \frac{SD}{\overline{RF}}(100)$$

where:

SD Standard Deviation calculated in equation number 3

$\overline{RF}$ Average or Mean RF

15.7.9 Equation Number 9

Concentration (C):

$$C = \frac{Area}{\overline{RF}} \times \frac{D_{SLV}}{A_{SLV}}$$

or

$$C = \frac{\overline{Area}}{\overline{RF}} \times \frac{D_{SLV}}{A_{SLV}}$$

where:

Area is the area obtained from the chromatogram

$\overline{Area}$ Mean area for both injections, if performing analysis without modification

$\overline{RF}$ Average (or Mean) RF of all concentration levels in the initial calibration curve

D_{SLV} default sample loop volume

A_{SLV} actual sample loop volume

15.7.10 Equation Number 10

Percent Recovery (%R):

$$\%R = \frac{C}{S} x100$$

where:

C = Concentration of the analyte recovered
S = Spiked amount

15.7.11 Equation Number 11

Normalization
Divide each analyte's calculated concentration (percent) by the percent sum of the permanent gases in the sample and multiply by 99.99 or the adjusted value.

15.7.12 Equation Number 12

Quadratic (Coefficient of Determination)

$$COD = \frac{\sum_{i=1}^{n}(y_{obs} - \bar{y})^2 - \left(\frac{n-1}{n-p}\right)\sum_{i=1}^{n}(y_{obs} - Y_i)^2}{\sum_{i=1}^{n}\left(y_{obs} - \bar{y}\right)^2}$$

where:

y_{obs} = Observed response (area) for each concentration from each initial calibration standard

$\bar{y}$ = Mean observed response from the initial calibration

Y_i = Calculated response at each concentration from the initial calibration

n = Total number of injections

p = Number of adjustable parameters in the polynomial equation (i.e., 3 for a third order; 2 for a second order polynomial)

15.7.13 Equation Number 13

Quadratic Fit

$R = AX^2 + BX + C$

where:

R = response
X = quantity, ng
A, B and C = are coefficients in the equation

15.7.14 Equation Number 14

Analyte Concentration (using equation number 13)

$$X = \frac{\sqrt{4A(R-C) + B^2} - B}{2A}$$

15.8 Data Review

The analyst must review data on a real time basis for all calibration and QC data. The QC data must be evaluated following the data review checklist in Attachment 3. The

data shall be reviewed and the sample results calculated and assessed by one analyst and reviewed by a second qualified analyst. The data review checklist shall be used to document the review process. Once it has been completed, the checklist must be initialed, dated and filed with each job file. Results must not be reported until after they are appropriately reviewed according to this SOP, the *SOP for Data Review and Reporting* and the *SOP for Laboratory Ethics and Data Integrity*.

Initial calibrations must be reviewed in the same manner as QC data with all ICAL documentation retained in a separate file. Refer to the initial calibration checklist in Attachment 2 for the review guideline. The ICAL file must contain all the pertinent information stated in Section 11.1.5.

15.9 Reporting

The results of each test shall be reported clearly, unambiguously and objectively, and shall include all the information necessary for the interpretation of the test results and all information required by this SOP and the *SOP for Data Review and Reporting*. The following are situations whereby the results shall be reported as being analyzed by Modified EPA Method 3C: single injection, reporting hydrogen and carbon monoxide and if analyzing replicate injections (for 3C without modification) and the samples are submitted in Tedlar bags.

15.9.1 EPA Method 3C Modifications

- Single injection
- Sample container other than backfilled Summa canisters
- Reporting carbon monoxide and /or hydrogen

15.10 Sample Preparation and Analysis Observations / Case Narrative Summary Form

This form, which is included in the *SOP for Laboratory Storage, Analysis, and Tracking* must be generated when there are any specific sample composition information, sample preparation, analysis issues and/or observations. In addition, during the analysis, specific identification information or problems, interferences, calibration issues, flags, and additional/expanded explanation of flags should be added to the form. This form may be modified as long as the sections and basic concepts are reserved.

This form is necessary as a means for documenting any unusual or noncompliant information. This form, among other information, will be reviewed when compiling the final report and case narrative. All information regarding the job shall remain in the file, in order that sufficient documentation is available to recreate the job from sample receipt through preparation, analysis, data reduction, and reporting.

16) Quality Control, Acceptance Criteria, and Corrective Action

16.1 This section of the standard operating procedure contains technical acceptance criteria and preferred corrective actions to data nonconformities. Corrective actions shall follow the procedures outlined in the *SOP for Nonconformance and Corrective Action*, where appropriate.

16.2 To the extent possible, samples shall be reported only if all of the quality control measures are acceptable. If a quality control measure is found to be out of control, and the data must be reported, all samples associated with the out of control quality control measure shall be reported with the appropriate data qualifier(s).

16.3 It must be determined if there are any instrumentation problems contributing to out of control QC data and the analyst must determine if this has affected sample results. This being the case, all samples (including QC) that are affected by instrumentation problems must be re-analyzed following any necessary maintenance activity.

16.4 Initial Calibration

16.4.1 Acceptance Criteria

- If a quadratic fit (for hydrogen) is used it should be forced through zero.
- The percent relative standard deviation (%RSD) for the response factors must be ≤15% for all compounds except hydrogen if utilizing a quadratic curve.
- Hydrogen may be fitted to a quadratic curve where the coefficient of determination (COD) shall be ≥0.99.
- The retention time for each point must within 0.06 minutes of the mean RT. However it must be noted that higher injection volumes and/or higher concentrations of any analyte may not meet this criteria, which is acceptable.

16.4.2 Corrective Action

If the initial calibration technical acceptance criteria are not met, inspect the system for possible sources. Check standards and re-analyze (per ICAL policy in Section 11.1.2), if necessary. Also, it may be necessary to perform maintenance or perform other corrective actions to meet the technical acceptance criteria. Attempt another initial calibration and make a notation in the maintenance logbook regarding any maintenance steps taken. If the recalibration does not meet the established criteria, new calibration standards must be made. A demonstration of an in-control system is required before proceeding with the analysis.

16.5 Initial Calibration Verification (ICV) Standard

16.5.1 Acceptance Criteria

- The percent difference for each compound in the ICV must be ≤15%.

16.5.2 Corrective Action

If the ICV does not pass the criteria the standard must be reanalyzed and reevaluated. If reanalysis also fails to produce an acceptable recovery, documented corrective action must be initiated. This may include instrument maintenance, a new ICV standard or the analysis of a new initial calibration curve.

16.6 Continuing Calibration Verification (CCV) Standard

16.6.1 Acceptance Criteria

- The percent difference for each analyte in the CCV must be ≤10%, except hydrogen which must be ≤15%.
- The retention time for each analyte in the standard must be within 0.33minutes of the mean RT (of the corresponding analyte) from the ICAL.

16.6.2 Corrective Action

If the continuing calibration fails to meet expected criterion, the CCV may be reanalyzed (no more than two runs of the CCV standard may be analyzed without documented corrective action, i.e. a notation in the logbook). If the acceptance criterion is still not met, it may be necessary to perform maintenance prior to reanalysis. If routine maintenance does not correct the problem, a new initial calibration must be performed on the instrument.

If the retention time criterion is not met, leak check the system, check the carrier gas cylinders, determine if there has been a loss of pressure in lines. If the analytes do not fall within the generated windows, a new retention time window should be generated.

DoD QSM 5.0 Requirement: If a CCV fails, the laboratory must immediately analyze two additional consecutive CCVs (immediately is defined as within one hour).

- Both of these CCVs must meet acceptance criteria in order for samples to be reported without reanalysis.
- If either of these two CCVs fail or if the laboratory cannot immediately analyze two CCVs, the associated samples cannot be reported and must be reanalyzed.
- Corrective action(s) and recalibration must occur if the above scenario fails. All affected samples since the last acceptable CCV must be reanalyzed.
- Flagging data for a failed CCV is only appropriate when the affected samples cannot be reanalyzed. The laboratory must notify the client prior to reporting data associated with a failed CCV.

16.7 Ambient Air

16.7.1 Acceptance Criteria

- The sum of the results for nitrogen and oxygen/argon must fall between 90% and 110% (un-normalized).

16.7.2 Corrective Action

Reanalyze the lab ambient air and if the results still do not meet the criterion, the sample line should be purged with nitrogen to release any blockage. This is particularly important if the results for the first criterion are low. Also, if the result is low the system should be checked for leaks. All standards, samples and QC samples associated with the lab ambient air should be reanalyzed following the maintenance activity if it is determined that the results could have been affected.

16.8 Method Blank

16.8.1 Acceptance Criteria

- The method blank result for any target analyte must not be greater than the method reporting limit. Also, the blank should not contain additional compounds with elution characteristics that would interfere with identification and measurement of a target analyte.
- For DoD samples, the method blank will be considered to be contaminated if:
  1. The concentration of any target analyte in the blank exceeds 1/2 the reporting limit and is greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater);
  2. The concentration of any common laboratory contaminant in the blank exceeds the reporting limit and is greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater); or
  3. The blank result otherwise affects the samples results as per the test method requirements or the project-specific objectives.

  The laboratory shall evaluate whether reprocessing of the samples is necessary based on the above criteria.

16.8.2 Corrective Action

Re-inject the method blank and if the results are the same, analyze an instrument blank (inject without turning on the pump) to determine if the contamination is the blank canister or the analytical system. Corrective action documentation must be initiated following a failed second analysis. If the

system is contaminated, then both the method blank(s) and the associated samples in question must be re-analyzed.

16.9 Laboratory Duplicates (Modified EPA Method 3C)

16.9.1 Acceptance Criteria

- Every batch of twenty or fewer samples, if performing EPA Method 3C with modification, must include the analysis of a laboratory duplicate as a measurement of method precision. Refer to Attachment 4 of this document.

16.9.2 Corrective Action

If the replicate results do not fall within the technical acceptance window, the sample should be re-analyzed. If the results are still unacceptable and there does not appear to be any matrix effects, interfering peaks, or instrument problems, the results for both injections shall be reported to the client with the appropriate qualifier.

16.10 Sample Analysis

16.10.1 Acceptance Criteria

- Samples out of holding time must be handled according to Section 16.12.
- The sample replicate injections are acceptable when the RPD is within ±5% (analysis without modification must consist of consecutive injections).
- Analyte retention time must be within the daily RT window and within 0.33minutes of the mean RT in the ICAL.

16.10.2 Corrective Action

Analysis Without Modification If the two injections do not agree, run additional samples until consistent area data are obtained in two consecutive injections.

Analysis With or Without Modification If the retention time for any analyte falls outside of the retention time window from the latest daily calibration or average initial calibration retention time, the system must be inspected for a change in the head pressure and the results evaluated and reported accordingly.

Results not bracketed by initial instrument calibration standards (within calibration range) must be reported as having less certainty, e.g., defined qualifiers or flags.

16.11 Laboratory Control Sample (LCS)

16.11.1 Acceptance Criteria

- The percent recovery must fall within the fixed recoveries of 85-115% or laboratory generated control limits when available. Refer to Attachment D.

16.11.2 Corrective Action

If the LCS criteria are not met, determine whether the cause is instrumentation problems, result of poor injection or a poor LCS. If necessary perform maintenance, re-inject the LCS or make a new standard. If the LCS criteria are still not met, a new ICAL must be run or the data must be qualified.

16.12 Expired Sample Holding Time

The customer shall be notified by the Project Manager (best attempt) when informed by an Analyst, Team Lead or SMO that the sample's holding time was missed. The customer must decide if the sample analysis shall continue. The documentation of missed holding time and the client's decision to proceed must be included in the

corresponding job file. A statement dictating all holding time occurrences must accompany the sample results in the final report.

17) Data Records Management

17.1 All data resubmittal forms and job documentation including Service Requests, Chain of Custody forms, Sample Acceptance Check forms and hardcopy electronic mail messages must be filed in the project file. Final reports, revised reports, and final invoices are stored electronically.

17.2 All laboratory and client documentation must be retained for a minimum of five years.

18) Contingencies for Handling Out of Control Data

18.1 To the extent possible, samples shall be reported only if all of the quality control measures are acceptable. If a quality control measure is found to be out of control, and the data must be reported, all samples associated with the out of control quality control measure shall be reported with the appropriate data qualifier(s) as detailed in Appendix D of the most current Quality Assurance Manual.

18.2 When analysis quality control results are unacceptable:

If the associated samples are within holding time, re-analyze the sample with criteria under control. Alternatively, evaluate the effect on the sample results and report the results with qualifiers and/or discuss in the case narrative if the effect is judged insignificant.

18.2.1 Method Blank If an analyte in the method blank is found to be unacceptable and the analyte is also found in associated samples, those sample results shall be "flagged" in the report. If the analyte is found in the blank but not in the sample and all other quality control meets acceptance criteria then the results for the sample may be reported without a qualifier. However, if other QC is out of control then an evaluation must be made and the results reported accordingly.

18.2.2 Laboratory Duplicate (Analysis with Modification) If the results from the reanalysis are unacceptable, and there does not appear to be any matrix effects, interfering peaks, or instrument problems, the results for both injections shall be reported to the client. In addition, other results from the same analytical sequence should be reported with the appropriate qualifier.

18.2.3 Laboratory Control Sample An unacceptable LCS must be evaluated along with the sample analysis and reported accordingly.

18.2.4 Initial Calibration Sample data may NOT be reported with an unacceptable ICAL.

18.2.5 CCV Sample data associated with an unacceptable calibration verification may be reported as qualified data under the following special condition:

When the acceptance criteria for the continuing calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise the sample affected by the unacceptable CCV shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

18.3 Sample Out of Control

18.3.1 Hold Time All Tedlar bag samples analyzed outside of the required hold time of 72 hours must be reported with the appropriate qualifier.

18.3.2 Retention Time All analytes outside of the retention time window (following a retention time evaluation) must be reported with the appropriate qualitative uncertainty, where necessary.

18.3.3 Duplicate Results (Analysis without modification) If the results from any of the repeated injections are still unacceptable (and other sample results were acceptable), and there does not appear to be any matrix effects, interfering peaks, or instrument problems, the results for both injections shall be reported to the client. If the out-of-control results are due to matrix interferences, report the results with a matrix interference qualifier.

19) Method Performance

19.1 An on-going assessment of method performance is conducted in order to ensure that the laboratory is capable of reporting results which are acceptable for its intended use. Validation of the method is confirmed by the examination and provision of objective evidence that these requirements are met.

19.2 Method Detection Limit (MDL)

The procedure used to determine the method detection limits are as stated in the *Code of Federal Regulations* (40 CFR 136 Appendix B) as defined in the *SOP for Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. MDLs can be obtained using standards at a concentration of about 300ppm to 1000ppm and making at least seven replicate measurements of the compounds of interest, computing the standard deviation, and multiplying this value by the appropriate Student's t value for 99 percent confidence.

The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects. Refer to Section 12.11.1 for the LOD verification criteria.

Note: Per the DoD QSM 5.0 and TNI Standard, it is not necessary to perform a MDL study when results are not to be reported below the LOQ/MRL.

19.3 Accuracy and Precision

Refer to Section 16.9 for information on replicate precision criteria for method performance. Single laboratory accuracy is presented as the second source initial calibration verification standard, which meets the method performance criteria of 15%. Additionally, laboratory generated control limit data for LCSs are presented for the analytes of interest and may be referenced in attachment 4. Refer to Section 12.4 for the accuracy and precision LOQ requirements.

19.4 Demonstration of Capability

This laboratory has continuously performed this method since before July 1999. Ongoing demonstration of capability shall be performed and documented; however, the initial demonstration of method capability is not required.

20) Summary of Changes

Table 20.1

Revision Number	Effective Date	Document Editor	Description of Changes
13.0	12/31/15	C. Humphrey	7.3 – Removed reference to NELAC
			12.11.1 – Removed reference to NELAC
			12.13.1 – Revised to add clarification to EPA 3C method modifications
			19.2 – Removed reference to NELAC
			Attachment 4 – Updated control limits

21) References and Related Documents

21.1 "*Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen from Stationary Sources*", EPA Method 3C

21.2 ASTM D 1946-90 (Reapproved 2006), "*Standard Practice for Analysis of Reformed Gas by Gas Chromatography*".

21.3 ASTM D 1945-03 (Reapproved 2010), "*Standard Test Method for Analysis of Natural Gas by Gas Chromatography".*

21.4 *Department of Defense Quality Systems Manual for Environmental Laboratories*, Version 5.0, July 2013.

21.5 *SOP for Batches and Sequences*, SOP ID ADM-BATCH_SEQ

21.6 *SOP for Making Entries onto Analytical Records*, SOP ID CE-QA007

21.7 *SOP for Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*, SOP ID CE-QA011

21.8 *SOP for Manual Integration Policy*, SOP ID CE-QA002

21.9 *SOP for Nonconformance and Corrective Action*, SOP ID CE-QA008

22) Appendix

22.1 Tables

Table 1 – Loop Ratios

22.2 Attachments

Attachment 1 – Training Plan

Attachment 2 – Initial Calibration Checklist

Attachment 3 – Data Review Checklist

Attachment 4 – MRLs and Control Limits

Attachment 5 – Calibration Curve Concentrations

Table 1

Loop Ratios	
Normal Loop	1.00
Small Loop	0.1556
Medium Loop 1	0.4202
Medium Loop 2	0.8521
Large Loop	1.280

Note: New loop ratios may be established prior to the revision of this document, refer to the most recent loop ratios.

Attachment 1

Training Plan

Training Plan for Analysis of Fixed Gases by GC/TCD

Trainee _____ Trainer _____ Instrument _____

1. Read SOP Trainer ____ Trainee ____ Date _____
2. Read Method: EPA Method 3C, ASTM D 1946, ASTM D 1945 Trainer ____ Trainee ____ Date _____
3. Demonstrated understanding of the scientific basis of the analysis
   Gas chromatography Thermal Conductivity Detector Trainer ____ Trainee ____ Date _____
4. Demonstrated familiarity with related SOPs Trainer ____ Trainee ____ Date _____
   SOP for Batches and Sequences
   SOP for Making Entries onto Analytical Records
   SOP for Manual Integration Policy
   SOP for Significant Figures
   SOP for Nonconformance and Corrective Action
   SOP for Performing MDL Studies and Establishing Limits of Detection and Quantitation
5. Observe performance of SOP Trainer ____ Trainee ____ Date _____
   ___standard preparation
   ___sample preparation (gas-phase dilutions)
   ___analytical sequence setup
   ___initial calibration and initial calibration verification
   ___continuing calibration verification
   ___sample analysis
   ___EnviroQuant introduction
   ___data reduction and reporting
6. Perform SOP with supervision Trainer ____ Trainee ____ Date _____
   ___standard preparation
   ___sample preparation (gas-phase dilutions)
   ___analytical sequence setup
   ___initial calibration and initial calibration verification
   ___continuing calibration verification
   ___sample analysis
   ___EnviroQuant use
   ___data reduction and reporting
7. Independent performance of the SOP Trainer ____ Trainee ____ Date _____
   ___standard preparation
   ___sample preparation (gas-phase dilutions)
   ___analytical sequence setup
   ___initial calibration and continuing calibration verification
   ___sample analysis
   ___EnviroQuant proficiency
   ___data reduction and reporting
   ___initial demonstration of competency
      ___ Four consecutive laboratory control samples
8. Instrument operation and maintenance Trainer ____ Trainee ____ Date _____
   ___gas chromatograph and column installation (packed)
   ___detector (TCD) setup and maintenance
   ___data system

Attachment 2

Initial Calibration Checklist

Initial Calibration Checklist (Fixed Gases)

Analysis: EPA Method 3C / ASTM D 1946 / ASTM D 1945

ICAL Date _____ Instrument ☐ GC01 ☐ GC ____

Analyst		Reviewer
☐	1. Is the required documentation in the ICAL file?	☐
	☐ Sequence report	
	☐ Blank analysis Quantitation Report	
	☐ Calibration Status Report (aka Calibration History) – Initial	
	☐ Response Factor Report and Plot for Hydrogen	
	☐ Quantitation Report for each calibration standard (including manual integration documentation – before and after printouts)	
	☐ ICV Quantitation Report and Evaluate Continuing Calibration Report (aka Percent Diff. report)	
☐	2. Was the ICAL performed continuously (i.e., not interrupted for maintenance or sample analysis)?	☐
☐	3. All the calibration standards analyzed within 48 hours of each other?	☐
☐	4. Were the standards analyzed from low concentration to high concentration?	☐
☐	5. Are all the analytes in the blank analysis < MRL?	☐
☐	6. Does each analyte's ICAL include a minimum of 5 consecutive concentrations?	☐
☐	7. Was each standard concentration included in the ICAL?	☐
☐	8. If a point is dropped, is information noted in the ICAL explaining the reason?	☐
☐	9. Does this follow the Laboratory's point dropping policy? Are the injections dropped for that concentration for each analyte?	☐
☐	10. For each analyte, is the lowest standard's concentration at or below the analyte's MRL?	☐
☐	11. For each analyte, are there no levels skipped?	☐
☐	12. For analytes calibrated using RF, is the RSD ≤15%? For Hydrogen ≥0.99?	☐
☐	13. For the ICV analysis, is the percent recovery for each analyte 85-115%?	☐
☐	14. Are all peak integrations including manual integrations (per *SOP for Manual Integration Policy*) acceptable? *If so, initial and date the appropriate pages.*	☐

COMMENTS:

_____

_____

_____

_____

Analyst _____ Secondary Reviewer _____

Date _____ Date _____

Attachment 3

Data Review Checklist

Fixed Gases per EPA Method 3C / ASTM D 1946 / ASTM D 1945
Data Review Checklist
(Note exceptions and include Sample Preparation and Analysis Observations / Case Narrative Summary Form as appropriate)

Analysis Date _____ Instrument ☐ GC19 ☐ GC ____

Client _____ QC Level _____

Project # _____ Due Date _____

Modification ☐ Yes ☐ No

Analyst **Reviewer**

Initial Calibration

☐ 1. Is the referenced ICAL the most recent ICAL performed? ..... NA

☐ 2. Has the referenced ICAL been peer reviewed and all associated documentation including the ICAL review checklist available for review? ..... NA

☐ 3. Were all associated requirements within the specified limits? ..... NA

Data

☐ 1. Is the sample data documentation present and correct? ..... ☐
- ☐ Sample raw data?
- ☐ All target analyte responses within calibration range?
- ☐ All peak integration acceptable?
- ☐ All manual integrations flagged and documented (before and after)? If so, initial and date.
- ☐ All analyte retention times within the generated RT window?
- ☐ All calculations correct?
- ☐ First quantitation report initialed and dated by analyst?

☐ 2. Do all sample duplicate injections (if analyzing without modification have a RSD ≤5%? ..... ☐

☐ 3. CCV have a percent difference of ≤10% (≤15% for hydrogen)? ..... ☐

☐ 4. Is the retention time (for CCV) for each analyte in the standard within 0.33min from the mean RT (of the corresponding analyte) from the ICAL? ..... ☐

☐ 5. Is the sum of the gases in the lab air within 90% and 110%? ..... ☐

☐ 6. Are the %R for the LCS within the acceptance criteria for each analyte? ..... ☐

☐ 7. Are the analytes in the MB < MRL? ..... ☐

☐ 8. Do all reported analytes fall within the generated retention time windows? If not, is the reason for reporting analyte in the sample documented? ..... ☐

☐ 9. Is the RPD (with modification) for the LD within the laboratory generated RPD limits? ..... ☐

☐ 10. **DOD: Are manual integrations notated in the case narrative**? ..... ☐

COMMENTS:

_____

_____

_____

☐ LIMS Run Approval ☐ LIMS Supervisor Approval

Analyst _____ Secondary Reviewer _____

Date _____ Date _____

Attachment 4

Method Reporting Limits and Control Limits

Target Analytes with Associated MRLs

Compound	Method Reporting Limit
Hydrogen	1000ppm
Oxygen	1000ppm
Nitrogen	1000ppm
Carbon monoxide	1000ppm
Methane	1000ppm
Carbon dioxide	1000ppm

Laboratory Generated Control Limits – ASTM D 1946-90 / Modified EPA 3C Single Injection

Analyte	LCS - LCL (%R)	LCS - UCL (%R)	LD (RPD)
Hydrogen – H_2	83	114	16
Oxygen – O_2	84	121	16
Nitrogen – N_2	88	122	21
Carbon monoxide - CO	87	118	16
Methane – CH_4	85	116	16
Carbon dioxide – CO_2	84	117	16

Note: New limits may be established prior to the revision of this document, refer to the most recent control limits.

Attachment 5

Calibration Curve Concentrations

Suggested Calibration Curve Concentrations (ppm unless noted as %)

ICAL	Hydrogen	Oxygen	Nitrogen	Carbon Monoxide	Methane	Carbon Dioxide
1	373.69	467.11	466.18	470.85	373.69	467.11
2	2000	2500	2495	2520	2000	2500
3	7473.77	9342.21	9342.21	9379.58	7511.14	9323.53
4	40000	50000	50000	50200	40200	49900
5	467731.47	584664.34	584664.34	587002.99	470070.13	583495
6	99.999%					
7		99.999%				
8			99.999%			
9					99.999%	
10						99.999%

ICAL	Amount of Standard Spiked onto Instrument
1	small loop injection of a 2500ppm/2000ppm standard [1,2]
2	standard loop injection of a 2500ppm/2000ppm standard [1,2]
3	small loop injection of a purchased 5%/4% standard (see section 10.3.1.1) [2]
4	standard loop injection of a purchased 5%/4% standard (see section 10.3.1.1) [2]
5	large loop injection of a purchased 5%/4% standard (see section 10.3.1.1) [2]
6 through 10	standard loop injection of neat gas compounds (see section 10.3.1.1)

[1]2500ppm/2000ppm standard is made by introducing 600ml of a purchased 5%/4% standard into a 6 liter summa canister and pressurized to +14.7psig (29.4psi) with helium.
[2]The loop injection volumes are calculated as described in section 12.14 and shown in Table 1.

Calibration Range	
Hydrogen	1000ppm – 99.999%
Oxygen	1000ppm – 99.999%
Nitrogen	1000ppm – 99.999%
Carbon Monoxide	1000ppm – 58.700%
Methane	1000ppm – 99.999%
Carbon Dioxide	1000ppm – 99.999%

ALS Standard Operating Procedure

Proprietary - Uncontrolled Copy

DOCUMENT TITLE:	DETERMINATION OF AIR-PHASE PETROLEUM HYDROCARBONS (APH) BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)
REFERENCED METHOD:	MADEP APH
SOP ID:	VOA-MAPH
REV. NUMBER:	09.0
EFFECTIVE DATE:	03/21/2015

ALS Environmental

STANDARD OPERATING PROCEDURE

DETERMINATION OF AIR-PHASE PETROLEUM HYDROCARBONS (APH) BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

MADEP APH

SOP ID:	VOA-MAPH	Rev. Number:	09.0	Effective Date:	03/21/2015

Approved By: _____ Date: 3/10/15
Technical Manager (Volatile GC/MS) - Chris Parnell

Approved By: _____ Date: 3/10/15
QA Manager - Chaney Humphrey

Approved By: _____ Date: 3/11/15
Laboratory Director - Kelly Horiuchi

Archival Date:	_____	Doc Control ID#:	Non-Controlled	Editor:	_____

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DETERMINATION OF AIR-PHASE PETROLEUM HYDROCARBONS (APH) BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

1) Scope and Applicability

1.1 This procedure is based on and incorporates the requirements detailed in the Method for the Determination of Air-Phase Petroleum Hydrocarbons (APH), Revision 1, December 2009, Massachusetts Department of Environmental Protection. It is designed to measure the gaseous-phase concentrations of volatile aliphatic and aromatic petroleum hydrocarbons in air. Volatile aliphatic hydrocarbons are collectively quantitated within two carbon number ranges: C5 through C8 and C9 through C12. In addition, volatile aromatic hydrocarbons are collectively quantitated within the C9-C10 range. Also, this method may be used to measure the individual concentrations of target APH analytes 1,3-butadiene, methyl-tert-butyl ether (MtBE), benzene, toluene, ethylbenzene, m-xylene, p-xylene, o-xylene, and naphthalene in air. An extended list of target analytes also may be reported since this method overlaps with EPA Method TO-15.

1.2 This method typically applies to whole air samples received in Summa stainless steel canisters, with subsequent analysis by gas chromatography/mass spectrometry (GC/MS). The method reporting limit (MRL) for this method for each of the collective aliphatic and aromatic fractional ranges is approximately 2.5 – 20ug/m3. The MRL for the target APH analytes is compound specific but is approximately 0.50ug/m3. Refer to the most recent method detection limit study and initial calibration for the corresponding method detection and reporting limits. The reported MRL may be adjusted higher; however, the capability of achieving lower MRLs for specific project requirements must be thoroughly demonstrated and documented. The number of samples that may be analyzed in a 24-hour period is about twenty.

2) Summary of Procedure

2.1 Samples are collected in pre-cleaned, evacuated Summa stainless steel canisters. An aliquot of an air sample is concentrated on a solid adsorbent trap to collect the analytes of interest. To remove co-collected water vapor, the concentrated sample then goes through a water removal (dry purge) step. After the sample is pre-concentrated on a trap, the trap is heated and the APHs are thermally desorbed onto a refocusing cold trap. The APHs are then thermally desorbed onto the head of a capillary column once the cold trap is heated. The oven temperature (programmed) increases and the APHs elute and are detected by the mass spectrometer. The GC/MS utilizes a linear quadrupole system, which allows for it to be operated by either continuously scanning a wide range of mass to charge ratios (SCAN mode) or by Select Ion Monitoring mode (SIM), which consists of monitoring a small number of ions from a specified compound list.

2.2 Target APH analytes are identified and quantitated using characteristic ions. Collective concentrations of C9-C10 aromatic hydrocarbons are quantitated using extracted ions. Collective concentrations of aliphatic hydrocarbons fractions are quantitated using a total ion chromatogram, subtracting out target APH analytes and C9-C10 aromatic hydrocarbons. The target analytes will be quantitated and reported using EPA method TO-15. Since the sample pre-concentration steps and analytical conditions are identical for TO-15 and the Massachusetts APH method, all sample results can be generated from the same analytical run.

3) Definitions

3.1 Cryogen A refrigerant used to obtain sub-ambient temperatures in the VOC concentrator and/or on front of the analytical column. Liquid nitrogen (cryogen) is used for this purpose and it has a boiling point of -195.8°C.

3.2 Gauge Pressure Pressure measure with reference to the surrounding atmospheric pressure, usually expressed in units of psi. Zero gauge pressure is equal to atmospheric (barometric) pressure.

3.3 MS-SCAN Mass spectrometric mode of operation in which the gas chromatograph (GC) is coupled to a mass spectrometer (MS) programmed to SCAN all ions repeatedly over a specified mass range.

3.4 Analytical Sequence The analytical sequence describes exactly how the field and QC samples in an analytical batch are to be analyzed.

3.5 Stock Standard A purchased, multi-component gas-phase mixture having certified concentrations, used to prepare working calibration standards.

3.6 Working Calibration Standard A gas-phase mixture of all the target analytes at a known concentration prepared by diluting a gas-phase stock standard into a Summa canister. Used for calibrations. Standard canisters prepared from methanol stocks are not allowed.

3.7 Calibration or Standard Curve A calibration or standard curve is a graph which plots the concentration of a compound (or an analyte) versus the instrument response to the compound.

3.8 Initial Calibration Verification (ICV) Standard A gas-phase standard prepared in the laboratory containing known concentration(s) of analytes of interest. It is prepared from gas-phase stock standards which are from a different source than the standards used to prepare the working calibration standards. Standard canisters prepared from methanol stocks are not allowed.

3.9 Continuing Calibration Verification (CCV) Standard A working calibration standard which is analyzed at specific intervals in order to verify that the instrument continues to meet the calibration criteria.

3.10 Field Sample A sample collected and delivered to the laboratory for analysis.

3.11 Manual Integration This term applies to a data file in which setpoints have been changed and reintegration has occurred under the changed setpoints; baselines have been adjusted; peak integration start and stop "ticks" have been changed; peak area, or peak height, are changed after the time of data collection and data file generation.

3.12 Batch Quality Control (QC) Batch QC refers to the QC samples that are analyzed in an analytical batch of field samples and includes the Method Blank (MB), Laboratory Control Sample (LCS) and Laboratory Duplicate (LD).

3.13 Internal Standard Calibration Compares the instrument responses from the target compound in the sample to the responses of specific standards (called internal standards), which are added to the sample or sample preparation prior to analysis. The ratio of the peak area (or height) of the target compound in the sample or sample preparation is compared to a similar ratio derived for each calibration standard.

3.14 May This action, activity, or procedural step is neither required nor prohibited.

3.15 Must This action, activity, or procedural step is required.

3.16 Shall This action, activity, or procedural step is required.

3.17 Should This action, activity, or procedural step is suggested, but not required.

3.18 Service Request A form generated, at the time of sample receipt, which details pertinent information such as client name, address, contact, client and laboratory sample identifications, sampling and receipt dates and times, requested analyses, sample type, canister pressures (initial and final), and the service request number (unique number for each submitted job) and serves as an inter-laboratory "custody" form which accompanies all samples throughout the laboratory.

3.19 Air-Phase Petroleum Hydrocarbons (APH) These are defined as collective fractions of hydrocarbons compounds eluting from isopentane to n-dodecane, excluding target APH analytes. APH is comprised of C5-C8 aliphatic hydrocarbons, C9-C12 aliphatic hydrocarbons, and C9-C10 aromatic hydrocarbons.

3.20 APH Component Standard A mixture of the aliphatic and aromatic compounds listed in Table 4. The compounds comprising the APH Component Standard are used to define and establish the retention time windows for the collective aliphatic and aromatic hydrocarbon ranges of interest, and determine average chromatographic response factors that can in turn be used to calculate the collective concentration of hydrocarbons within these ranges. The APH target analytes are in a separate stock standard cylinder (also used for EPA Method TO-15) and are prepared as separate working standards in Summa canisters.

3.21 Laboratory Control Sample A humidified canister fortified with a gaseous-phase mixture of the APH Component Standard obtained from a different stock solution than the APH working/calibration standards.

4) Health and Safety Warnings

4.1 Refer to the laboratory's Environmental, Health and Safety Manual as it makes reference to the safe handling of chemicals, Safety Data Sheet (SDS) location, and the laboratory waste management plan for the safe disposal of chemicals and samples.

4.2 Pollution Prevention and Waste Management

All waste disposals shall be carried out in accordance with the requirements detailed in the *SOP for Waste Disposal.* In addition, canisters must be cleaned in accordance with the requirements detailed in the *SOP for Cleaning and Certification of Summa Canister and Other Specially Prepared Canisters.*

4.3 This procedure may include CHEMICAL, OPERATIONAL and/or EQUIPMENT hazards. Employees must review and understand the following hazards and their preventive measures prior to proceeding with this activity.

HAZARD ASSESSMENT		
Job Task #1: Standard and Sample Preparation	**Hazards**	**Preventative Measures**
Compounds, mixtures of compounds, standards, surrogates, and samples.	Exposure to potential health hazards through absorption through skin. Inhalation hazards.	Reduce exposure through the use of gloves and fume hoods. Safety glasses must be worn when working in the prep lab. Care should be taken when handling standard material in a neat or highly concentrated form. Personal protective clothing (safety glasses, gloves, and lab coat) are required when handling standard material in neat form. Consult Safety Data Sheets (SDS) for compounds being handled in this procedure, and be familiar with proper safety precautions.
Job Task #2: Working with Liquid Nitrogen	**Hazards**	**Preventative Measures**
Turning valves and handling tubing and fittings that have been in contact with the cryogen.	Can cause serious tissue damage (frostbite) with only a few seconds of contact.	Wear neoprene or leather gloves. Valves on cryogen dewars should be opened slowly so leaky fitting can be identified.
Job Task #3: Working with Pressurized Gases	**Hazards**	**Preventative Measures**
Using and moving compressed gas cylinders.	Gas leak, fire, and explosion. Personal injury due to falling during transport.	All cylinders must be secured in an upright position to a wall or immovable counter with a chain or a cylinder clamp when not in use. Keep safety caps on when cylinders are not in use. A handcart must be used when transporting cylinders. The cylinder must be secured to the handcart with a chain or belt. The regulator should never remain on small "D" size cylinders following use. Full cylinders must be kept separate from empty cylinders. Flammable gases (i.e. pressurized hydrogen) must be clearly labeled. Flammables and oxidizers must be separated by a ½-hour fire wall or by at least twenty feet.
Job Task #4: Glass Syringes	**Hazards**	**Preventative Measures**
Glass syringe use	Skin lacerations and punctures.	The proper use of syringes should be part of employee training for this SOP. Care should be taken to avoid personal injury as a result or improper handling techniques.

Hazard information related to this activity which is not included or referenced in this document, should be immediately brought to the attention of the Department Supervisor.

5) Cautions

5.1 A maintenance log will be kept documenting maintenance performed on each analytical system. The serial numbers of each instrument shall be recorded, and each log entry must include a description of the maintenance performed and be initialed by the analyst performing or observing/authorizing maintenance by an outside contractor.

The instrument maintenance log must be kept current. An entry shall be made in the appropriate log every time maintenance is performed (no matter the extent). The entry in the log must include:

(a) the date of maintenance
(b) who did the maintenance
(c) description of the maintenance
(d) proof that the maintenance activity was successful

A notation of a successful tune and continuing calibration or initial calibration and the file number that accompanies the data will serve as proof that the maintenance is complete and the instrument is in working order.

The extent of the maintenance is not important, however, it is important that a notation be included for each maintenance activity such as changing a column, tuning the instrument, changing the pump oil, cleaning the source, or ordering a part. In addition, a notation should be made in the logbook stating that no samples were analyzed during the days that the instrument was down and no active maintenance was being conducted (i.e., where no other notation was made in the logbook for those days).

5.2 Concentrating Trap Routine maintenance includes periodic solvent cleaning of the Silcosteel lines in the valve oven if contamination is suspected. Also, periodic replacement of the multi-sorbent or partial replacement of the trap if analyte specific deterioration is detected is required. After repacking the trap it should be baked for a minimum of two hours (until a clean blank is generated), whereas a partial repacking requires baking the trap for a minimum of 20 minutes (or until a clean blank is generated).

5.3 GC System Column performance is monitored by observing both peak shapes and column bleed. Over time, the column will exhibit a poor overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced (see Section 9.4). Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column.

Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and “clean” (uniform, without fragmentation) by using the proper column-cutting tool. When removing any major portion of the column, which will affect the retention times and elution characteristics, a change in instrument conditions may be required to facilitate nominal analytical activity.

Performance can also be due to ineffective column ferrules, which should be replaced when a tight seal around the column is no longer possible. This can be detected with the use of a leak detector.

5.4 Mass Spectrometer The Mass Selective Detector (MSD) ion source requires periodic cleaning to maintain proper performance. Symptoms of a dirty ion source include difficulty keeping the MSD in tune and fluctuating internal standard areas. The vacuum system should be serviced every six months, including changing the pump oil and checking the molecular sieve in the backstreaming trap.

5.5 Instrument Tuning The instrument is tuned with guidance from the procedure described in the Agilent Operations Manual, when necessary. The tune shall meet the tune criteria described in this document.

6) Interferences

6.1 Summa Canisters Canisters should be stored in a contaminant free location and should be capped tightly during shipment to prevent leakage and minimize any compromise of the sample. The pressure/vacuum is checked prior to shipment and upon receipt from the field. Any problems with the sample from the field are noted on the service request form and the Project Manager contacted.

Also, canisters must be cleaned and certified to be free from target analytes before being shipped to the field for sample collection. The procedure is described in detail in the *Standard Operating Procedure for Cleaning and Certification of Summa Canister and Other Specially Prepared Canisters* (refer to this procedure as well as Section 12.7.1 for the acceptance criteria.).

6.2 Analytical System The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running humidified zero air blanks. The use of non-chromatographic grade stainless steel tubing, non-PTFE thread sealants, or flow controllers with buna-N rubber components must be avoided.

6.3 Glassware Interferences caused by contaminants in solvents, reagents, glassware, and other sample processing hardware results in discrete artifacts and/or elevated baselines in the detector profiles should be minimized. All glassware associated with this method must be scrupulously cleaned to avoid possible contamination. The cleaning shall be performed in accordance with the procedure outlined in the *SOP for Glassware Cleaning.* The use of high purity water, reagents, and solvents helps to minimize these problems.

6.4 Organic Compounds Certain organic compounds not associated with the release of petroleum products, including chlorinated solvents, ketones and ethers will be detected by this method and quantified within an aliphatic or aromatic hydrocarbon range. *When noted by the analyst, the identification and/or quantitation of such compounds must be disclosed on the laboratory report.* Non-APH compounds may be subtracted out of the hydrocarbon ranges before reporting results. When requested by the data user the identification of such non-APH compounds must be disclosed on the laboratory report or case narrative.

7) Personnel Qualifications and Responsibilities

7.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP may perform analysis, and interpretation of the results. The analyst must also ensure that a second analyst that is familiar with this analysis reviews the results and all applicable QC.

7.2 The supervisor/manager must ensure that method proficiency is documented initially and whenever significant changes in the instrument type, personnel, matrix or test

method are made.

7.3 The department supervisor/manager or designee shall perform final review and sign-off on the data.

7.4 All analysts must be trained in accordance with the guidelines detailed in the *SOP for Training Policy.* The training plan (Attachment 1) shall be used to document the training certification of new analysts.

8) Sample Collection, Handling, and Preservation

8.1 Air samples are collected in the field and delivered to the laboratory and should be collected in a specially prepared, leak-free, stainless steel pressure vessel (with valve) of desired volume (e.g., 6L). It is also acceptable to use Bottle Vacs (Entech Instruments, Simi Valley, CA) which are specially treated amber glass bottles fitted with a fused silica-coated valve (typically one liter volume). The use of Tedlar bags is considered a modification and is discouraged due to the inherent chemical artifacts which can interfere with the analysis.

8.2 Time-integrated samples require the use of a properly calibrated flow controller (refer to the Standard Operating Procedure for Flow Controllers and Critical Orifices). The flow controller must be calibrated prior to sample collection. Upon receipt at the laboratory, a post sampling calibration check must be performed on the flow controller. The relative percent difference (RPD) between the initial and post sampling calibration readings must be calculated. As long as the RPD is ≤20%, the calibration is considered to still be valid and thus the sample collection interval is also assumed to be valid. If the RPD is >20%, consideration must be given to whether resampling is necessary to achieve data quality objectives. If the sample is analyzed, a notation must be provided on the data reporting sheet and case narrative disclosing the RPD value.

8.3 There are no special preservation requirements for canisters. Canisters should be stored on the appropriate shelves until they are to be analyzed. The required holding time for samples in canisters for this method is 30 days.

9) Equipment and Supplies

9.1 Gas Chromatograph (GC) An instrument capable of temperature programming, with a column oven that may be cooled to sub-ambient temperature at the start of the gas chromatographic run to result in the resolution of the VOCs.

9.2 Autosampler

Teledyne-Tekmar AutoCan Autosampler:	14-ACAN-074
Concentrating Trap (cryogenic trap, built-in):	14-6938-020
Cryofocusing Module w/split valve:	14-6520-A00
GAST Vacuum Pump:	DOA-P104-AA

9.3 Mass Spectrometer (MS) A MS capable of scanning from 33 to 350 amu every second or less, using 70 volts (nominal) electron energy in the electron impact ionization mode. The mass spectrometer must be capable of producing a mass spectrum for Bromofluorobenzene (BFB) which meets all of the criteria when 50ng or less of BFB is injected onto the GC/MS system.

9.3.1 Ionization Gauge Controller

Granville-Phillips 330 Ionization Gauge Controller:	330001/2/3
Hewlett Packard Ionization Gauge Controller:	59864B

9.4 Analytical Column

Restek Rxi-1ms Fused Silica Capillary Column
60m x 0.25mm ID
1.0 micron film thickness

NOTE: Based upon data obtained from the MADEP VPH Round Robin testing programs, the choice of chromatographic column may have a significant impact on the apportionment and quantitation of aliphatic and aromatic compounds within the fractional ranges specified in this method. Substitution of the required column is not allowed, unless it can be demonstrated that the selected column has equivalent chromatographic properties and elution order for the aliphatic and aromatic compounds and ranges of interest.

To demonstrate equivalency of column chromatography, a mid-range calibration standard must be analyzed on both the required column and the proposed substitute column, with all other run and system parameters held constant. The concentrations of C5-C8 and C9-C12 aliphatic hydrocarbons, C9-C10 aromatic hydrocarbon ranges and target analytes must be determined for each column. The relative percent difference between the concentrations of each hydrocarbon range and target analyte, excluding naphthalene, obtained from each column must be ≤25. The RPD for naphthalene must be ≤40. The elution order of APH Components on the proposed substitute column must be equivalent to the elution order on the required column.

9.5 Data Systems IBM-compatible PC with Windows 95/98/NT/XP and Hewlett Packard Chemstation software including EnviroQuant with Extracted Ion Current Profile (EICP), National Institute of Standards and Technology (NIST) library or equivalent.

9.6 Canister Pressurization Station Vacuum/Pressure Gauge [0 to –30 in Hg; 0-90 psig]

9.7 Canister Sampling Devices VICI Condyne Model 300 Flow Controller

9.8 Gas Collection Devices

- Lab Commerce, Aerosphere Model S6L, 6.0L Summa Passivated Canisters or equivalent

10) Standards and Reagents

10.1 Reagents

10.1.1 UHP Grade Helium (99.999%)(GC carrier gas and preconcentrator purge/sweep gas)
10.1.2 Cryogen - Liquid nitrogen (used to cool preconcentrator traps)
10.1.3 UHP/Zero Grade Air
10.1.4 ASTM Type II Water or equivalent
10.1.5 High purity grade methanol

10.2 Standards

10.2.1 Instrument Performance Check, Internal Standard and Surrogate Spiking Mixture Prepare a standard solution of p-Bromofluorobenzene (BFB-used as both a tune check and surrogate compound), bromochloromethane, chlorobenzene-d5, and 1,4-difluorobenzene, 1,2-dichloroethane-d4(surrogate), and toluene-d8(surrogate) at 500ug/m^3 each in humidified zero air or nitrogen. This mixture may be purchased from an approved vendor in a high-pressure cylinder at the working concentration and Summa canisters filled directly from it for use on the sample preconcentrator. Otherwise, prepare this standard

according to the procedure outlined in Volume 6.5 of the *Tekmar*-DOHRMANN Application Note.

10.2.1.1 An intermediate standard can be prepared from neat compounds in a glass static dilution bottle (SDB). After the volume of the SDB is determined, calculate the mass of each compound to be spiked to achieve a final concentration of 5.0ug/mL. Then use the density of each neat compound to calculate the microliter amount to be spiked into the SDB. The SDB is then heated for a minimum of one hour at ~60˚C to completely volatilize all components.

Concentration of the intermediate standard prepared in a SDB is 5.0µg/mL. The amount required to achieve this concentration is determined through the use of the following equation.

$$A = \frac{(C)(V)}{D} \qquad \text{(Equation 1)}$$

Where:

A Amount of each compound required to achieve the desired concentration of the standard in the SDB (µL)
C Desired concentration of SDB (µg/mL)
V Actual volume of the SDB (mL)
D Density of the compound in question (µg/µL)

Example:

Calculate the amount of neat bromochloromethane needed to achieve the final concentration of 5.0µg/mL of that compound in the SDB.

V = 2010mL
D = 1934.4µg/µL
C = 5.0µg/mL

$$A = \frac{\left(5.0\frac{\mu g}{mL}\right)2010mL}{1934.4\frac{\mu g}{\mu L}} = 5.2\mu L$$

Table 1 – Tune, IS and Surrogate Compound Densities

Density (µg/µL)	Compound
1934.4	Bromochloromethane
1170.1	1,4-Difluorobenzene
1157	Chlorobenzene-d5
1307	1,2-Dichloroethane-d4
943	Toluene-d8
1593	BFB

10.2.1.2 The Working standard is prepared in a Summa canister by spiking an aliquot of the stock SDB standard (8.2.1.1) using a heated gastight syringe. Connect a cleaned, evacuated Summa canister to a source of

pure diluent gas (humidified zero air) using a teflon line with a stainless steel tee directly above the canister valve. One port of the tee is fitted with a septum. Spike the SDB stock and following removal of syringe a small flow of diluent gas to flush the spike into the can. Pressurize the can to positive 83.3 psig with humid zero air, and allow the contents to equilibrate for approximately 24 hours before using.

Concentration of the working standard prepared in a Summa canister is 500ng/L. The final pressure of the canister is 83.3psig; therefore, the pressurized volume is 40L, which is obtained through the use of the following equation.

PV = PDF(V) (Equation 2)

Where:

PV Pressurized canister volume (L)

PDF Pressure Dilution Factor, where PF = $\frac{P_{atm} + P_f}{P_{atm} + P_i}$

P_f Final Canister Pressure

P_i Initial Canister Pressure

V Volume of canister @ 1atm

P_{atm} Atmospheric Pressure = 14.7psig

Example:

$\frac{14.7 + 83.3}{14.7 + 0}(6L)$ = 40L

In order to prepare the canister with a concentration of 500ng/L, it must be determined how much of the intermediate standard is required. This is achieved through the use of the following equation.

$$A = \frac{(F)(V)}{(C)\left(1000\frac{ng}{\mu g}\right)}$$ (Equation 3)

Where:

F Desired concentration of working standard (ng/L)

V Pressurized Volume of Canister (L)

C Concentration of prepared SDB (µg/mL)

A Amount of standard (mL) of the SDB required to obtain the desired working standard concentration

Example:

$$A = \frac{500\frac{ng}{L}(40L)}{\left(5.0\frac{\mu g}{mL}\right)\left(1000\frac{ng}{\mu g}\right)} = 4mL$$

10.2.1.3 Currently the working standard is purchased in a cylinder at a certified concentration of 500ng/L (prepared by Liquid Technology Corporation). The working standard is filled directly into a summa canister to a pressure of 70 to 80 psig.

10.2.2 APH Component Standard (Stock Standard) Stock standards are purchased from an approved vendor as a mixture in a balance gas of nitrogen in high-pressure inert cylinders, and are available from several vendors. Each standard cylinder must be accompanied by a certificate of analysis stating the certified concentrations of each component. These concentrations must be used as the starting point when calculating the nanogram on-column amounts for the initial calibration points. See Table 5.

10.2.3 APH Working Standards Prepare gaseous-phase APH Working Standards at a minimum of two concentration levels in 6.0L Summa canisters pressurized with humidified zero air to 14.7psig. The contents should be allowed to equilibrate for approximately 24 hours prior to use.

Step 1: Concentration of the working standards prepared in Summa canisters should be 200ng/L and 20ng/L. The final pressure of the canister is 14.7psig; therefore, the pressurized volume is 12L, which is obtained through the use of the following equation.

PV = PDF(V) (Equation 6)

Where:

PV Pressurized canister volume (L)

PDF Pressure Dilution Factor, where PF = $\frac{P_{atm}+P_f}{P_{atm}+P_i}$

P_f Final Canister Pressure

P_i Initial Canister Pressure

V Volume of canister @ 1atm

EXAMPLE:

$$\frac{14.7+14.7}{14.7+0}(6L) = 12L$$

Step 2: Use the Entech dynamic diluter to prepare the working standards in Summa canisters. The stock standard is typically at a concentration of 1000ng/L, so a 200ng/L can will be a 5X dilution, and the 20ng/L can will be a 50X dilution. Instructions for using the diluter and calculating flows can be

found in the instruction manual and in the TO-15 SOP (VOA-TO15).

10.2.4 Initial Calibration Verification (ICV) - (Laboratory Control Sample - LCS) For the second-source standard, use the TO-15 second source working standard. This standard contains all of the target analytes and at least one calibration compound from each hydrocarbon range.

Note 2: Any of the desired standard concentrations may change as long as the equations and the appropriate densities remain the same. In addition, the SDB volumes will change with each specific SDB utilized (indicated by the etched volumes on the specific SDB being utilized). The final pressures of the canisters may also change as long as the actual pressurized volumes are properly calculated in accordance with the corresponding equations detailed in this document. Use this section to calculate the alternate concentrations, pressurized volumes of the Summa canisters, etc., as needed.

10.3 Storage and Expiration Dates

- Static Dilution Bottle (SDB) standards (internal standard/surrogate) must be stored in an oven at a temperature of 60°C to ensure analyte vaporization. Every time a standard is prepared from the static dilution bottle (SDB), the concentration changes. To increase the useful lifetime of an SDB standard, remove volumes of 25mL or less. The volume removed can be manipulated by increasing the SDB concentration or by adjusting the canister final volume/pressure. Depending upon the volume removed, a SDB intermediate standard is stable for approximately *two months* as long as new working standards made from this standard continue to meet acceptance criteria. These bottles must be in the oven at 60°C for a minimum of one hour prior to use in preparing working standards.
- Stock Standard cylinders – These standards have an expiration date on the certificate of analysis (typically one year). Expired cylinders with sufficient volume remaining are sent back to the original vendor for recertification.
- APH Working Standards (excluding the ICV/LCS) prepared in canisters may be stored at laboratory conditions for *two months* in an atmosphere free of potential contaminants. Upon preparation, canister standards should be allowed to sit for approximately 24 hours prior to use in order for equilibration to take place. Shorter equilibration periods may be necessary and acceptable as long as performance criteria are met.

11) Method Calibration

11.1 Initial Calibration The APH Component Standards are used to calibrate the GC/MS system. Two distinct calibration operations are necessary:

Target APH Analytes: Relative Response Factors (RRFs) are calculated for the 9 Target APH Analytes (Table 4) and internal standards, based upon a correlation between the mass of analyte and area counts for the relevant quantitation ions. This allows for the individual identification and quantitation of these specific compounds. IT IS NOT NECESSARY TO DEVELOP RESPONSE FACTORS FOR ANY OTHER INDIVIDUAL APH COMPONENT STANDARD. However, an extended list of target analytes may be reported if needed since all the APH target analytes are included in the calibration for EPA Method TO-15 which is performed using the same GC and data acquisition parameters as the hydrocarbon range calibration.

Collective Aliphatic/Aromatic ranges: Relative Response Factors are calculated for C_5-C_8 Aliphatic Hydrocarbons and C_9-C_{12} Aliphatic Hydrocarbons based upon a correlation

between the TOTAL mass of aliphatic APH Component Standards eluting within the range of interest and the total ion area count. A Relative Response Factor is calculated for C_9-C_{10} Aromatic Hydrocarbons based upon a correlation between the TOTAL mass of aromatic APH Component Standards eluting within this range and the total area count of extracted ions 120 and 134. Specified APH Component Standards are designated "marker" compounds to define the beginning and end of the hydrocarbon ranges.

Primary and secondary extracted ions for all APH Component Standards and recommended internal standards are provided in Table 4. The recommended internal standards and associated Target APH Analyte and Hydrocarbon Ranges are provided in Table 3.

Table 3

Internal Standards and Associated Target APH Analytes and Hydrocarbon Ranges

Bromochloromethane (IS #1)	1,4-Difluorobenzene (IS #2)	Chlorobenzene-d5 (IS #3)
1,3-Butadiene Methyl tert-Butyl Ether	Benzene Toluene C_5-C_8 Aliphatics	Ethylbenzene m&p-Xylenes o-Xylene Naphthalene C_9-C_{12} Aliphatics C_9-C_{10} Aromatics

Table 4
Primary (Quantitation) & Secondary Ions for APH Component/Internal Standards

APH Component Standard	CAS Number	Mol Wt. (g/mol)	Target APH Analyte	Quantitation Ion	Secondary Ion(s)
Bromochloromethane (IS1)	74-97-5			130	49, 130
1,3-Butadiene	106-99-	54.09	✓	54	53, 39
Isopentane (Range Marker)	78-78-4			43	42, 41, 57
Methyl-tert-butyl ether	1634-	88.15	✓	73	57, 45
n-Hexane	110-54-			57	41, 43, 56
Cyclohexane	110-82-			56	84, 41
1,4-Difluorobenzene (IS2)	540-36-			114	88
2,3-Dimethylpentane	565593			56	43, 57, 41
Benzene	71-43-2	78.11	✓	78	52, 51
n-Heptane	142-82-			43	71, 57,
Toluene	108-88-	92.14	✓	91	92, 65
Chlorobenzene-d5 (IS3)	3114-			82	117
n-Octane	111-65-			43	85, 57, 71
Ethylbenzene	100-41-	106.17	✓	91	106
2,3-Dimethylheptane	3074-			43	84,85
m-Xylene	108-38-	106.17	✓	91	106, 105
p-Xylene	106-42-	106.17	✓	91	106, 105
n-Nonane (Range Marker)	111-84-			43	57, 85
o-Xylene (Range Marker)	95-47-6	106.17	✓	91	106, 105
Isopropylbenzene	98-82-8			105	120
1-Methyl-3-ethylbenzene	620-14-			105	120
1,3,5-Trimethylbenzene	108-67-			105	120
n-Decane	124-18-			57	43, 71, 85
Butylcyclohexane	1678-			83	55, 82
p-Isopropyltoluene	99-87-6			119	105, 134
1,2,3-Trimethylbenzene	526-73-			105	120
n-Undecane	1120-			57	43, 71, 85
n-Dodecane (Range Marker)	112-40-			57	43, 71, 85
Naphthalene (Range Marker)	91-20-3	128.17	✓	128	127, 102

Table 5
Standard Concentrations of APH Component Standards for Target APH Analytes and Hydrocarbon Ranges for Initial Calibration

Range	APH Component Standards used to Establish Range Response Factor	Calib. Level	Working Std conc (ng/L)	Injection Volume	Approximate Concentration
C_5-C_8 Aliphatic Hydrocarbons	Isopentane n-Hexane Cyclohexane 2,3-Dimethylpentane n-Heptane n-Octane	1	20	25mL	0.50ng
		2	20	50mL	1.0ng
		3	20	250mL	5.0ng
		4	200	125mL	25g
		5	200	250mL	50ng
		6	200	500mL	100ng
C_9-C_{12} Aliphatic Hydrocarbons	2,3-Dimethylheptane n-Nonane n-Decane Butylcyclohexane n-Undecane n-Dodecane	1	20	25mL	0.50ng
		2	20	50mL	1.0ng
		3	20	250mL	5.0ng
		4	200	125mL	25ng
		5	200	250mL	50ng
		6	200	500mL	100ng
C_9-C_{10} Aromatic Hydrocarbons	Isopropylbenzene 1-Methyl-3-ethylbenzene 1,3,5-Trimethylbenzene 1,2,3-Trimethylbenzene p-Isopropyltoluene	1	20	25mL	0.50ng
		2	20	50mL	1.0ng
		3	20	250mL	5.0ng
		4	200	125mL	25ng
		5	200	250mL	50ng
		6	200	500mL	100ng
Target APH Analytes	1,3-Butadiene Methyl tert-Butyl Ether Benzene Ethylbenzene m,p-Xylenes[b] o-Xylene Naphthalene	1	20	25mL	0.50ng
		2	20	50mL	1.0ng
		3	20	250mL	5.0ng
		4	200	125mL	25ng
		5	200	250mL	50ng
		6	200	500mL	100ng

[a] The actual concentrations shall depend on the certified analyte concentration from the applicable manufacturer's certificate of analysis.
[b] Xylene concentration is doubled.

11.1.1 Calibration Points Analyze a minimum of five levels of the calibration standard (analyze low to high) that span the monitoring range of interest of the samples. The range is typically 0.50ng to 100ng on column (m,p-Xylene is doubled). The dynamic range is dependent on the sensitivity of a particular instrument as well as the required reporting limit for a given project and may be adjusted accordingly. Refer to Table 5 for the approximate concentrations of the compounds of interest in the initial calibration. These concentrations may

change with the purchase and/or preparation of new standards; therefore, they should be verified.

The initial calibration is performed to determine instrument sensitivity and the linearity of the GC/MS response for the target compounds. One of the calibration points from the initial calibration curve must be at the same concentration as the continuing calibration verification standard. Also, one of the standards must be at or below the method reporting limit for the compounds of interest or the MRL must be adjusted accordingly.

11.1.2 Recalibration Each GC/MS system must be recalibrated following any instrument maintenance which may change or effect the sensitivity or linearity of the instrument or if the continuing calibration verification acceptance criteria have not been met as specified in Section 16.6.4.

11.1.3 Analytical Window If time remains in the 24-hour tune window after meeting the acceptance criteria for the initial calibration, samples may be analyzed according to the procedure described in this document. If time does not remain in the analytical window, a new sequence shall commence with the analysis of the instrument performance check compound (BFB) and the continuing calibration verification standard.

11.1.4 Procedure The system should be operated using temperature and flow rate parameters equivalent to those in Section 12.3. Use the standards prepared in accordance with Section 10 of this SOP. Attach the calibration standard and internal standard canisters to the designated inlets on the preconcentrator and open the canister valves. Analyzing different volume aliquots of the calibration standards produces differing concentrations. Internal standards must be added at the same volume for every standard, sample and QC sample.

Analyte responses (target ion areas) are tabulated and recorded using the Enviroquant program. Quantitation ions for the target compounds are shown in Table 4 and the primary ion should be used unless interferences are present, in which case the secondary ion may be used.

11.1.5 Initial Calibration Requirements

Initial calibration requirements are as follows:

1. A minimum of 5 concentrations must be used to calculate the calibration curve.
2. Highest concentration, together with the lowest concentration, defines the calibration range.
3. Lowest concentration must be at or below the method reporting limit.
4. A blank should be analyzed prior to beginning the analysis of the calibration standards.
5. The initial calibration event may not be interrupted by maintenance.
6. Only one value per concentration may be used.
7. Analyze calibration standards from low to high concentration.
8. All ICAL analyses must be completed within the 24-hour tune window.
9. If 5 calibration standards are in the ICAL, one standard may be re-analyzed. If 6 to 10 calibration standards are in the ICAL, two calibration standards may be re-analyzed.
10. Point dropping policy
    - Minimum of 5 consecutive concentrations must be used to calculate the calibration curve.
    - Lowest concentration must be at or below the MRL and may not be

dropped unless the MRL is changed to the concentration of the remaining lowest standard.

- Points at the high end may be dropped, but doing so lowers the calibration range.
- Points may not be dropped from the interior of the curve unless an assignable cause (i.e., gross dilution error, missing internal standards, purge malfunction, standard preparation error, or instrument malfunction) is accounted for and documented. In these instances, all analytes in that calibration standard must be dropped from the calibration curve as the corrective action (the reason must be documented and the results maintained with the documentation for the final ICAL).
- Dropping individual compound points from the upper or lower end of the calibration range to improve linearity is not considered an error correction. The reason for dropping these points does not need to be documented but the ICAL documentation must state the revised calibration range if the MRL must be adjusted or the calibration range is lowered for a particular compound. This must be documented on the ICAL Review Checklist.
- A calibration standard may be re-analyzed if the first analysis of the standard has been dropped and other requirements in this policy are met (i.e., still within 24 hours).
- Once the ICAL has been used to calculate and report sample results, it is not to be changed.

11.1.6 Recalibration Each GC/MS system must be recalibrated following any instrument maintenance which may change or effect the sensitivity or linearity of the instrument, if the continuing calibration verification acceptance criteria are not met and at least annually. The following procedure must be followed when updating an initial calibration method.

1. Open the most recent method.
2. Save the method with the new ICAL method ID using the "Save Method As" option. Date used in the method ID must be the date files were analyzed.
3. Quantitate midpoint standard and check retention times and integrations. Update retention times if necessary using QEdit or Easy ID (Tools → Easy ID). Requant if any changes are made and verify all peaks are identified correctly. Print.
   a. While midpoint standard is loaded update reference spectra (Continuing Calibration → Update Reference Spectra).
   b. With midpoint standard loaded update qualifier ion ratios and retention times (Initial Calibration → Update Levels → Select Update Level and then select Retention Times (Replace) and Replace Qualifier Ion Relative Responses).
   c. If necessary adjust integration parameters prior to processing remaining ICAL points.
4. Quantitate remaining ICAL standards. Review each peak for retention time, integration, and print. Review low level standards for acceptable signal to noise ratios and high level standards for saturation.
5. All responses must be cleared from ICAL before updating (Initial Calibration → Clear All Calibration Responses).
6. Update responses for each standard level (Initial Calibration → Update Levels) or (Initial Calibration → Quick Levels Update). If Quick Levels Update is used do not requant datafiles.

7. Save method.
8. Check Response Factor Report and evaluate whether any points should be dropped following the criteria outlined in this SOP.
9. Save method if any changes are made.
10. Verify calibration files listed on Response Factor Report are correct.
11. Verify file ID, acquisition time, quant time, update time, and last update information is correct on the Calibration Status Report.

11.1.7 Initial Calibration Review Analyst's calculation and assessment along with a peer review of all ICAL data and documentation as stated in Attachment 2 is required before the ICAL may be used to analyze samples. In the case where samples are placed on the autosampler and allowed to run overnight, the sample results may only be reported if the ICAL is reviewed and found to be acceptable. The ICAL checklist in Attachment 2 must be used to document the review and approval process.

Analyte concentrations, which are not "real", not to be reported, or otherwise marked off the initial calibration, should be followed by a short explanation regarding the reason for the omission.

11.1.8 Initial Calibration File An ICAL file is to be created for each initial calibration performed per instrument into which is placed the following ICAL documents. The file shall remain in the laboratory and be filed by instrument and date.

- ICAL Checklist filled out, reviewed and approved
- BFB tune analysis report
- Blank analysis quantitation report
- Calibration status report (aka Calibration History)
- Relative Response Factor Report / Percent Relative Standard Deviation
- Quantitation report for each calibration standard (including manual integration documentation – before and after manual integration)
- ICV quantitation report and %recovery report.

11.2 Initial Calibration Verification Standard Verify the initial calibration by analyzing an initial calibration verification standard (ICV). This standard shall be obtained or prepared from materials acquired from a different manufacturer or lot from that of the initial calibration and prepared according to Section 10.2.4. At a minimum, it must contain 1,3-butadiene, benzene, toluene, ethylbenzene, m-&p-xylene, o-xylene, and naphthalene, and at least one compound from each hydrocarbon range. Methyl tert-butyl ether may be included but may have wider recovery acceptance limits.

Inject 25ng or less (refer to the appropriate manufacturer's certificate of analysis for the actual secondary source standard concentrations) of the ICV standard depending on the dynamic range of a given instrument.

12) Sample Preparation/Analysis

12.1 Sample Preparation and Leak Check The initial pressure/vacuum is checked and the canister pressurized as needed upon receipt by the laboratory. Samples collected in canisters shall be pressurized with humidified zero grade air or Nitrogen. However, if the samples are to be analyzed in accordance with EPA Method 3C then the samples must be pressurized with UHP Helium. The client must be made aware of this in advance and given the option of either submitting two canisters for analysis or receiving a report with qualified results.

Canister Pressurization Samples must be pressurized (to approximately 3.5psig) prior to analysis with humidified zero air (refer to exception stated above). This may be

accomplished by connecting the sample canister to a source of pure diluent gas (zero air) using a teflon line with a stainless steel tee directly above the canister valve. One port of the tee is fitted with a septum and injecting 100uL of water into the can through the septum and allowed to vaporize for approximately 10 minutes. Alternatively, pressurize at a fill station by bubbling the diluent gas through a zero air bubbler. Both of these procedures shall utilize ASTM Type II water or equivalent. Additional information may be found in the *Standard Operating Procedure for Evaluation and Pressurization of Specially Prepared Stainless Steel Canisters*. Initial and final pressures shall be recorded and the dilution factor created by filling the sample canister is calculated using Equation 25 in Section 15.3.4.

Leak Check Connect the canister(s) to the autosampler. Place a ¼" stainless steel nut and ferrule on the inlet line facing the canister. Push the inlet line into the orifice of the canister and hold in place while tightening the fitting finger tight. Turn the stainless steel nut ¼ turn more with a wrench. The canister valves should be closed at this point. For Bottle Vacs, connect the female Micro-QT fitting to the autosampler. A leak check must be performed before connecting the sample bottles since the valve is open as soon as the bottle is connected.

Leak Checks – Leak check all canister inlet connections. Analysis may not begin until the leak check has passed for each canister being tested. If a leak is detected, it should be confirmed by placing on a different location. In addition, the valve threads should be inspected for defects which may prevent a good seal with the AutoCAN. Once a canister has "failed" the leak check it must be tagged, an NCAR initiated, and the PM notified. Regardless of what the client or PM specifies as the fate of the sample, the canister must be put on maintenance hold to complete a full 24-hour leak check. A yellow sheet is to be completed in addition to, but not in lieu of an NCAR. This is a fixed QA procedure with no allowance for deviation.

12.2 Analytical Sequence

12.2.1 Analytical Sequence For this internal standard calibration method analysis, a CCV standard is to be analyzed every 24 hours. That is, the last analysis in the sequence must be started within 24 hours from the time of the initiation of the sequence. The initiation is considered to be the injection of the BFB tune standard.

The analytical sequence must be completed for the analysis of ≤20 field samples. A method blank (MB) shall be run to monitor for laboratory introduced contamination. There must be at a minimum a laboratory duplicate (LD) analyzed in each batch to access batch precision. A laboratory control sample (LCS) shall be analyzed at a rate of at least one per batch of twenty or fewer samples. The concentration of the LCS (ICV standard) should be at the lower end of the calibration curve as an indication that the system allows for good recovery at those concentrations. The following is the analytical sequence guideline for this method.

Analytical Sequence Guideline

With Calibration	Tune Check[1]
	Calibration Standards (5 Standards Minimum)
	ICV Standard[2] (Acts as the ICV and LCS)
	QC Canister Checks[6]
	MB[7]
	Sample(s)
	Laboratory Duplicate[4]

With Continuing	Calibration Tune Check[1]
	CCV Standard[5]
	QC Canister Checks[6]
	MB[7]
	LCS[3]
	Sample(s)
	Laboratory Duplicate[4]

[1] The introduction of the tune check standard is the start of the 24 hour analysis window. The instrument performance check solution must be analyzed initially and once per 24 hour time period of operation.
[2] In this scenario, the ICV may also be evaluated as the LCS.
[3] An LCS shall be analyzed at a rate of 1 in 20 or fewer samples. The LCS is the second source calibration check standard.
[4] A laboratory duplicate must be analyzed at a rate of 1 per 20 or fewer samples. The duplicate must be reported even if it is a batch duplicate.
[5] A CCV must be analyzed at the beginning of every analytical sequence.
[6] Any number of QC check canisters may be analyzed in the sequence to determine a canister cleaning batch or batches acceptability.
[7] Any of the QC Check Canisters may serve as the method blank as long as the minimum requirements detailed in this document are met. A method blank shall be analyzed at a rate of 1 in 20 or fewer samples.

12.3 Conditions

12.3.1 Sample Collection Conditions The suggested settings and system parameters are as follows:

Adsorbent Trap

Set Point:	40˚
Sample Volume:	25ml to 1,000ml
Dry Purge:	300mL
Sampling Rate:	100ml/min or 40ml/min
Desorb Temp.:	210˚C
Desorb Flow Rate:	8-10mL/min He
Desorb Time:	3.0 minutes

Refocusing Trap

Temperature:	-175˚C
Injection Temp.:	150˚C
Injection Time:	1.0 min

Adsorbent Trap Reconditioning Conditions

Temperature:	10°C above desorb temperature
Initial Bakeout:	2 hours or until clean blank is obtained
After each run:	10 minutes

12.3.2 GC/MS System

Optimize GC conditions for compound separation and sensitivity.

Item	Condition
Carrier Gas	Helium
Flow Rate	1.0-1.6mL/minute
Temperature Program	Initial Temperature: 10˚C Initial Hold Temperature: 1 minute Ramp Rate: 5˚C/min to 50˚C 2nd Ramp: 10˚C/min to 100˚C 3rd Ramp: 20˚C/min to 240˚C for 4 min hold
Detector B (MSD *Interface)*:	260˚C
Electron Energy	70 Volts (nominal)
Mass Range	33 to 280 amu (SCAN mode)
Scan Time	To give at least 10 scans per peak, not to exceed 1 second per scan.

12.4 Retention Time Windows The laboratory should calculate retention time windows initially and whenever a new GC column is installed. The laboratory must retain these data.

Before establishing retention time windows, ensure that the GC/MS system is operating within optimum conditions. Analyze an APH Calibration Standard on three separate occasions throughout the course of a 72-hr period. Serial analyses over less than a 72-hr period may result in retention time windows that are too restrictive.

Calculate the standard deviation of the three absolute retention times for each Target APH Analyte, range "marker" compound, internal standard, and MS tuning standard.

The retention time window is defined as plus or minus three times the standard deviation of the absolute retention times for each analyte of interest. However, the experience of the analyst should weigh heavily in the interpretation of chromatograms.

In those cases where the standard deviation for a particular standard approaches zero, the laboratory should substitute the standard deviation of a closely eluting structurally similar compound to develop an operational retention time window.

Table 2
APH Range "Marker" Compounds and Range Retention Time Windows

Hydrocarbon Range	Beginning Marker	Ending Marker
C_5-C_8 Aliphatic	0.1 min. before isopentane	0.01 min. before n-nonane
C_9-C_{12} Aliphatic Hydrocarbons	0.01 min. before n-nonane	0.1 min. after naphthalene*
C_9-C_{10} Aromatic Hydrocarbons	0.1 min. after o-xylene	0.1 min before naphthalene

*The method specifies using n-dodecane as this marker, but in practice naphthalene elutes after n-dodecane so the laboratory must use naphthalene as the marker.

The relative retention time (RRT) and RRT window for each Target APH Analyte, internal

standard, and hydrocarbon range "marker" compound must be verified on a daily basis. The RRT for each analyte of interest shall be established as the midpoint of the window. The retention time window equals the midpoint ± three times the standard deviation (Equation 9).

12.5 Instrument Performance Check Since the BFB tuning compound is included in the internal standard canister and a autosampler is used, it is necessary to establish that a given GC/MS meets tuning and standard mass spectral abundance criteria prior to the reduction and approval of any data collection. The 24-hour time period for GC/MS instrument performance check and standards calibration (initial calibration or continuing calibration verification criteria) begins at the injection of the BFB, which shall be documented in laboratory records. Upon completion of the successful BFB tune, the tune report must be printed and retained on file for future reference.

The following is the procedure to follow when performing the instrument performance check.

- Inject 50ng or less (on column)
- Three scans (peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged.
- Background subtraction is conducted using a single scan prior to the elution of BFB.

All subsequent standards, samples and QC samples associated with a BFB analysis must use identical instrument conditions. Refer to Section 16.6.1 (Table 7) for the acceptance criteria and required corrective action.

12.6 Continuing Calibration Verification Standard Verify the calibration each working day, where necessary (e.g., an ICAL was not analyzed or the 24-hour tune window has closed) by analyzing a continuing calibration verification (CCV) standard from the initial calibration standard canister. The concentration of the calibration verification should be varied within the established calibration range.

12.7 Canister Quality Control Check and Method Blank A Quality Control (QC) check canister may also serve as a method blank (see note 1 below) as long as the analyte concentration requirements stated in the canister quality control check section (Section 12.7.1) and the other requirements (refer to Section 16.6.7 for internal standard requirements) are met. If a QC canister fails with respect to the analyte concentration criterion, it may still be used as a method blank as long as the method blank criteria stated in 12.7.2 are met. If a QC canister still fails, another QC canister or a new canister must be prepared and analyzed (per Section 12.7.2) in order to verify that no system contamination exists.

Note 1: The use of a QC canister as a method blank is considered acceptable since a canister that has been sent into the field, returned and cleaned more closely resembles the manner in which client samples are handled.

12.7.1 Canister Quality Control Check The actual cleaning procedure, number of cans to select for analysis (to release a cleaning batch) and corrective actions are covered in the *Standard Operating Procedure for Cleaning and Certification of Summa Canister and Other Specially Prepared Canisters* and are not covered in this section. However, the procedure for analyzing and certifying a cleaning batch is included.

The canister to be checked, shall be pressurized with humidified zero grade air prior to analysis. Analyze an aliquot of one liter along with the same volume of internal standard as standards and samples. The unique laboratory barcode given to a canister shall be the information included in the sample analysis

identification, which is for tracking purposes. A canister is considered "clean" if the analysis shows <0.2ppbv of any target analyte or hydrocarbon range (refer to Note 1).

12.7.2 Method Blank In order for a method blank to be considered acceptable all target analytes must be less than the method reporting limit and fulfill the additional requirement in Section 16.6.5. If the QC canister(s) fail the corresponding criteria then the following must be performed.

- Prepare a canister that has not left the building by pressurizing with humidified zero air.
- Analyze an aliquot of the blank (1 liter) with internal standard
- Be consistent with the volume of internal standards introduced for each analysis.

Additionally, analyze a method blank whenever a high concentration sample is encountered and carryover is suspected.

The analyst should cross out those concentrations that are not real and initial and date the quantitation report for those QC Check canisters and method blanks that meet the acceptance criteria included in this section.

12.8 Laboratory Control Sample The laboratory control sample is an injection of the initial calibration verification standard. Inject the LCS (ICV) at concentrations at or below the midpoint of the calibration curve. Make sure that all of the pertinent information is included on the quantitation report including the sample identification (LCS), concentration, standard used, and analyst.

12.9 Sample Analysis Prior to analysis, all sample containers should be at temperature equilibrium with the laboratory.

- Attach sample canisters Tekmar AUTOCan using a 9/16" wrench. Bottle Vacs use a proprietary quick connect fitting (Micro-QT, Entech Instruments).
- Before opening the valve, check for leaking fittings by running the leak check program in the Teklink software. Quick connect fittings must be leak checked before connecting the sample container.
- If system is leak tight, open the canister valves and start the automated preconcentration procedure. Make sure the Chemstation data acquisition software has been readied.
- Maintain the trap at an elevated temperature until the beginning of the next analysis.
- Introduce the same volume of internal standards as used for the standards and QC samples.

Note 1: The secondary ion quantitation is only allowed if there is sample matrix interference with the primary ion. If the secondary ion quantitation is performed, document the reasons in the instrument run logbook and/or on the quantitation report (initial and date any notation).

Note 2: Each female Micro-QT fitting must be purged after use to remove any remaining sample residue and prevent contamination from subsequent usage. Connect a male Micro-QT fitting to a source of ultrapure or carbon-filtered gas. Adjust the pressure to about 10 psig using an inline regulator. Connect the female fitting for several seconds, then remove and place in an oven kept at 60ºC until the next use. Do not heat the fitting higher than 80ºC.

12.9.1 Qualitative Identifications The Target APH Analytes must be identified by an analyst competent in the interpretation of chromatograms and mass spectra.

Two criteria must be satisfied to verify the identification: (1) elution of the component in the sample at the same GC relative retention time (RRT) as the component in the standard, and (2) agreement of the sample component and standard component mass spectra.

If co-elution of interfering components prohibits accurate assignment of the sample component RRT from the total ion chromatogram, the RRT should be assigned using extracted ion current profiles for the ion unique to the component of interest.

For comparison of the standard and sample component mass spectra, mass spectra of standards obtained on the GC/MS under the same instrument conditions are required. Once obtained, these standard spectra may be used for identification and reference purposes. The requirements for qualitative verification by comparison of mass spectra are as follows:

All ions present in the standard mass spectra 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 ions specified must agree within ±20% between the standard and sample spectra.

Ions greater than 10% in the sample spectrum must be considered and accounted for by the analyst making the comparison.

The primary and secondary ions for all APH Component Standards are provided in Table 4.

12.9.2 Sample Dilution If any target analyte results are above the highest level of the initial calibration, a smaller sample aliquot should be analyzed. The smallest volume used shall not be less than that used for the initial calibration (see Table 5). The dynamic range of volume aliquots for the automatic cryogenic concentrator is 15ml to 1L. If a volume smaller than 15ml is to be analyzed, a dilution should be made in a Tedlar bag, or the sample directly injected using a gastight syringe. Guidance in performing dilutions and exceptions to this requirement are given below.

- Use results of the original analysis to determine the approximate dilution factor required and get the largest analyte peak within the initial calibration range.
- The dilution factor chosen should keep the response of the analyte peak for a reported target compound in the upper half of the initial calibration range of the instrument.
- All dilution factors (Equation 25) must be documented and included in the final report.

Note: Refer to Section 18.7.3 for requirements on reporting results outside of the initial calibration range.

12.10 Manual Integration The integration for each peak shall be checked to ensure that it has been integrated properly. Assuming an incorrect automatic integration the analyst shall conduct the manual integration in accordance with the *SOP for Manual Integration Policy* including all documentation and reviews associated with the process. The review shall include the analyst and reviewer initialing and dating the manual integration as an indication of acceptability and approval.

13) Troubleshooting

13.1 Prepare new standards, check instrument maintenance, prepare a new curve as needed, etc. Refer to the corrective actions listed in Section 16 of this SOP for additional troubleshooting details.

14) Data Acquisition

14.1 Data System Setup

For the Tekmar AutoCan, fill in the sequence log of the Teklink program with the appropriate information. Refer to the Section 12.3.1 for the operating parameters.

For the HP Chemstation, load the appropriate acquisition method for the GC/MS in the top window of the Chemstation program. Suggested GC/MS operating parameters are given in Section 12.3.2.

14.2 Storing Electronic Data The initial calibration data must be stored in a quantitation method (on the server) using a unique filename and may not be overwritten at any time in order to maintain an accurate audit trail. Therefore, files will be named with an eight-character notation indicating the compound list and the date of the corresponding initial calibration. In addition, all data files including method blanks, continuing calibration verification, laboratory control samples and client submitted samples files are saved in a unique sub-directory on the server.

14.3 Sufficient raw data records must be retained of the analysis, instrument calibrations and method detection limit studies including: analysis/calibration date and time, test method, instrument, sample identification, analyte identification, analyst's initials, concentrations and responses, as well as standards used for the analysis and calibrations, all manual calculations including sample dilutions and manual integrations to permit reconstruction of analyses. Information entered and reported on the quantitation report and instrument run log must be complete and accurate. Retain all daily QC per sequence on file for future reference including tune checks, opening standards, method blanks, laboratory control samples, laboratory duplicates, and initial calibrations and initial calibration verifications. Additionally, all passing QC Canister checks must also be retained on file.

Note: All data records must explicitly connect data to the initial instrument calibration. This includes all samples, continuing calibrations and QC samples.

14.4 The essential information to be associated with analysis, such as computer data files, run logs, etc. shall include: Sample ID code, date of analysis, instrument operating conditions/parameters (or reference to such data), analysis type, all manual calculations including dilutions and manual integrations, analyst's initials, sample preparation (pressure readings and balance gas if pressurized with helium), standard and reagent origin, receipt, preparation, and use, as well as calibration criteria, frequency and acceptance criteria, data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions.

15) Calculation and Data Reduction Requirements

15.1 Initial Calibration Calculations

15.1.1 Target APH Analytes Quantitation of the target analytes is done using the same data analysis method used for EPA TO-15 since all the APH target analytes are part of the laboratory's TO-15 analyte list. Tabulate the area response of the characteristic ions against the mass of each Target APH Analyte and internal standard and calculate relative response factors (RRFs) for each compound

using Equation 12. Perform this calculation for each Target APH Analyte.

Equation 12: Relative Response Factor for Target APH Analytes

$$RRF = [(A_{EC})*(C_I)] / [(A_{EI})*(C_c)]$$

where:

RRF = relative response factor
A_{EC} = area count of the extracted ion for the analyte of interest
C_I = mass of internal standard (ng)
A_{EI} = area count of the extracted ion for the associated internal standard
C_C = mass of analyte of interest (ng)

15.1.2 Hydrocarbon Ranges Calculate a response factor for the C_5-C_8 Aliphatic Hydrocarbon range using the following steps.

Using total ion integration, sum the individual peak areas of the six (6) APH Component Standards that are used to establish an average range response factor for C_5-C_8 Aliphatic Hydrocarbons, as designated in Table 5. Do not include the peak areas of internal/tuning standards.

Using the total area generated, calculate the Range RRF using Equation 13.

Equation 13: Relative Response Factor for C_5-C_8 Aliphatic Hydrocarbons

$$\text{Range } RRF = [(A_T)*(C_I)] / [(A_{EI2})*(C_T)]$$

Where:

Range RRF = relative response factor for the hydrocarbon range
A_T = total ion area count of the six aliphatic APH Component Standards which elute within this range (see Table 5)
C_I = mass of internal standard #2, ng (1,4-Difluorobenzene)
A_{EI2} = area count of the extracted ion for internal standard #2
C_T = summation of the masses of the six aliphatic APH Component Standards (ng) which elute within this range (see Table 5)

15.1.2.1 Calculate a response factor for the C_9-C_{12} Aliphatic Hydrocarbon range using the following steps.

Using total ion integration, sum the individual peak areas of the six (6) APH Component Standards that are used to establish an average range response factor for C_9-C_{12} Aliphatic Hydrocarbons, as designated in Table 5. Do not include the peak areas of internal/tuning standards.

Using the total area generated, calculate the Range RRF using Equation 14.

Equation 14: Relative Response Factor for C_9-C_{12} Aliphatic Hydrocarbons

$$\text{Range } RRF = [(A_T)*(C_I)] / [(A_{EI3})*(C_T)]$$

where:

Range RRF = relative response factor for the hydrocarbon range
A_T = total ion area count of the six aliphatic APH Component Standards which elute within this range (see Table 5)
C_I = mass of internal standard #3, ng (Chlorobenzene d5)
A_{EI3} = area count of the extracted ion for internal standard #3
C_T = summation of the masses of the six aliphatic APH Component Standards (ng) which elute within this range.

15.1.2.2 Calculate a response factor for the C_9-C_{10} Aromatic Hydrocarbon range using the following steps.

Using extracted ion 120, sum the individual peak areas of the five (5) APH Component Standards that are used to establish an average range response factor for C_9-C_{10} Aromatic Hydrocarbons (only four of the compounds will contribute area from m/z 120), as designated in Table 5. Do not include the peak areas of internal/tuning standards.

Using extracted ion 134, sum the peak areas of the five (5) APH Component Standards that are used to establish an average range response factor for C_9-C_{10} Aromatic Hydrocarbons (only one compound will contribute area from m/z 134), as designated in Table 5. Do not include the peak areas of internal/tuning standards.

Sum the area counts from each extracted ion.

Using the area count generated, calculate the RRF using Equation 15.

Equation 15: Relative Response Factor for C_9-C_{10} Aromatic Hydrocarbons

$$\text{Range } RRF = [(A_T)*(C_I)] / [(A_{EI3})*(C_T)]$$

where:

Range RRF = relative response factor for the hydrocarbon range
A_T = summation of area counts using extracted ions 120 and 134
C_I = mass of internal standard #3, ng (Chlorobenzene d5)
A_{EI3} = area count of the extracted ion for internal standard #3
C_T = summation of the masses of the five aromatic APH Component Standards (ng) which elute within this range (see Table 5)

Calculate the average response factor for each of the Target APH Analytes and each hydrocarbon range.

Calculate the percent relative standard deviation (%RSD) of the response factors over the working range of the curve for each of the Target APH Analytes and each hydrocarbon range using Equation 16.

Equation 16: Percent Relative Standard Deviation

This equation is also used for initial demonstration of capabilities, method detection limits studies, and method reporting limit verifications.

$$\%RSD = [(SD_{n-1}) / (AVG_X)]*100]$$

where:

%RSD = percent relative standard deviation
SD_{n-1} = standard deviation (n-1 degrees of freedom)
AVG_x = average response factor from the initial calibration curve

15.2 Sample Calculations

15.2.1 Individual Target APH Analytes The average response factor from the initial calibration is used to calculate the amount of analyte detected in the sample. Equation 17 is used to calculate the mass of sample analyte in ng. Equation 18 is used to convert ng to µg/m³. Equation 19 is used to convert of µg/m³ to ppbV.

Equation 17: Calculation of Analysis Results in ng

$$ng = [(A_x)*(C_{IS})] / [(A_{IS})*(RRF_{avg})]$$

where:

A_x = area of quantitation ion for the Target APH Analyte (see Table 4)
C_{IS} = mass of the internal standard
A_{IS} = area of quantitation ion for the associated internal std (see Table 4)
RRF_{avg} = average response factor for the specific compound to be measured**

Equation 18: Conversion of ng to µg/m³

$$\mu g / m3 = (ng / VA) * DF$$

where:

V_A = volume of sample analyzed (liters)
DF = dilution factor (Equation 25); if no dilution was made, the dilution factor =1

Equation 19: Conversion of µg/m³ to ppbV

$$ppbV = (\mu g / m3) * 24.46 / MW$$

where:

MW = molecular weight of the compound of interest, g/mol (see Table 4 for a list of the molecular weights of the Target APH Analytes)

15.2.2 Hydrocarbon Ranges The average range response factor from the initial calibration is used to calculate the mass (ng) of range hydrocarbons in samples. Collective peak area integration for the hydrocarbon ranges must be from baseline to baseline (i.e., must include the unresolved complex mixture).

15.2.3 The contribution of compounds not meeting the definition of aromatic or aliphatic hydrocarbons may be omitted from the collective hydrocarbon range calculations at the discretion of the laboratory and the data user. Only peaks with a peak height greater than half of the nearest internal standard need to be evaluated for exclusion. The guidance for making this decision includes the following:

- If the non-APH compound co-elutes with an aliphatic petroleum hydrocarbon, the area may not be subtracted from the aliphatic range.

- In complex sample matrices (i.e. many co-eluting peaks, complex petroleum patterns), this type of data adjustment may not be possible.
- Spectral identification of the excluded peak must be evaluated by a qualified mass spectrometrist. The analyst should consider the quality of the spectral library match, presence and relative intensity of major ions, and potential interferences in making a professional judgment on exclusion.

C_5-C_8 Aliphatic Hydrocarbons

- Using total ion integration, sum all peaks in the appropriate retention time window as specified in Sections 12.4 and Table 2.
- From this sum, subtract the total ion area counts of all internal standards and surrogates which elute in this range (all three of the recommended internal standards and two of the surrogates elute in this range). Also subtract the total ion area counts of all non-APH compounds that are not to be included in the final result.
- Calculate a preliminary mass amount in ng using Equation 20.

Equation 20: Calculation of Preliminary Sample Analysis Results (ng)

$$ng = [(A_x)*(C_{IS})]/[(A_{IS})*(RRF_{avg})]$$

where:

A_x = total ion area count of all peaks eluting within C5-C8 Aliphatic Hydrocarbon range window
C_{IS} = mass of the internal standard, ng
A_{IS} = area of quantitation ion for internal standard #2 (1,4-Difluorobenzene)
RRF_{avg} = average range response factor for the C5-C8 Aliphatic Hydrocarbon range

- From the preliminary amount (ng), calculate an adjusted mass amount of range hydrocarbons by subtracting the masses of Target APH Analytes which elute in this range (MtBE, benzene, toluene, ethylbenzene, m-xylene, p-xylene, and o-xylene,).
- Convert the adjusted ng value to µg/m³ using Equation 21.

Equation 21: Conversion of ng to µg/m³

$$\mu g/m^3 = (C_{ng}/V_A)*DF$$

where:

C_{ng} = adjusted total mass of range hydrocarbons in ng
V_A = volume of sample analyzed (liters)
DF = dilution factor (Equation 25); if no dilution was made, the dilution factor = 1.

C_9-C_{10} Aromatic Hydrocarbons

- Using extracted ion 120, sum all peaks in the appropriate retention time window as specified in Section 12.4 and Table 2.
- Using extracted ion 134, sum all peaks in the appropriate retention time window as determined in Section 12.4 and Table 2.
- Sum the areas of ions 120 and 134.

- Subtract the extracted ion area (mass 120 and 134) of any non-APH compounds that are not to be included in the final result.
- Calculate an amount in ng using Equation 20, using the summed areas of ions 120 and 134.
- Convert the ng value to µg/m³ using Equation 21.

C_9-C_{12} Aliphatic Hydrocarbons

- Using total ion integration, sum all peaks in the appropriate retention time window as specified in Section 12.4 and Table 2.
- From this sum, subtract the total ion area counts of the 4-bromofluorobenzene (Surrogate #3) peak.
- Subtract the total ion area counts of all non-APH compounds that are not to be included in the final result.
- Calculate a preliminary mass amount in ng using Equation 20.
- From the preliminary amount (ng), calculate an adjusted mass amount of range hydrocarbons by subtracting the masses of Target APH Analytes which elute in this range (naphthalene), and by subtracting out the mass amount of C_9-C_{10} Aromatic Hydrocarbons.
- Convert the ng value to µg/m³ using Equation 21.

15.3 Additional Calculations

15.3.1 Relative Percent Difference This equation is used for laboratory duplicates and post calibration check of flow controllers when they are received back by the laboratory following sampling.

Equation 22: Relative Percent Difference

$$\frac{x_1 - x_2}{\bar{x}} \ (100)$$

where:

x_1 First measurement value
x_2 Second measurement value
$\bar{x}$ Average of the two values

15.3.2 Percent Difference This equation is used for the continuing calibration verification standards.

Equation 23: Percent Difference

$$\%D = [(RF_C) - (RF_I)] / [(RF_I)] * 100$$

where:

%D = percent difference
RF_C = response factor from the continuing calibration verification standard
RF_I = average response factor from the initial calibration curve

15.3.3 Percent Recovery This equation is used for the initial calibration verification standard, laboratory control sample, initial demonstration of capability, method detection limit study, and method reporting limit verifications.

Calculate the percent recovery (%R) of the Target APH Analyte or hydrocarbon range using Equation 24.

Equation 24: Percent Recovery

$$\%R = [(C_{found}) / (C_{true})]*100$$

%R = percent recovery
C_{found} = mass of the analyte or hydrocarbon range detected in the standard (ng)
C_{true} = true mass of the analyte or hydrocarbon range in the standard (ng)

15.3.4 Dilution Factors

Equation 25: Dilution Factor for Pressurization of Subatmospheric Samples:

$$PDF = \frac{P_{atm} + P_f}{P_{atm} + P_i}$$

where:

P_{atm} is the ambient atmospheric pressure, 14.7 psi at sea level.
P_f is the final sample canister pressure, in psig.
P_i is the initial sample canister pressure, in psig. This will most often be a negative value (sub-ambient initial pressure.)

15.3.5 Relative Retention Time

Equation 26: Relative Retention Time (RRT)

$$RRT = \frac{RT_C}{RT_{is}}$$

where:
RT_C Retention time of the target compound, seconds.
RT_{is} Retention time of the internal standard, seconds.

15.4 Data Review The analyst must review data on a real time basis for all calibration and QC data. The QC data must be evaluated by analytical sequence following the data review checklist in Attachment 3. The data shall be reviewed and the sample results calculated and assessed by one analyst and reviewed by a second analyst. The data review checklist is used to document the reviews and once it has been completed, initialed and dated it must be filed with each job file.

Initial calibrations must be reviewed in the same manner as QC data with all ICAL documentation retained in a separate file organized by instrument and date. Refer to the initial calibration checklist in Attachment 2 for the review guideline. The ICAL file must contain all the pertinent information stated in Section 11.1.8.

15.5 Reporting The results of each test shall be reported clearly, unambiguously and objectively, and shall include all the information necessary for the interpretation of the test results and all information required by the reference method and the laboratory quality control program.

In addition to sample results, the APH data report must include the following items:

- Method Blank results
- LCS results

- Sample duplicate results
- Internal standard results (areas) for all field samples and QC samples

15.5.1 Analysis Observations / Case Narrative Summary Form This form, which is included in the *SOP for Sample Analysis, Storage and Tracking*, must be generated when there are specific sample composition information or analysis issues and/or observations. In addition, during the analysis, specific identification information or problems, interferences, calibration issues, flags, and additional/expanded explanation of flags should be added to the form. This form may be modified as long as the sections and basic concepts are reserved. This form is necessary as a means for documentation and will be reviewed along with other information when compiling the final report and case narrative.

Any sample flow controller that does not meet the post calibration check criteria (refer to Section 8.2) must be noted on this form so that it may be reported to the client.

All information regarding the job shall remain in the file, in order that sufficient documentation is available to recreate the job from sample receipt through analysis, data reduction, and reporting.

15.5.2 Significant Modifications "Significant Modifications" to the APH Method shall include, but are not limited to, any of the following and must be reported accordingly, if they occur.

(1) The use of sample collection devices other than evacuated passivated stainless steel canisters or glass Bottle Vacs (i.e., Tedlar bags).
(2) The use of alternative detectors other than GC/MS to quantify Target APH Analytes and/or hydrocarbon range concentrations.
(3) The use of extracted ions other than 120 and 134 to quantify C9-C10 aromatic hydrocarbons.
(4) The failure to provide all of the data and information required in the report form presented in Appendix 3.

Data produced using an analytical method incorporating any of the "Significant Modifications" described above may *not* be reported as APH data. APH range concentrations are method-defined parameters and as such may only be reported as APH data when produced using the method without "Significant Modifications."

Helium Pressurization – If a canister is pressurized with helium, a correction factor is applied to sample volumes extracted from the canister via auto sampler. This is due to the difference in thermal properties between helium and air. A correction factor worksheet has been generated to determine the exact volume taken from a canister and may be found at J:\\A-GCMS\Helium Pressurization (save the job as P1_____h.xls). Print the sheet and include with the data. Refer to the instruction page in the template for all of the instructions and calculations including backfilled canisters.

16) Quality Control, Acceptance Criteria, and Corrective Action

16.1 This section of the standard operating procedure contains technical acceptance criteria. To the extent possible, samples shall be reported only if all of the quality control measures are acceptable. If a quality control measure is found to be out of control, and the data must be reported, all samples associated with the out of control quality control measure shall be reported with the appropriate data qualifier(s).

16.2 Any maintenance which may alter instrument sensitivity or linearity must result in the re-analysis of the entire sequence including the tune compound, ICAL or CCV. Corrective actions shall follow the procedures outlined in the *SOP for Nonconformance and Corrective Action,* where appropriate.

16.3 Analytical Sequence Refer to Section 12.2.1 for the analytical sequence requirements. All analytical sequences and data must be recorded in an instrument run logbook.

16.4 Minimum Instrument QC (Additional) The following are additional requirements or are reiterated from previous sections.

- Internal standards used must be adequately resolved from individual compounds in the APH Component Standard.
- Retention time windows and relative retention times must be established for each target APH analyte, range "marker" compound, and internal standard initially and each time a new GC column is installed, and must be verified and/or adjusted on a daily basis (see Section 16.6.4).

16.5 Initial and Periodic Method QC Demonstrations The following procedures must be conducted as an initial demonstration of laboratory capability (IDLC). Subsequent to this initial demonstration, additional evaluations of this nature should be conducted on a periodic basis, in response to changes in instrumentation or operations, and/or in response to confirmed or suspected systems, method or operational problems.

16.5.1 Accuracy and Precision To demonstrate initial laboratory capability, analyze a minimum of four replicate samples obtained from a humidified canister fortified with each Target APH Analyte.

- Calculate the measured concentrations of each analyte in all replicates, the mean accuracy (as a percentage of true value) for each analyte and hydrocarbon range, and the replicate precision (as %RSD) of the measurements for each analyte.
- For each analyte and hydrocarbon range, the mean accuracy, expressed as a percentage of the true value, must be between 70% and 130%, and the %RSD must be less than or equal to 25. The IDLC must meet these conditions for analysis to proceed.
- If desired, the accuracy and precision evaluation may be combined with the MDL evaluation specified in Sections 16.5.2 and 16.5.3.

16.5.2 Method Detection Limits for Target APH Analytes Although the method does not require that MDL studies be performed, the APH target compounds are a subset of the EPA TO-15 analysis for which laboratory performs annual MDL determinations as follows. Analyze a minimum of seven replicate samples obtained from a canister fortified with all Target APH Analytes of interest at 3 to 5 times the calculated or estimated Instrument Detection Limits (IDLs) or at the low level initial calibration standard concentration. Analyze each replicate according to the procedures described in this document. Calculate the Method Detection Limit (MDL) of each analyte using Equations 9 and 10 and Table 6 below.

Equation 9: Standard Deviation

$$SD = \sqrt{\sum_{i=1}^{N} \frac{\left(C_i - \overline{C}\right)^2}{N-1}}$$

where:

C_i are the individual concentrations from each MDL replicate analysis

$\overline{C}$ Average (or Mean) concentration of all MDL replicate analyses

N total number of MDL replicate analyses

Equation 10: Method Detection Limit

$$MDL = (t) \times (SD)$$

where:

t = student t value at the 99% confidence level.
SD = standard deviation of the replicate analysis.

Table 6
Student t Values

Number of replicates	t value
7	3.143
8	2.998
9	2.896
10	2.821

16.5.3 Method Detection Limits for Hydrocarbon Ranges The method does not require that MDL studies be performed. However, the laboratory may choose to perform them in anticipation of client requests. Analyze a minimum of seven replicate samples obtained from a humidified canister fortified with all of the APH range calibration compounds at 3 to 5 times the calculated or estimated Instrument Detection Limit (IDL) or at the low level initial calibration standard concentration. Analyze each replicate according to the procedures described in this document. Calculate the Method Detection Limit (MDL) of each range using Equations 9 and 10 and Table 6.

16.5.4 Method Reporting Limits

16.5.4.1 Target APH Analytes The method reporting limit for each target APH analyte must be at or above the low level calibration standard and should be verified on an annual basis by analyzing at least 4 replicate samples from a canister spiked at the reporting limit, where the precision is demonstrated to be equal to or less than 25% RSD, and the mean accuracy is demonstrated to be between 70%-130% of the spiked value.

16.5.4.2 Collective Hydrocarbon Ranges The method recommends that the MRL for each hydrocarbon range be based upon the concentration of the lowest range calibration standard for the components that make up this range. The minimum MRL for each range is equal to the sum of the mass amounts of all the individual components in the lowest calibration standard point that are used for creating that range's RRF. In practice, this leads to MRLs that are so low that chromatographic

baseline noise often yields a false positive result. The laboratory will set the MRLs at or above this level so long as it meets the data quality objectives of the data user.

16.6 Ongoing Method QC Demonstrations

16.6.1 Instrument Performance Check

Acceptance Criteria – The GC/MS system must meet the mass spectra ion abundance criteria listed in Table 7. The appropriate corrective action is described below. Results of the BFB tune check as well as any actual tuning must be recorded and a copy of the tune report maintained on file.

Table 7 BFB Key Ions and Abundance Criteria

Mass	Ion Abundance Criteria
50	8.0 – 40.0 percent of the base peak
75	30.0 – 66.0 percent of the base peak
95	base peak, 100 percent relative abundance
96	5.0 – 9.0 percent of the base peak
173	less than 2.0 percent of mass 174
174	50.0 to 120.0 percent of the base peak
175	4.0 – 9.0 percent of mass 174
176	greater than 93.0 percent but less than 101.0 percent of mass 174
177	5.0 – 9.0 percent of mass 176

Corrective Action – Re-analyze the BFB compound or perform auto tune or manual tune and then re-analyze BFB. If the BFB acceptance criteria are still not met, the MS must be retuned according to the procedure outlined in the instrument user's manual. Perform necessary maintenance and make notations in the instrument maintenance logbook. It may be necessary to clean the ion source, or quadrupole, or take other necessary actions to achieve the acceptance criteria.

16.6.2 Initial Instrument Calibration

Acceptance Criteria

- Refer to Section 11.1.5 for the initial calibration procedure requirements (i.e., number of points, dropping points, etc.)
- The calculated percent relative standard deviation (%RSD, linear or quadratic regression is not allowed) for the relative response factors (RRF) for each compound in the calibration standard must be ≤30% with *Naphthalene* up to ≤40%.
- All of the following information must be retained to permit reconstruction of the initial instrument calibration: calibration date, test method, instrument, analysis date, analyte identification, analyst's initials, concentration and responses, and response factors.
- All initial instrument calibrations must be verified with an acceptable initial calibration verification (ICV) (refer to Section 16.6.3).

Corrective Action – Follow the initial calibration guidelines detailed in this document for information on re-analyzing or dropping points and the restriction of maintenance performed during the analysis of the initial calibration standards. If the criteria are not met it may be necessary to perform maintenance, if this is the case then all calibration points must be re-analyzed.

16.6.3 Initial Calibration Verification Standard (ICV) / Laboratory Control Sample (LCS)

Acceptance Criteria – The spike recovery (%R) must be between 70%-130%.

Corrective Action – If the technical acceptance criteria are not met, reanalyze and if it still fails prepare a new canister and analyze. If the criteria are still not met inspect the system for possible sources and perform any necessary maintenance and make a notation in the maintenance logbook of any steps taken. It may be necessary to clean the ion source or change the column. Perform a new initial calibration if any performed maintenance has altered instrument linearity and/or sensitivity. A demonstration of an acceptable ICV is required.

16.6.4 Continuing Calibration Verification (CCV)

Acceptance Criteria

- The percent difference (%D) must be ≤30% (single analyte or hydrocarbon range). If more than one compound fails to meet this criteria, or any one analyte or range is >50% then the CCV is considered unacceptable.
- The relative retention time (RRT) and RRT window for each target APH analyte, internal standard, and hydrocarbon range "marker" compound must be verified with each CCV analyzed.

Corrective Action – If the continuing calibration verification technical acceptance criteria are not met, reanalyze and if it still fails prepare a new canister and analyze. If the criteria are still not met inspect the system for possible sources of the problem and perform any necessary maintenance and make a notation in the maintenance logbook of any steps taken. It may be necessary to clean the ion source or change the column.

If any corrective action and/or reanalysis fails to produce continuing calibration verification within acceptance criteria (analyzed immediately following the initial failure), then either two consecutive successful verifications must be performed following corrective action or a new initial calibration must be performed. However, sample data associated with an unacceptable calibration verification may be reported as qualified data under the following special conditions:

When the acceptance criteria for the continuing calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. If however, the acceptance criteria for the continuing calibration verification are exceeded low, i.e., low bias, and there are associated samples that are non-detects, then those non-detects may be reported with the reporting limit adjusted to the next level in the calibration curve (typically 5 times higher) to prove the nonexistence of a false negative. Otherwise the sample affected by the unacceptable CCV shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

16.6.5 Method Blank

Acceptance Criteria – The method blank result for any target analyte must not be greater than the reporting limit and should not contain additional compounds with elution characteristics and mass spectral features that would interfere with identification and measurement of a method analyte.

Corrective Action – If the analyte concentration results in the blank do not meet the acceptance criteria repeat analysis with remaining QC canisters until results

are acceptable.

If the analyte results in the blank still do not meet the acceptance criteria the source of the problem must be investigated and measures taken to eliminate the source. Determine whether the contamination is from the instrument or due to contamination in the blank container (if results from the new can are not acceptable then the system is probably contaminated). Regardless, appropriate corrective measures must be taken and documented before sample analysis proceeds. However, if this is not a possibility and the results must be reported follow the reporting requirements stated in Section 18.3.

16.6.6 Laboratory (Sample) Duplicate

Acceptance Criteria – The relative percent difference (RPD) must be <30% when the results are >5x the MRL.

- If the RPD exceeds 30 and both results are >5x the MRL, the sample analysis must be repeated.
- If an analyte is detected in one analysis at >5x the MRL but not detected in the duplicate analysis, the analysis must be repeated.
- If an analyte is detected in one analysis at ≤5x the MRL but not detected in the duplicate analysis, the RPD is not calculable and the analysis does not have to be repeated.

Corrective Action – If the duplicate results do not meet the technical acceptance criteria, perform another duplicate analysis. If the results are still unacceptable and the associated samples are not reanalyzed then all of the sample results in the associated batch must be flagged accordingly.

16.6.7 Internal Standards

Acceptance Criteria – Internal standards must be adequately resolved from individual compounds in the APH calibration standard. A minimum separation requirement of 50% (maximum peak height to valley height) must be met, particularly for n-hexane and bromochloromethane (IS1). The internal standard area counts of each sample, blank, and Laboratory Control Sample must be evaluated against the corresponding continuing calibration standard or the midlevel initial calibration standard (if analyzed in the same sequence). The internal standard area counts must be within 50-200% of the continuing calibration standard area counts. If the internal standards fall outside this range, the sample, blank, or Laboratory Control Spike must be reanalyzed.

Corrective Action – If the problem is with the instrument, perform maintenance. If the problem is with a sample, check for interferences. If the response is high, it is likely that interference is present. In this case, lower the volume or aliquot of the sample and re-analyze. If the problem persists, report the results with the best quality and qualify the results. If the problem is corrected with the lower volume analysis, report those results.

16.6.8 Sample Analysis

Acceptance Criteria – Sample results must be quantitated from the initial instrument calibration and may not be quantitated from any continuing instrument calibration verification.

- The field sample must be analyzed on a GC/MS system meeting the BFB tuning, initial calibration, initial calibration verification technical acceptance criteria.

- All target analyte peaks must be within the initial calibration range or reported with the appropriate data qualifier.
- The internal standard with each sample must comply with the requirements listed in Section 16.6.7.
- Each analyte, in order to be reported, must meet the qualitative identification requirements listed in Section 12.9.1.

Corrective Action – When corrective actions are made, samples analyzed while the instrument was not functioning properly must be re-analyzed or the appropriate data qualifiers must be attached to the results.

To the extent possible, samples shall be reported only if all of the quality control measures are acceptable. If a quality control measure is found to be out of control, and the data must be reported, all samples associated with the out of control quality control measure shall be reported with the appropriate data qualifier(s).

16.7 Sample's Holding Time Expired The customer is to be notified that the sample's holding time was missed and the customer is to decide if the sample analysis is to continue. The documentation of missed holding time and the client's decision to proceed must be included in the corresponding job file. A statement dictating all holding time occurrences must accompany the sample results in the final report.

17) Data Records Management

17.1 All data resubmittal forms and job documentation including Service Requests, Chain of Custody forms, Sample Acceptance Check forms and hardcopy electronic mail messages must be filed in the project file. Final reports, revised reports, and final invoices are stored electronically.

17.2 All laboratory and client documentation must be retained for a minimum of five years.

18) Contingencies for Handling Out of Control Data

18.1 The following is specific information on how to report unacceptable data. If the data requires a data qualifier flag, as specified in this SOP, refer to Appendix D of the most recent version of the Quality Assurance Manual.

Note: No analyte results may be reported with an unacceptable initial calibration or initial calibration verification standard. However, any analyte not meeting such requirements (and the initial calibration is to be used) must be eliminated from the reporting list and any action taken fully documented.

18.2 Continuing Calibration Verification

- When the acceptance criteria for the continuing calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported without a qualifier.
- If however, the acceptance criteria for the continuing calibration verification are exceeded low, i.e., low bias, and there are associated samples that are non-detects, then those non-detects may be reported with the reporting limit adjusted to the next level in the calibration curve (typically 5 times higher) to prove the nonexistence of a false negative. If this is the case then a full explanation must be noted in the case narrative of the final report. Refer to Section 15.5 for additional reporting requirements.

18.3 Method Blank

- If an analyte in the blank is found to be out of control and the analyte is also found in associated samples, those sample results shall be "flagged" in the report and the method blank results reported.
- If the analyte is found in the blank but not in the sample then the results for the sample may be reported without a qualifier.

18.4 Laboratory Control Sample All results associated with an out of control laboratory control sample must be reported with the appropriate data qualifier. An indication of whether the LCS was out high or low should also be included.

18.5 Laboratory Duplicate All batch sample results associated with an out of control laboratory duplicate must be flagged with the appropriate data qualifier.

18.6 Internal Standard All target analytes associated with an out of control internal standard must be flagged with the appropriate data qualifier.

18.7 Estimated Sample Results

18.7.1 Sample Hold Time All occurrences of missed holding times must be included on the final report including those samples received and/or analyzed outside of the specified hold times detailed in this standard operating procedure.

18.7.2 Matrix Interference Sample data associated with matrix interference must be flagged with the appropriate data qualifier.

18.7.3 Results Outside Initial Calibration Range All sample results not bracketed by initial calibration standards (within calibration range) must be reported has having less certainty by reporting with the appropriate data qualifier.

19) Method Performance

19.1 An on-going assessment of method performance is conducted in order to ensure that the laboratory is capable of reporting results which are acceptable for its intended use.

19.2 Method Detection Limit (MDL) This method does not require that MDL studies be performed. However, the APH target compounds are a subset of the EPA TO-15 analysis for which the laboratory performs MDL studies. The procedure used to determine the method detection limits are as stated in the *Code of Federal Regulations* (40 CFR 136 Appendix B) as defined in the *SOP for Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation.* The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. The MDL concentrations are listed in Tables 2 of the *SOP for Determination of Volatile Organic Compounds in Air Samples Collected in Specially Prepared Canisters and Gas Collection Bags by Gas Chromatography/Mass Spectrometry (GC/MS)* and were obtained using spiked canisters prepared with humidified zero air, making at least seven replicate measurements of the compounds of interest, computing the standard deviation, and multiplying this value by the appropriate Student's t value for 99 percent confidence. The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects. All MDLs, regardless of the mode of operation, meet the method performance criteria of <0.5ppbV.

19.3 Accuracy and Precision Refer to Section 16.5.1 above for information on replicate precision and accuracy criteria for method performance. Single laboratory accuracy is presented as the second source initial calibration verification standard, which meets

the method performance criteria of 30%. Additionally, laboratory generated control limit data for LCSs are presented for the analytes of interest and may be referenced in the TO-15 Method Manual.

19.4 Selectivity Mass spectrometry is considered a more definitive identification technique than single specific detectors such as flame ionization detector (FID), electron capture detector (ECD), photoionization detector (PID), or a multidetector arrangement of these (see discussion in Compendium Method TO-14A). The use of both gas chromatographic retention time and the generally unique mass fragmentation patterns reduce the chances for misidentification.

It is necessary to establish that a given GC/MS meets tuning and standard mass spectral abundance criteria prior to initiating any data collection. Upon sample injection onto the column, the GC/MS system is operated so that the MS scans the atomic mass range from 35 to 300 amu. At least ten scans per eluting chromatographic peak must be acquired. Scanning also allows identification of unknown compounds in the sample by searching through library spectra.

The sample analysis using the GC/MS is based in part on a combination of retention times and relative abundances of selected ions. The retention time of each chromatographic peak should be ±0.10 minutes of the library/reference retention time of the compound. The acceptance level for relative abundance should be set at ±20% of the expected abundance. The data should be manually examined by the analyst to determine the reason for the # flag [(#) = qualifier out of range], if present and whether the compound should be reported as found or if there is matrix interference. A background subtraction may aid in this determination. Manual inspection of the qualitative results should also be performed to verify concentrations outside the expected range.

Specific selectivity information is provided in this section and document (such as relative retention time) as well as in the referenced method. Refer to the method for additional information on selectivity.

- Use NIST Library 98 or newer version
- The *reference spectra updates* must be performed with every new ICAL utilizing the mid-level standard (minimum). If needed, the reference spectra may be updated sooner with the continuing calibration standard.
- *Retention time updates* must be performed using EasyID and not by updating to the method (InitCal \ Update Calibration). Refer to the Help selection of the software.

19.5 Demonstration of Capability

See Sections 16.5 and 16.6 for initial and ongoing method QC requirements.

20) Summary of Changes

Table 20.1

Revision Number	Effective Date	Document Editor	Description of Changes
09.0	03/21/15	C. Humphrey	Section 4 – Revised section to include Hazard Assessment table
			Section 12.9 – Added Note 2
			Attachment 3 – Replaced Data Review Checklist with combined TO-15/MAPH Daily QC and Sample Review Checklists

21) References and Related Documents

21.1 *Method for the Determination of Air-Phase Petroleum Hydrocarbons (APH)*, Final Revision 1, Massachusetts Department of Environmental Protection, December 2009.

21.2 *SOP for Batches and Sequences*, SOP ID ADM-BATCH_SEQ

21.3 *SOP for Making Entries onto Analytical Records*, SOP ID CE-QA007

21.4 *SOP for the Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*, SOP ID CE-QA011

21.5 *SOP for Manual Integration Policy*, SOP ID CE-QA002

21.6 *SOP for Nonconformance and Corrective Action*, SOP ID CE-QA008

21.7 *SOP for Cleaning and Certification of Summa Canisters and Other Specially Prepared Canisters,* SOP ID SMO-CanCert

21.8 *SOP for Flow Controllers and Critical Orifices,* SOP ID SMO-Flow_Cntrl.

21.9 *SOP for Determination of Volatile Organic Compounds in Air Samples Collected in Specially Prepared Canisters and Gas Collection Bags by Gas Chromatography/Mass Spectrometry (GC/MS),* SOP ID VOA-TO15

21.10 2009 TNI Standards

22) Appendix

22.1 Attachments

Attachment 1 – Training Plan

Attachment 2 – Initial Calibration Checklist

Attachment 3 – Daily QC and Sample Review Checklists

Attachment 1

Training Plan

Training Plan for Analysis of Air-Phase Petroleum Hydrocarbons (APH) by GC/MS

SOP Title: _____ Revision:_____ Date: _____

Trainee: _____ Trainer: _____ Instrument: _____

1. Read SOP — Trainer ____ Trainee ____ Date _____

2. Read Method — Trainer ____ Trainee ____ Date _____

3. Demonstrated understanding of the scientific basis of the analysis — Trainer ____ Trainee ____ Date _____
   Training Duration _____
   - Whole air sample preconcentration techniques
   - Gas chromatography
   - Mass spectrometry

4. Demonstrated familiarity with related SOPs — Trainer ____ Trainee ____ Date _____
   Training Duration _____
   - SOP for Batches and Sequences
   - SOP for Making Entries onto Analytical Records
   - SOP for Manual Integration Policy
   - SOP for Significant Figures
   - SOP for Nonconformance and Corrective Action
   - SOP for Performing MDL Studies and Establishing Limits of Detection and Quantitation
   - SOP for Cleaning and Certification of Summa Canisters

5. Observe performance of SOP *Training Duration* _____ Trainer ____ Trainee ____ Date _____
   - ___sample preparation/dilution and sample loading and analysis
   - ___analytical sequence setup
   - ___standard preparation
   - ___BFB tuning evaluation/initial calibration/initial calibration verification
   - ___continuing calibration verification
   - ___EnviroQuant introduction
   - ___data reduction and reporting
   - ___canister handling

6. Perform SOP with supervision *Training Duration* _____ Trainer ____ Trainee ____ Date _____
   - ___sample preparation/dilution and sample loading
   - ___analytical sequence setup
   - ___standard preparation
   - ___BFB tuning evaluation/initial calibration/initial calibration verification
   - ___continuing calibration verification
   - ___sample analysis
   - ___EnviroQuant use
   - ___data reduction and reporting
   - ___canister handling

7. Independent performance of the SOP *Training Duration* _____ Trainer ____ Trainee ____ Date _____
   - ___sample loading and sample dilutions
   - ___analytical sequence setup
   - ___standard preparation
   - ___BFB tuning evaluation/initial calibration/initial calibration verification
   - ___continuing calibration verification
   - ___sample analysis
   - ___EnviroQuant proficiency
   - ___data reduction and reporting
   - ___canister handling
   - ___initial demonstration of competency
     - -4 Laboratory Control Samples

8. Instrument operation and maintenance *Training Duration* _____ Trainer ____ Trainee ____ Date _____
   - ___autosample
   - ___GC and capillary column installation
   - ___mass spectrometer
   - ___data system

Attachment 2

Initial Calibration Checklist

Method: **MAPH**
ICAL Date: _____
Instrument: ☐ MS8 ☐ MS9 ☐ MS13 ☐ MS16 ☐ MS____

Air-Phase Petroleum Hydrocarbons
Initial Calibration Review Checklist

Analyst **Reviewer**

☐ 1. Is the required documentation in the ICAL file? ☐
- ☐ BFB Tune analysis Report ☐
- ☐ Calibration Status Report (aka Calibration History) ☐
- ☐ Response Factor Report/Percent RSD (target analytes) ☐
- ☐ Percent RSD Report (hydrocarbon ranges) ☐
- ☐ Quantitation Report for each calibration standard (including manual integration documentation) ☐
- ☐ ICV Quantitation Report ☐

☐ 2. Was the ICAL performed continuously (i.e., not interrupted for maintenance or for sample analysis)? ☐

☐ 3. Have all the calibration standards been analyzed within 24 hours of each other? ☐

☐ 4. Does the BFB tune check standard analysis at the start meet the tune criteria? ☐

☐ 5. Are all the analytes in the blank analysis <MRL? ☐

☐ 6. Does each analyte's ICAL include a minimum of 5 concentrations at 5 consecutive levels? ☐

☐ 7. Were the standards analyzed from low concentration to high concentration? ☐

☐ 8. For each analyte or range, are there no levels skipped? ☐

☐ 9. For each analyte or range, is there only one value used for each calibration level? ☐

☐ 10. For each analyte range, is the lowest standard's concentration at or below the analyte's MRL? ☐

☐ 11. If a calibration level is dropped, are all the responses for each target analyte and range dropped and is the information noted in the ICAL explaining the reason? ☐

☐ 12. Is the average RSD ≤30% for all analytes and ranges, except *naphthalene* can be ≤40%? ☐

☐ 13. For the ICV analysis, are all the analytes within 70%-130% recovery? ☐

☐ 14. If there are any manual integrations, are they performed correctly according to the corresponding SOP? If so, initial and date the appropriate pages. ☐

COMMENTS:

Analyst: _____ Date: _____

Secondary Reviewer: _____ Date: _____

Attachment 3

Daily QC and Sample Review Checklists

Daily QC Review Checklist

(Note exceptions in Comments and include Analysis Observations/Case Narrative Summary Form as appropriate)

EPA Compendium Method TO-15

Method: ☐ EPA TO-15 ☐ EPA TO-14A **Analysis Date:** _____

Instrument: ☐ MS3 ☐ MS8 ☐ MS9 ☐ MS13 ☐ MS16 ☐ MS19 ☐ MS21

Mode: ☐ SIM ☐ Scan **Scan Low Level (0.1ng):** ☐ Yes ☐ No **DOD:** ☐ Yes ☐ No

Analyst		**Reviewer**
☐	1. Is the required documentation present? ☐ CORRECT BFB Tune analysis Report ☐ CCV analysis Quantitation Report & %D Report ☐ LCS analysis Quantitation Report ☐ MB analysis Quantitation Report	☐
☐	2. BFB **tune** check standard analysis meet the tune criteria for the method indicated above?	☐
☐	3. Analyses within the tune's **24-hr window or** ☐ **Client's 12hr window requirement**?	☐
☐	4. Does the **CCV** have a difference ≤30% for all analytes? [Note all outliers biased high and/or low]	☐
☐	5. All **IS** retention times within 20 seconds of the CCV RT or the RT from the midpoint (ICAL)?	☐
☐	6. All **IS** responses within ±40% of CCV or the midpoint in the ICAL?	☐
☐	7. All **surrogate** recoveries (in CCVs, MB, LCSs, etc.) within acceptance limits (70%-130%)	☐
☐	8. All analytes in the **MB** <MRL? (DoD <1/2MRL, except Acetone, MeCl2, EtOH, Carbon Disulfide)?	☐
☐	9. **LCS** %R within the lab control limits for all analytes except AZ samples (70%-130%, VA 50%-150%)?	☐
☐	10. All analytes in the **Lab Duplicate / DLCS** within ±25% or the client specified limits?	☐

COMMENTS:

Air-Phase Petroleum Hydrocarbons

☐	1. Does the **CCV** meet the following criteria? • Percent difference ≤30%. • One compound or range can be >30%, but less than 50%. • No single analyte or range may be >50%. [Note outliers biased high and/or low]	☐
☐	2. Does lab **duplicate** meet an RPD of ≤30% for results >5x MRL? Repeat analysis if:	☐
☐	3. Are the analytes in the **LCS** within 70%-130% recovery?	☐

RPD >30 (where both analyses are >5x RL	1st analysis detect @ >5x MRL, Dup=ND
1st analysis ≤5x RL; Dup=ND (RPD not calculable)	

COMMENTS:

☐ LIMS Run Approval ☐ LIMS Supervisor Approval

Analyst: _____ Secondary Reviewer: _____

Date: _____ Date: _____

Sample Review Checklist
(Note exceptions in Comments and include Analysis Observations/Case Narrative Summary Form as appropriate)

EPA Compendium Method TO-15

Method: ☐ EPA TO-15 ☐ EPA TO-14A **Analysis Date:** _____ **Project #:** _____

Instrument: ☐ MS3 ☐ MS8 ☐ MS9 ☐ MS13 ☐ MS16 ☐ MS19 ☐ MS21

Mode: ☐ SIM ☐ Scan **Scan Low Level (0.1ng):** ☐ Yes ☐ No **DOD:** ☐ Yes ☐ No

Analyst		Reviewer
☐	1. All analyte hits in the samples within the **calibration range** and/or noted?	☐
☐	2. All **peak integrations** acceptable?	☐
☐	3. All **manual integrations** flagged and documented?	☐
☐	4. Have **Q values** been verified for each peak?	☐
☐	6. All **calculations** correct?	☐
☐	7. Has the analyst initialed and dated each **quantitation report**?	☐
☐	8. For **TICs** are the relative intensity and other requirements met?	☐
☐	9. **Auto report** correct?	☐
☐	10. **MRL** = _____ ☐ ng ☐ pg (ethanol, acetone, vinyl acetate = 5.0ng)	☐
☐	11. Pressurized with **Helium**? Is the worksheet completed for all samples?	☐
☐	12. Report to **MDL**? ☐ Yes ☐ No	☐
☐	13. **Global Minimum Detection Limit** = _____ ☐ ng ☐ pg	☐
☐	14. **DOD:** Are **manual integrations** notated in the **case narrative?**	☐

COMMENTS:

Air-Phase Petroleum Hydrocarbon

☐	1. Are all manual **integrations** flagged and documented (except for HC ranges)?	☐
☐	2. Are all peak **integrations** acceptable?	☐
☐	3. Has the analyst initialed and dated each **quantitation report**?	☐
☐	4. Are the associated ICAL responses correct?	☐
☐	5. Are the sample responses entered into the template correctly?	☐
☐	6. Are the TO-15 target compounds entered into the template correctly?	☐
☐	7. Does the lab **duplicate** meet a RPD of ≤30% for results >5x the MRL? Otherwise, repeat analyses if:	☐

RPD >30 (where both analyses are >5x RL	1st analysis detect @ >5x MRL, Dup=ND
1st analysis ≤5x RL; Dup=ND (RPD not calculable)	

COMMENTS:

☐ LIMS Run Approval

Analyst: _____

Date: _____

☐ LIMS Supervisor Approval

Secondary Reviewer: _____

Date: _____

ALS Standard Operating Procedure

DOCUMENT TITLE:	DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN AIR SAMPLES COLLECTED IN SPECIALLY PREPARED CANISTERS AND GAS COLLECTION BAGS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)
REFERENCED METHOD:	EPA TO-15
SOP ID:	VOA-TO15
REV. NUMBER:	22.0
EFFECTIVE DATE:	03/21/2015

Proprietary - Uncontroll Copy

STANDARD OPERATING PROCEDURE

DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN AIR SAMPLES COLLECTED IN SPECIALLY PREPARED CANISTERS AND GAS COLLECTION BAGS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

EPA TO-15

SOP ID:	VOA-TO15	Rev. Number:	22.0	Effective Date:	03/21/2015

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Archival Date: _____ Doc Control ID#: Non-Controlled Editor: _____

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DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN AIR SAMPLES COLLECTED IN SPECIALLY PREPARED CANISTERS AND GAS COLLECTION BAGS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

1) Scope and Applicability

1.1 This procedure is based on and incorporates the requirements detailed in EPA Compendium Methods TO-15 and TO-14A and is used to quantify a wide range of volatile organic compounds (VOCs) in gaseous matrices collected in gas collection bags (method modification) and specially prepared stainless steel canisters or glass bottles. This method typically applies to ambient concentrations of VOCs 0.50ug/m3 (down to 0.10ug/m3 for low level ambient analyses) and above for the SCAN mode and 0.010ug/m3 and above for the SIM mode; however, refer to Tables 3 and 3A for the specific laboratory initial calibration ranges for each target compound. The method requires VOC enrichment by concentrating up to one liter of a sample volume, with a virtually unlimited upper concentration range using dilutions from source level samples.

In this document, Tables 2 and 2A (see Note 1 below) list compounds that can be determined by this procedure along with their corresponding laboratory method reporting limits (MRLs) and method detection limits (MDLs). The reported MRL may be adjusted higher; however, the capability of achieving lower MRLs for specific project requirements must be thoroughly demonstrated (by an acceptable initial calibration and method reporting limit check standard) and documented as long as the MRL is higher than the current method detection limit for each compound. Additional compounds may be analyzed according to this procedure as described in the referenced methods as long as the requirements of this document are adhered to; however, if a compound is not listed in the TO-15 method, refer to Note 1 below. The number of samples that may be analyzed in a 24-hour period is about twenty. The number of sample results that may be reduced in an eight-hour day is approximately twenty.

2) Summary of Procedure

2.1 The analytical method involves using a high-resolution gas chromatograph (GC) coupled to a mass spectrometer (MS). The GC/MS utilizes a linear quadrupole system, which allows for it to be operated by either continuously scanning a wide range of mass to charge ratios (SCAN mode) or by Select Ion Monitoring mode (SIM), which consists of monitoring a small number of ions from a specified compound list.

An aliquot of an air sample is concentrated on a solid adsorbent trap (either cryogenically or fan cooled glass beads or stronger adsorbents at higher temperatures) to collect the analytes of interest. To remove co-collected water vapor, the concentrated sample then goes through a water removal (dry purge) step. After the sample is pre-concentrated on a trap, the trap is heated and the VOCs are thermally desorbed onto a refocusing cold trap. The VOCs are then thermally desorbed onto the head of a capillary column once the cold trap is heated. The oven temperature (programmed) increases and the VOCs elute and are detected by the mass spectrometer.

Mass spectra for individual peaks in the total ion chromatogram are examined with respect to the fragmentation pattern of ions corresponding to various VOCs including the intensity of primary and secondary ions. The fragmentation pattern is compared with stored spectra taken under similar conditions, in order to identify the compound. For any given compound, the intensity of the primary fragment is compared with the

system response to the primary fragment for known amounts of the compound. This method utilizes the internal standard calibration technique; refer to Section 3.16 for a complete definition.

3) Definitions

3.1 Cryogen A refrigerant used to obtain sub-ambient temperatures in the VOC concentrator and/or on front of the analytical column. Liquid nitrogen (cryogen) is used for this purpose and it has a boiling point of -195.8°C.

3.2 Gauge Pressure Pressure measure with reference to the surrounding atmospheric (barometric) pressure, usually expressed in units of psig. Zero gauge pressure is equal to atmospheric pressure.

3.3 MS-SCAN Mass spectrometric mode of operation in which the gas chromatograph (GC) is coupled to a mass spectrometer (MS) programmed to SCAN all ions repeatedly over a specified mass range.

3.4 MS-SIM Mass spectrometric mode of operation in which the GC is coupled to a MS that is programmed to scan a selected number of ions repeatedly [i.e., selected ion monitoring (SIM) mode].

3.5 Analytical Sequence The analytical sequence describes exactly how the field and QC samples in an analytical batch are to be analyzed.

3.6 Neat Stock Standard A purchased, single component assayed reference material having a stated purity used to prepare working calibration standards.

3.7 Stock Standards Solution A concentrated solution of one or more target analytes at a known concentration purchased from a reputable commercial vendor. Stock standard solutions are used to prepare working calibration standards.

3.8 Intermediate Calibration Standard A solution of one or more target analytes at a known concentration prepared either from one or more neat stock standards or from one or more stock standards solutions.

3.9 Working Calibration Standard A solution of all the target analytes at a known concentration prepared either from one or more intermediate calibration standards and/or from one or more stock standard solutions.

3.10 Calibration or Standard Curve A calibration or standard curve is a graph which plots the concentration of a compound (or an analyte) versus the instrument response to the compound.

3.11 Initial Calibration Verification (ICV) Standard A solution prepared in the laboratory containing known concentration(s) of analytes of interest. The solution is prepared from neat stock standards and/or stock standards solutions which are from a different source than the standards used to prepare the working calibration standards.

3.12 Continuing Calibration Verification (CCV) Standard A working calibration standard which is analyzed at specific intervals in order to verify that the instrument continues to meet the calibration criteria.

3.13 Field Sample A sample collected and delivered to the laboratory for analysis.

3.14 Manual Integration This term applies to a data file in which setpoints have been changed and reintegration has occurred under the changed setpoints; baselines have been adjusted; peak integration start and stop "ticks" have been changed; peak area, or peak height, are changed after the time of data collection and data file generation.

3.15 Batch Quality Control (QC) Batch QC refers to the QC samples that are analyzed in an analytical batch of field samples and includes the Method Blank (MB), Laboratory Control Sample (LCS) and Laboratory Duplicate (LD).

3.16 Internal Standard Calibration Compares the instrument responses from the target compound in the sample to the responses of specific standards (called internal standards), which are added to the sample or sample preparation prior to analysis. The ratio of the peak area (or height) of the target compound in the sample or sample preparation is compared to a similar ratio derived for each calibration standard.

3.17 May This action, activity, or procedural step is neither required nor prohibited.

3.18 Must This action, activity, or procedural step is required.

3.19 Shall This action, activity, or procedural step is required.

3.20 Should This action, activity, or procedural step is suggested, but not required.

3.21 SOP Standard Operating Procedure

3.22 Service Request A form generated, at the time of sample receipt, which details pertinent information such as client name, address, contact, client and laboratory sample identifications, sampling and receipt dates and times, requested analyses, sample type, canister pressures (initial and final), and the service request number (unique number for each submitted job) and serves as an inter-laboratory "custody" form which accompanies all samples throughout the laboratory.

3.23 Selectivity Selectivity of a method refers to the extent to which it can determine particular analyte(s) in a complex mixture without interference from other components in a mixture. Another definition is the extent to which a particular method can be used to determine analytes under given conditions in the presence of other components of similar behavior.

3.24 Limit of Detection (LOD) The smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate (Type II error) is 1%. (DoD Clarification). For consistency purposes, the LOD may be referred to as the MDL once it is reported; however, full verification will be on file in the laboratory per the procedures detailed in this document.

3.25 Limit of Quantitation (LOQ) The lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard. (DoD Clarification). For consistency purposes and since the LOQ and MRL are equivalent with regards to laboratory procedure, the LOQ will be referred to as the MRL in this document and once it is reported. Full verification will be on file in the laboratory per the procedures detailed in the document.

3.26 Detection Limit (DL) / Method Detection Limit (MDL) The smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate (Type 1 error) is 1%. (DoD Clarification). For consistency purposes, the DL may be referred to as MDL. Also, as far as reporting is concerned the MDL will be raised up (where necessary) to the verified LOD per the procedures defined in this document and reported accordingly.

4) Health and Safety Warnings

4.1 Refer to the laboratory's Environmental, Health and Safety Manual as it makes reference to the safe handling of chemicals, Safety Data Sheet (SDS) location, and the laboratory waste management plan for the safe disposal of chemicals and samples.

4.2 Pollution Prevention and Waste Management

All waste disposals shall be carried out in accordance with the requirements detailed in the *SOP for Waste Disposal.* In addition, canisters must be cleaned in accordance with the requirements detailed in the *SOP for Cleaning and Certification of Summa Canister and Other Specially Prepared Canisters.*

4.3 This procedure may include CHEMICAL, OPERATIONAL and/or EQUIPMENT hazards. Employees must review and understand the following hazards and their preventive measures prior to proceeding with this activity.

HAZARD ASSESSMENT		
Job Task #1: Standard and Sample Preparation	**Hazards**	**Preventative Measures**
Compounds, mixtures of compounds, standards, surrogates, and samples.	Exposure to potential health hazards through absorption through skin. Inhalation hazards.	Reduce exposure through the use of gloves and fume hoods. Safety glasses must be worn when working in the prep lab. Care should be taken when handling standard material in a neat or highly concentrated form. Personal protective clothing (safety glasses, gloves, and lab coat) are required when handling standard material in neat form. Consult Safety Data Sheets (SDS) for compounds being handled in this procedure, and be familiar with proper safety precautions.
Job Task #2: Working with Liquid Nitrogen	**Hazards**	**Preventative Measures**
Turning valves and handling tubing and fittings that have been in contact with the cryogen.	Can cause serious tissue damage (frostbite) with only a few seconds of contact.	Wear neoprene or leather gloves. Valves on cryogen dewars should be opened slowly so leaky fitting can be identified.
Job Task #3: Working with Pressurized Gases	**Hazards**	**Preventative Measures**
Using and moving compressed gas cylinders.	Gas leak, fire, and explosion. Personal injury due to falling during transport.	All cylinders must be secured in an upright position to a wall or immovable counter with a chain or a cylinder clamp when not in use. Keep safety caps on when cylinders are not in use. A handcart must be used when transporting cylinders. The cylinder must be secured to the handcart with a chain or belt. The regulator should never remain on small "D" size cylinders following use. Full cylinders must be kept separate from empty cylinders. Flammable gases (i.e. pressurized hydrogen) must be clearly labeled. Flammables and oxidizers must be separated by a ½-hour fire wall or by at least twenty feet.
Job Task #4: Glass Syringes	**Hazards**	**Preventative Measures**
Glass syringe use	Skin lacerations and punctures.	The proper use of syringes should be part of employee training for this SOP. Care should be taken to avoid personal injury as a result or improper handling techniques.

Hazard information related to this activity which is not included or referenced in this document, should be immediately brought to the attention of the Department Supervisor.

5) Cautions

5.1 A maintenance log will be kept documenting maintenance performed on each analytical system. The serial numbers of each instrument shall be recorded, and each log entry must include a description of the maintenance performed and be initialed by the analyst performing or observing/authorizing maintenance by an outside contractor.

The instrument maintenance log must be kept current. An entry shall be made in the appropriate log every time maintenance is performed (no matter the extent). The entry in the log must include.

(a) The date of maintenance
(b) Who did the maintenance
(c) Description of the maintenance
(d) Proof that the maintenance activity was successful

A notation of a successful tune and continuing calibration or initial calibration and the file number that accompanies the data will serve as proof that the maintenance is complete and the instrument is in working order.

The extent of the maintenance is not important, however, it is important that a notation be included for each maintenance activity such as changing a column, tuning the instrument, changing the pump oil, cleaning the source, ordering a part. In addition, a notation should be made in the logbook stating that no samples were analyzed during the days that the instrument was down and no active maintenance was being conducted (i.e., where no other notation was made in the logbook for those days).

5.2 Concentrating Trap

Routine maintenance includes periodic solvent cleaning of the Silco steel lines in the valve oven if contamination is suspected. Also, periodic replacement of the multi-sorbent or partial replacement of the trap if analyte specific deterioration is detected is required. For specific trap information refer to the instrument maintenance logbook and electronic method manual.

After repacking, the trap should be baked at 265°C for a minimum of two hours (or until a clean blank is generated) and a partial repacking requires baking (at 265°C) the trap for a minimum of 20 minutes (or until a clean blank is generated).

5.3 GC System

Column performance is monitored by observing both peak shapes and column bleed. Over time, the column will exhibit a poor overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced (see Section 9.5). Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column.

Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and “clean” (uniform, without fragmentation) by using the proper column-cutting tool. When removing any major portion of the column, which will affect the retention times and elution characteristics, a change in instrument conditions may be required to facilitate nominal analytical activity.

Declining performance can also be due to ineffective column ferrules, which should be replaced when a tight seal around the column is no longer possible. This can be detected with the use of a leak detector.

5.4 Mass Spectrometer

The Mass Selective Detector (MSD) ion source requires periodic cleaning to maintain proper performance. Symptoms of a dirty ion source include difficulty keeping the MSD in tune and fluctuating internal standard areas. The vacuum system should be serviced every six months, including changing the pump oil and checking the molecular sieve in the back-streaming trap.

5.5 Instrument Tuning

The instrument is tuned with guidance from the procedure described in the HP Operations Manual, when necessary.

5.6 Computer Troubleshooting

Computer care and troubleshooting is conducted by the IT department. Refer to Section 9.6 for the computer hardware and software requirements.

Computers are selected to meet or exceed operating system and or acquisition software requirements. Periodic upgrades of memory are performed to maintain or improve system performance and reliability. Upgrades may be performed on systems until instrument hardware configurations become the limiting factor.

Basic Troubleshooting Outline:

1) Document occurrence and severity in IT Log
2) Interview user(s)
3) Investigate any available logs (Event Logs, Acquisition Logs, etc.)
4) Determine if problem is isolated (single user or acquisition) or widespread (multi user or network).
5) If multiple possibilities exist for cause, then eliminate in systematic manner.
6) Hardware issues are addressed with component replacement (beginning with most suspect portion).
7) Software issues are addressed first with internet investigation (user blogs, software source updates/findings).
8) Network issues are investigated from the Server, to Switch, to Network Card; utilizing all available managed devices to help discover possible failure points.
9) In some cases, system corruption may require reload or complete system replacement.
10) Finalize documentation in IT Log with actions taken
11) Perform periodic follow-up with User and review any log found to have suspect events that suggested source of issue.

6) Interferences

6.1 Summa Canisters

Canisters shall be stored in a contaminant free location and shall be capped tightly during shipment to prevent leakage and minimize any compromise of the sample. The pressure/vacuum is checked prior to shipment and upon receipt from the field. Any problems with the sample from the field are noted and the Project Manager contacted.

Also, canisters must be cleaned and certified to be free from target analytes before being shipped to the field for sample collection. The procedure is described in detail in the *SOP for Cleaning and Certification of Summa Canister and Other Specially*

Prepared Canisters (refer to this procedure as well as Section 16.7 for the acceptance criteria).

Current laboratory practice entails the segregation of 6L canisters into ambient (low) level and source levels. All the ambient canisters are used for low level (indoor air, ambient air) projects and not intentionally for soil gas, SVE monitoring, or other higher level applications. It may be necessary to "retire" an ambient canister and re-assign for source level use if high concentrations are encountered. This decision will be made by management based on analytical concentrations and what compounds were encountered at these levels. If the level of any analyte is detected above 5,000ug/m*3* in the ambient can, then the supervisor/team leader must be contacted to determine if the canister(s) is to be retired. If retirement is decided upon, make a notation on the sample tag (or other color coded tag) of each canister in question. The notation must contain the analyte, threshold levels and retirement from ambient use (initial and date notation) so that the canister conditioning/management department may properly execute the retirement.

6.2 Analytical System

The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running humidified zero air blanks. The use of non-chromatographic grade stainless steel tubing, non-PTFE thread sealants, or flow controllers with buna-N rubber components must be avoided.

6.3 Carbon Dioxide

Excessive levels of carbon dioxide present in a sample may interfere with analysis by freezing up the cryogenic trap. A smaller aliquot must be analyzed to eliminate this problem, or the sample should be analyzed using the higher temperature multi-adsorbent trapping technique which allows carbon dioxide to pass.

6.4 Gas Collection Bags

This procedure covers the use of gas collection vessels such as Tedlar® or Mylar® bags. However, due to the nature of these types of bags it is not recommended that clients use this option for ambient air samples. Sample collection bags made out of ®Tedlar have contaminants that are inherent to the manufacturing process. The two main contaminants are phenol and N,N-Dimethylacetamide. However, this only becomes a problem when the concentration levels in the sample are low ppbv such as ambient air monitoring samples where more of the sample usually has to be concentrated and analyzed. To minimize the loss of sample integrity, a 72-hour hold time has been incorporated into the procedure.

6.5 Glassware

Interferences caused by contaminants in solvents, reagents, glassware, and other sample processing hardware results in discrete artifacts and/or elevated baselines in the detector profiles should be minimized. All glassware associated with this method must be scrupulously cleaned to avoid possible contamination. The cleaning shall be performed in accordance with the procedure outlined in the *SOP for Glassware Cleaning*. The use of high purity water, reagents, and solvents helps to minimize these problems.

7) Personnel Qualifications and Responsibilities

7.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP

may perform analysis, interpretation and peer review of the results. Data reduction and/or peer review may be performed by another qualified employee. This employee must be familiar with the analytical technique and have completed a data review training plan to ensure familiarity with specific analysis and requirements.

7.2 The supervisor/manager must ensure that method proficiency is documented initially and whenever significant changes in the instrument type, personnel, and matrix or test method are made.

7.3 The department supervisor/manager or designee shall perform final review and sign-off of the data.

7.4 Demonstration of Capability

All analysts must be trained in accordance with the guidelines detailed in the *SOP for Training Policy*. Demonstrations shall also be performed in accordance with the 2009 TNI Standards (Volume 1 Module 4 Section 1.6) and DoD Quality Systems Manual 5.0. Attachment 1 shall be used to document the training plan for new analysts' initial demonstration. Additionally, these demonstrations are performed anytime there is a change in instrument type, personnel or method.

Once performance is found to be acceptable, a required certification statement must be completed by the QA Manager and either the immediate supervisor or Laboratory Manager and retained on file as a demonstration of compliance.

7.4.1 Quarterly Demonstration A demonstration of method sensitivity must be performed *quarterly on each instrument* performing this method.

1) A spike at the current LOD must be analyzed.

2) Verification of precision and bias at the LOQ must be performed.

Refer to Section 11.1.4.2 (LOQ) and 12.14.1 (LOD) for additional information on how these demonstrations are to be performed as well as the acceptance criteria.

7.4.2 Annual Demonstration Each analyst must perform this demonstration both initially and annually. Analyze four LCS standards at 1-4x the MRL (LOQ) either concurrently or over a period of days as a verification of precision and bias of the quantitation range. The standard deviation (n-1) and average percent recovery of the four replicates are compared against the method requirement for precision (±25%) and current laboratory control limits for bias/LCS.

7.4.3 Change in Personnel, Instruments, Method and/or Matrix The requirements in Sections 7.4.1 and 7.4.2 must be performed per the schedule noted and when there is a change in personnel, instruments, method or matrix. "Change" refers to any change in personnel, instrument, test method, or sample matrix that potentially affects the precision and bias, sensitivity, or selectivity of the output (e.g., a change in the detector, column type, matrix, or other components of the sample analytical system, or a method revision).

All completed attempts at this demonstration must be completed and turned into the QA department for retention.

8) Sample Collection, Handling, and Preservation

8.1 Air samples are collected in the field and delivered to the laboratory and shall be collected in either a specially prepared, leak-free, stainless steel pressure vessel (with valve) of desired volume (e.g., 6L), a glass sampling bottle (Bottle Vac, Entech

Inntruments) or a sample collection bag (Tedlar). Canister samples may either be grab or time integrated (using a variable flow controller, refer to the *SOP for Flow Controllers and Critical Orifices*) utilizing the canister vacuum to draw the sample. Bags require the use of an upstream pump or a "lung machine."

8.2 There are no special preservation requirements for either canisters, Bottle Vacs or bags. However, bags should be stored in an environment free from puncture or deterioration sources (by hanging them from clips), labeled with the specific service request number, in accordance with the *SOP for Laboratory Storage, Analysis and Tracking*. Canisters and bottles should be stored on the appropriate shelves until they are to be analyzed.

8.3 Sample collection bags must be analyzed within 72 hours from the confirmed time of sampling. Samples received by the laboratory shall be analyzed within 30 days of sampling or sooner if project specific requirements dictate. Programs, which have shorter recommended or required hold times, include the Department of Toxic Substances Control (DTSC), which advises a 72 hour hold time. The Minnesota Pollutions Control Agency (MPCA) and EPA Region 9 both require a 14 days hold time. Additionally, the MPCA does not allow the use of Tedlar bags for sampling or sample dilution. The DTSC requirement is an advisory notice, but the laboratory shall make every effort to comply. However, the following statement shall be added to each report where sample analyses do not meet the 72 hour hold time and the client project is intended to comply with DTSC requirements. "The recommended 72-hour hold time for the analysis of TO-15 was exceeded per the DTSC and LARWQCB Advisory – Active Soil Gas Investigations document dated January 28, 2003; however, this specific hold time statement is advisory and not considered as regulation. In addition, the samples were analyzed within the EPA Method TO-15 stated requirement of 30 days."

9) Equipment and Supplies

9.1 Additional instruments and/or differing models may be utilized as long as they are equivalent and meet the minimum requirements of this document.

9.2 Gas Chromatograph (GC)

An instrument capable of temperature programming, with a column oven that may be cooled to sub-ambient temperature at the start of the gas chromatographic run to result in the resolution of the VOCs.

Hewlett Packard 5890 Series II Plus
Hewlett Packard 6890 Series
Hewlett Packard 6890A Series
Agilent 6890N Series
Agilent 7890A Series

9.3 Autosampler

Tekmar-Dohrmann AUTOCan Autosampler:	14-ACAN-074
Concentrating Trap (cryogenic trap, built-in):	14-6938-020
Cryofocusing Module w/split valve:	14-6520-A00
GAST Vacuum Pump:	DOA-P104-AA or equivalent

9.4 Mass Spectrometer (MS)

A MS capable of scanning from 34 to 350 amu every second or less, using 70 volts

(nominal) electron energy in the electron impact ionization mode. The mass spectrometer must be capable of producing a mass spectrum for Bromofluorobenzene (BFB) which meets all of the criteria when 50ng or less of BFB is injected onto the GC/MS system.

Hewlett Packard 5972 Series
Hewlett Packard 5973 Series
Agilent 5973N
Agilent 5973 *inert*
Agilent 5975B *inert*
Agilent 5975C *inert*

9.4.1 Ionization Gauge Controller

- Agilent: 59864B
- Granville-Phillips 330 Ionization Gauge Controller: 330001/2/3
- Hewlett Packard Ionization Gauge Controller: 59864B

9.5 Analytical Column

Any analytical column capable of separating the compounds of interest may be used. The capillary column should be directly coupled to the source of the mass spectrometer. The following are suggested columns; an alternative column may be used as long as sufficient peak resolution and separation is achieved.

- Restek Rxi-1ms Fused Silica Capillary Column; 30m x 0.25mm ID 1.0µm film thickness

  OR

- Restek Rxi-1ms Fused Silica Capillary Column; 60m x 0.25mm ID 1.0µm film thickness

9.6 Data Systems

IBM-compatible PC with Windows 95/98/NT/XP/7 (Microsoft Office EXCEL version 2003 or newer) and Hewlett Packard Chemstation software including EnviroQuant with Extracted Ion Current Profile (EICP), National Institute of Standards and Technology (NIST) library (2002 version or newer) or equivalent.

9.7 Canister Pressurization Station

Vacuum/Pressure Gauge [0 to –30 inHg; 0-90 or 100 psig]

9.8 Canister Sampling Devices

Refer to the *SOP for Flow Controllers and Critical Orifices* for specific calibration and other pertinent information.

- VICI Condyne Model 300 Flow Controller
- Critical Orifices (Laboratory manufactured)

9.9 Gas Collection Devices

- Lab Commerce, Aerosphere Model S6L, 6.0L Summa Passivated Canisters or equivalent
- Lab Commerce, Stabilizer Model 22.4L, 2.4L Canisters or equivalent
- Restek Corporation, #24203, 3.0L Silco Canisters or equivalent

- Tedlar bags – 0.5L, 1L, 3L, 5L, 10L, 25L, and 40L (other sizes are available; however, the volumes that are listed encompass the majority of the bags supplied and the samples submitted to the laboratory).

9.10 Dynamic Dilution System

- Entech Dynamic Diluter Model 4620A
- Toshiba laptop computer Model 2210CDT/6.0 and Software NT460

10) Standards and Reagents

10.1 Reagents and Equipment

10.1.1 UHP Grade Helium (99.999%) (GC carrier gas, preconcentrator purge/sweep gas, pressurization gas)

10.1.2 Cryogen - Liquid nitrogen from bulk tank or 50 psig dewars (used to cool preconcentrator traps)

10.1.3 UHP/Zero Grade Air (canister pressurization)

10.1.4 ASTM Type II Water, DI water or equivalent

10.1.5 UHP Grade Nitrogen (99.999%) (additional pressurization gas, based on other methods requested – modification to method)

10.2 Standards

Standards are prepared for both SCAN and Selective Ion Monitoring (SIM) modes according to the procedures detailed in this section. The preparation of standards for the analysis of air samples is carried out by following the procedure, "Preparation of Gas Phase Standards for Ambient Air Analysis", Application Note, Spring 96, Vol. 6.5, *Tekmar*-DOHRMANN AutoCan User's Manual. Neat standards that are used for making trace gas standards must be of high purity; generally a purity of 98 percent or better is commercially available.

10.2.1 Instrument Performance Check, Internal Standard and Surrogate Spiking Mixture Prepare a standard solution of p-Bromofluorobenzene (BFB-used as both a tune check and surrogate compound), bromochloromethane, chlorobenzene-d5, and 1,4-difluorobenzene, 1,2-dichloroethane-d4(surrogate), and toluene-d8(surrogate) at 500µg/m³ each in humidified zero air (Section 9.2.1.2). Prepare this standard according to the procedure outlined in Volume 6.5 of the *Tekmar*-DOHRMANN Application Note. This standard may also be prepared from a neat cocktail as in Section 10.2.2.2.1 or as stated in Section 10.2.1.3.

10.2.1.1 An intermediate standard is prepared from neat compounds in a glass static dilution bottle (SDB). After the volume of the SDB is determined, calculate the mass of each compound to be spiked to achieve a final concentration of 5.0µg/ml. Then use the density of each neat compound to calculate the microliter amount to be spiked into the SDB. The SDB is then heated for a minimum of one hour at ~60°C to completely volatilize all components.

Concentration of the intermediate standard prepared in a SDB is 5.0µg/mL. The amount required to achieve this concentration is determined through the use of the following equation.

$$A = \frac{(C)(V)}{D} \qquad \text{(Equation 1)}$$

Where:

A Amount of each compound required to achieve the desired concentration of the standard in the SDB (µL)
C Desired concentration of SDB (µg/mL)
V Actual volume of the SDB (mL)
D Density of the compound in question (µg/µL)

Example:

Calculate the amount of neat bromochloromethane needed to achieve the final concentration of 5.0µg/mL of that compound in the SDB.

V = 2010mL
D = 1934.4µg/µL
C = 5.0µg/mL

$$A = \frac{\left(5.0\frac{\mu g}{mL}\right)2010mL}{1934.4\frac{\mu g}{\mu L}} = 5.2\mu L$$

Density (µg/µL)	Compound
1934.4	Bromochloromethane
1170.1	1,4-Difluorobenzene
1157	Chlorobenzene-d5
1307	1,2-Dichloroethane-d4
943	Toluene-d8
1593	BFB

10.2.1.2 The Working standard is prepared in a Summa canister by spiking an aliquot of the stock SDB standard (Section 10.2.1.1) using a heated gastight syringe. Connect a cleaned, evacuated Summa canister to a source of pure diluent gas (humidified zero air) using a Teflon line with a stainless steel tee directly above the canister valve. One port of the tee is fitted with a septum. Spike the SDB stock and following removal of syringe a small flow of diluent gas to flush the spike into the can. Pressurize the can to positive 83.3 psig with humid zero air, and allow the contents to equilibrate for approximately 24 hours before using.

Concentration of the working standard prepared in a Summa canister is 500ng/L. The final pressure of the canister is 83.3psig; therefore, the pressurized volume is 40L, which is obtained through the use of the following equation.

PV = PDF(V) (Equation 2)

Where:

PV Pressurized canister volume (L)

PDF Pressure Dilution Factor, where PF = $\frac{P_{atm}+P_f}{P_{atm}+P_i}$

P_f Final Canister Pressure

P_i Initial Canister Pressure

V Volume of canister at 1atm

P_{atm} Atmospheric Pressure = 14.7psig

Example:

$\frac{14.7+83.3}{14.7+0}(6L)$ = 40L

In order to prepare the canister with a concentration of 500ng/L, it must be determined how much of the intermediate standard is required. This is achieved through the use of the following equation.

$$A = \frac{(F)(V)}{(C)\left(1000\frac{ng}{\mu g}\right)} \qquad \text{(Equation 3)}$$

Where:

F Desired concentration of working standard (ng/L)

V Pressurized Volume of Canister (L)

C Concentration of prepared SDB (µg/mL)

A Amount of standard (mL) of the SDB required to obtain the desired working standard concentration

Example:

$$A = \frac{500\frac{ng}{L}(40L)}{\left(5.0\frac{\mu g}{mL}\right)\left(1000\frac{ng}{\mu g}\right)} = 4mL$$

10.2.1.3 Currently the working standard is purchased in a cylinder at a certified concentration of 500ng/L (prepared by Linde SPECTRA Environmental Gases, Alpha, NJ).

10.2.1.3.1 For SCAN analyses, the working standard is filled directly into a summa canister to a pressure of 70 to 80 psig.

10.2.1.3.2 For SIM analyses, the working standard is diluted and pressurized with humid zero air to the desired concentration

using Equation 2 in Section 10.2.1.2. Typical concentrations will be 20ng/L, 40ng/L or 50ng/L.

10.2.2 Initial Calibration (ICAL) Standard Prepare the primary source calibration standards in Summa canisters with nominal concentrations of 1ng/L (optional), 20ng/L and 200ng/L for analyses in SCAN mode and 0.1ng/L, 5.0ng/L, and 200ng/L for analyses in Selective Ion Monitoring (SIM) mode for each of the target analytes. Differing injection volumes will create the standard concentrations listed in Tables 3 (SCAN) and 3A (SIM) of this document. The full list of analytes which are analyzed according to this method can also be found in Tables 2 (SCAN) and 2A (SIM).

Standards are prepared by diluting the stock standard with humid zero air into a Summa canister. The stock standard is a certified custom-blended cylinder (prepared by Linde SPECTRA Environmental Gases, Alpha, NJ). Refer to Tables 3 and 3A for the list of analytes and certified concentrations in the purchased cylinder.

10.2.2.1 Working standards are prepared into Summa canisters using the Entech Dynamic Diluter. Turn on the power to the diluter one hour prior to using to allow for the components to come to thermal equilibrium. Connect the computer and start the software. Connect a Zero Air source to the humidification chamber (flow controller #1). Connect stock standard cylinder#1 to flow controller #2 inlet. Open the cylinder valves. Adjust the inlet pressures to 50 to 60psig.

Standard Concentration Selection: The concentration of the three working standards prepared in Summa canisters should be 200ng/L, 20ng/L and 1ng/L (depending on the dynamic range of the initial calibration include 1ng/L if a 0.08ng and 0.4ng on column standard is desired or this standard may be used for the 0.5ng/L concentration as well) for SCAN and 0.2ng/L, 4.0ng/L, and 200ng/L for SIM.

Position 1 – Total Air Flow (Zero Air)
Position 2 – Standard Flow (Purchased Standard One)
Position 3 – Standard Flow (Purchased Standard Two if Applicable)
Position 4 – Total Air Flow (Zero Air) (utilized if preparing a two dilution standard)
Position 5 – Diluted Standard Flow (utilized if preparing a two dilution standard)

Step1: Determine the required flow rate of the stock standards (positions #2 and #3). The range must be from 5 to 50sccm (standard cubic centimeters per minute, same as ml/min). The flows listed below are guidelines to be used for the default standard flow (based on the desired standard concentration) and were chosen based on the ultimate final dilution required and limitations of the Dynamic Diluter (flows must be from 150 to 2000ml/min.).

Desired Standard Conc.	Default Standard Flow
200ng/L	50ml/min
100ng/L	50ml/min
20ng/L	20ml/min
5.0ng/L	10ml/min
4.0ng/L	8ml/min

1ng/L	50ml/min; 20ml/min (See Note 1 below)
0.2ng/L	10ml/min; 20ml/min (See Note 1 below)

Note 1: For the 1ng/L and 0.2ng/L standards (or any standard requiring more than a 400X dilution of the stock), a slightly different procedure is performed. In order to prepare these standards, a double dilution must be performed which involves taking the primary dilution flow and making a secondary dilution of that using the diluent gas. Unscrew the cover of the dilutor and connect the first mass flow controller as well as the tubing to re-route the first dilution output from the final standard Summa canister to the 2nd dilution chamber. Refer to example 2 for the calculation guidelines to prepare a two dilution standard.

Example 1: Prepare a 200ng/L working standard. The concentration of each stock standard is 1000ng/L.

Step 2: Determine the required dilution factor for each stock.
Dilution factor = Stock Conc. (ng/L) / Desired Standard Conc. (ng/L)
Dilution Factor = 1000ng/L / 200ng/L = 5

Step 3: Calculate Total Flow
Total Flow= (stock std. flow-see table above)*(Dilution Factor)
Total Flow=50ml/min*5 = 250ml/min

Step 4: Calculate Diluent Air Flow
Air Flow=Total Flow-(Sum of stock std. flows-purchased cylinders)
Air Flow=250ml/min-(50+50)ml/min = 150ml/min

Example 2: Prepare a 0.2ng/L working standard. The concentration of each stock standard is 1000ng/L.

Step 2: Determine the required total dilution factor for the 0.2ng/L standard.
Dilution factor = Stock Conc. (ng/L) / Desired Standard Conc. (ng/L)
Dilution Factor = 1000ng/L / 0.2ng/L = 5,000

The two dilutions must be performed which total the dilution factor calculated above. Since the flow for the Diluter is restricted to a maximum of 2000ml/min, the total flow (as calculated in Step 3 below) cannot exceed 2000ml/min; therefore, the dilutions must be chosen accordingly.

Step 3: Calculate Total Flow
Total Flow = (stock std. flow-see table above)*(Dilution Factor)
Total Flow (Dilution 1) = 10ml/min*200 = 2000ml/min

For the 2nd dilution take the stock standard flow selected for dilution 1 for the two purchased cylinders (10ml/min each based on the desired final concentration) and add them together (10ml/min + 10ml/min for 20ml/min) to get the stock standard flow for the 2nd dilution.

2nd Dilution Factor Needed = Total Dilution/1st Dilution
2nd Dilution Factor = 10000/200(1st dilution) = 50

Total Flow (Dilution 2) = 20ml/min*50 = 1000ml/min

Step 4: Calculate Diluent Air Flow
Air Flow=Total Flow-(Sum of stock std. flows-purchased cylinders)
Air Flow=2000ml/min-(10+10)ml/min = 1980ml/min (Dilution 1)
Air Flow=1000ml/min-20ml/min = 980ml/min (Dilution 2)

Position 1 = 1980ml/min
Position 2 = 10ml/min
Position 3 = 10ml/min
Position 4 = 980ml/min
Position 5 = 20ml/min

Step 5: Enter flow rates in the appropriate fields in the Entech software. Start flows by clicking the "GO" button in the top right of the window. Allow flows to equilibrate for at least fifteen minutes, then attach an empty canister to the outlet port and open the valve. The outlet pressure will be displayed in the lower right of the window, in units of psia. Close the canister valve when the pressure reaches 30psia. There is a relief valve on the diluter that will open when the pressure reaches 35psia, so the canister will still be usable if the valve is not closed in time.

10.2.2.2 When analysis of additional (extra) compounds are requested which are not in the purchased stock cylinders, the following preparation instructions should be used. In addition, the internal standard / surrogate standard may also be prepared in this manner (Sections 10.2.2.2.1 – 10.2.2.2.2) as mentioned in Section 10.2.1.

10.2.2.2.1 *Equi-mass "soup"* (contains compounds in equal mass amounts) or *cocktail* prepared from the neat compounds for a large number of components. If additional SIM compounds are requested, the same cocktail may be used.

Cocktail Preparation:

Step 1: This cocktail is prepared by combining 25mg of each neat compound into a small glass vial. Use a microliter syringe to transfer each compound, cleaning with solvents in between. Put the vial in the freezer between aliquots to minimize volatilization. Take the density of each compound into account to determine the actual amount of each compound to spike into the cocktail by using the following equation.

$$S = \frac{A}{D} \qquad \text{(Equation 4)}$$

Where:

S Actual spike amount (µL)
A Desired amount for each compound (mg)
D Density (mg/µL); refer to Table 2 for the density

Example: The actual volume of acrolein to add to the cocktail is calculated by the following.

$$S(Acrolein) = \frac{25mg}{\left(0.840\frac{mg}{\mu l}\right)} = 29.8\mu L$$

Step 2: The concentration of each compound in the cocktail is determined by the following equation.

$$C = \frac{A}{V}\left(1000\frac{\mu g}{mg}\right) \qquad \text{(Equation 5)}$$

Where:

C Concentration of cocktail (µg/µL)
A Amount of each compound (mg)
V Final volume of cocktail (total spike volumes of each compound) (µL)

Example:

$$C = \frac{25mg}{631.8\mu L}\left(1000\frac{\mu g}{mg}\right) = 39.569\mu g/\mu L$$

10.2.2.2.2 *An intermediate standard* is prepared from neat compounds by spiking individual compounds into a glass static dilution bottle (SDB) as described in Section 10.2.1.1 or spiking an aliquot of a cocktail into the SDB. The spike amount of a cocktail is determined by using the following equation.

$$S = \frac{C_1 V}{C_2} \qquad \text{(Equation 6)}$$

Where:

S Spike amount required in order to obtain the desired concentration (µL)
C_1 Desired concentration of SDB (µg/mL)
C_2 Concentration of cocktail (µg/µL)
V Volume of SDB (L)

Example: Determine the spike amount of the cocktail required to achieve the desired intermediate standard concentration.

$$S = \frac{\left(1\frac{\mu g}{ml}\right)(2010ml)}{27.81\frac{\mu g}{\mu L}} = 72.28\mu L$$

10.2.2.2.3 *Intermediate Standard Preparation (Gaseous Compounds*) As an alternative to the glass SDB method, if the extra compounds needed to be analyzed are gases at room temperature, use a gastight syringe to prepare an intermediate standard in a 1L Tedlar bag filled with humidified zero-grade air. Use the molecular weight of the compound to calculate the microliter amount to be spiked into the bag to achieve desired concentration. The spike amount is determined by using the following equation.

$$S = \frac{C * V * 24.46}{M * \left(1000\frac{ng}{\mu l}\right)}$$

S	Spike amount required in order to obtain the desired concentration (µl)
C	Desired concentration (ng/L)
V	Volume of the Tedlar Bag (1L)
M	Molecular Weight of the compound
24.46	Molar Volume of gas at 25°C, 1atm

Example:

Make a 100,000ng/L intermediate standard of Chloro-difluoromethane (Freon22) in a Tedlar Bag, where M=86

$$S = \frac{100{,}000\frac{ng}{L} * 1L * 24.46}{86 * \left(1000\frac{ng}{\mu l}\right)} = 28.44\mu l$$

10.2.2.2.4 *The Working standard* for extra compounds is prepared in a Summa canister by spiking an aliquot of the intermediate standard (glass SDB or Tedlar bag) using a heated gastight syringe. The preparation of these standards shall follow the instructions detailed in Section 10.2.1.2. The concentrations for working standards are usually 20 and 200ng/L, however different concentrations can be chosen which work best for a particular project.

10.2.3 Initial Calibration Verification (ICV) - (Laboratory Control Sample - LCS) Prepare a secondary source standard (either a different manufacturer or different lot from the same manufacturer as the initial calibration standard) using the same procedures as the primary source. The ICV/LCS working standard should

contain each target analyte present in the calibration working standard. Prepare the ICV/LCS working standard at a concentration of 200ng/L. Differing injection volumes account for the allowed concentrations listed in Table 4 for SCAN and 4A for SIM. The preparation of this standard shall follow the instructions detailed in Section 10.2.2, using the certified second-source standard cylinder.

10.2.4 Continuing Calibration Verification (CCV) Standard The CCV is the same as the initial calibration working standards detailed in Section 10.2.2.

10.2.5 Screening Standards Recommended procedure: Prepare a 0.5ug/mL and/or a 3.0ug/mL concentration standard so that the GC may be calibrated utilizing a few levels (may include approximately 0.5ng, 150ng and 600ng). However, other concentrations can be prepared depending on the desired range.

Any of the desired standard concentrations (primary and secondary) may change as long as the equations and the appropriate densities remain the same.

10.3 Storage and Expiration Dates

All standards that are to be stored in a freezer shall be stored at ≤-10˚C for DoD projects.

- Neat Stock Liquids are stored at < -10˚C (-10˚C to -20˚C) as specified by the manufacturer or for a period of five years.
- Equi-Mass Primary Stock Standard is a cocktail or soup of neat compounds (containing compounds in equal mass amounts) used to in preparing intermediate gas phase standards and shall be stored in the freezer at < -10˚C (-10˚C to -20˚C) for up to six months. This is assuming that the soup is sealed with a septum-containing screw cap or Mininert™ valve. The selection of the compounds for the soup should be performed in accordance with the guidelines in Volume 6.5 of the *Tekmar*-DOHRMANN Application Note.
- Purchased Stock Standards Cylinders must be stored at laboratory temperature for a period of 2 years or as specified by the manufacturer before vendor re-certification or purchase of new standards.
- Intermediate Calibration Standards prepared by static dilution must be stored in an oven at a temperature of approximately 60°C to ensure analyte vaporization. Every time a standard is prepared from the static dilution bottle (SDB), the concentration changes. To increase the useful lifetime of an SDB standard, remove volumes of 25mL or less. The volume removed can be manipulated by increasing the SDB concentration or by adjusting the canister final volume/pressure. Depending upon the volume removed, an SDB intermediate standard is stable for approximately two months as long as new working standards made from this standard continue to meet acceptance criteria. These bottles must be in the oven for a minimum of one hour prior to use in preparing working standards. The guidelines for the storage and expiration date for the intermediate calibration standards are stated in Volume 6.5 of the *Tekmar*-DOHRMANN Application Note.
- Prepared Stock / Intermediate Calibration Standards prepared in Summa canisters (1000ng/L) may be stored at laboratory conditions for up to three months in an atmosphere free of potential contaminants. Upon preparation, canister standards should be allowed to sit for approximately 24 hours prior to use in order for equilibration to take place. Shorter equilibration periods may be necessary and acceptable as long as performance criteria are met.

- Calibration or Working Calibration Standards prepared in canisters may be stored at laboratory conditions for one month in an atmosphere free of potential contaminants. Upon preparation, canister standards should be allowed to sit for approximately 24 hours prior to use in order for equilibration to take place. Shorter equilibration periods may be necessary and acceptable as long as performance criteria are met.

11) Method Calibration

11.1 Initial Calibration

The initial calibration is performed to determine instrument sensitivity and the linearity of the GC/MS response for the target compounds.

Initial calibration requirements are as follows:

1. A minimum of 5 concentrations must be used to calculate the calibration curve.
2. An initial calibration must be performed at a minimum initially per instrument, annually thereafter or whenever the continuing calibration verification standard does not meet the acceptance criteria.
3. Highest concentration, together with the lowest concentration, defines the calibration range.
4. The method reporting limit for any reported analyte must be at >/= the lowest calibration point.
5. The initial calibration event may not be interrupted by maintenance.
6. Only one value per concentration may be used.
7. Analyze calibration standards from lowest to highest concentration.
8. All ICAL analyses must be completed within the 24-hour tune window.
9. If 5 calibration standards are in the ICAL, one standard may be re-analyzed. If 6 to 10 calibration standards are in the ICAL, two calibration standards may be re-analyzed.
10. One of the calibration points from the initial calibration curve must be at the same concentration as the continuing calibration verification standard.
11. The upper end of the calibration range must not exhibit any peak saturation for any analyte or the range must be lowered accordingly.
12. The initial calibration model must be linear calibration using average of response factors and cannot be changed for any reason.
13. Point dropping policy
    - Minimum of 5 consecutive concentrations must be used to calculate the calibration curve.
    - Lowest concentration must be at or below the MRL (LOQ) and may not be dropped unless the MRL is changed to the concentration of the remaining lowest standard.
    - Points at the high end may be dropped, but doing so lowers the calibration range.
    - Points may not be dropped from the interior of the curve unless an assignable cause (i.e., gross dilution error, missing internal standards, purge malfunction, standard preparation error, or instrument malfunction) is accounted for and documented. In these instances, all the analytes in that calibration standard must be dropped from the calibration curve as the corrective action (the reason must be documented and the results maintained with the documentation for the final ICAL).
    - Dropping individual compound points from the upper or lower end of the calibration range to improve linearity is not considered an error correction. The reason for dropping these points does not need to be documented but

the ICAL documentation must state the revised calibration range if the MRL must be adjusted or the calibration range is lowered for a particular compound. This must be documented on the ICAL Review Checklist.

- A calibration standard may be re-analyzed if the first analysis of the standard has been dropped and other requirements in this policy are met (i.e., still within 24 hours).
- Once the ICAL has been used to calculate and report sample results it MUST not to be changed for any reason.
- It is recommended that if an analyte has a higher MRL than the lowest concentration analyzed that the low standard be automatically dropped from the curve (i.e., acetone MRL is 5, drop at least the 0.4ng point).

11.1.1 Calibration Points Analyze the calibration standards (analyze low to high) that span the monitoring range of interest of the samples. For SCAN, the range is typically 0.4ng-100ng on column; however, 0.08ng on column may be added if low level analyses are requested. For SIM, the range is 10pg on column to 50,000pg on column. The dynamic range is dependent on the sensitivity of a particular instrument as well as the required reporting limit for a given project and may be adjusted accordingly. Refer to Table 3 (SCAN) and Table 3A (SIM) for the concentrations of the compounds of interest in the initial calibration at each particular calibration concentration level.

Note: Refer to the EXCEL TO-15 Standard Concentration templates, located on the network at Q:\\TO15 Std. Concentrations\Std. Conc. Templates for both the SIM and SCAN templates. These templates must be utilized for the documentation of the standard canister concentration selection, final ICAL level concentrations and the determination of the correct injection volumes for the selected standard canister concentrations. If the primary or secondary stock standard cylinder concentrations are revised (upon re-certification or new purchases), the EXCEL spreadsheet templates, injection amounts and the ICAL concentrations in each instrument method must be adjusted accordingly. Other templates may be employed as long as they are validated and provide at least the same information.

SCAN

1. Determine if the lower end of the calibration range is to be 0.08ng or 0.4ng on column. If the low end is 0.08ng, then the 1ng/L standard must be utilized.
2. Determine if the 1ng/L or 20ng/L standard canister is to be used for the 0.4ng on column point.
3. Follow the instructions in the spreadsheet and save the file under the correct instrument folder and the initial calibration method identification.
4. Print the final ICAL concentration sheets and place into the corresponding ICAL folder

11.1.2 Recalibration Each GC/MS system must be recalibrated following any instrument maintenance which may change or effect the sensitivity or linearity of the instrument, if the continuing calibration verification acceptance criteria are not met and at least annually. The following procedure must be followed when updating an initial calibration method.

1. Open the most recent method.
2. Save the method with the new ICAL method ID using the "Save Method As" option. Date used in the method ID must be the date files were analyzed.

3. Quantitate midpoint standard and check retention times and integrations. Update retention times if necessary using QEdit or Easy ID (Tools → Easy ID). Requant if any changes are made and verify all peaks are identified correctly. Print.
   a. While midpoint standard is loaded update reference spectra (Continuing Calibration → Update Reference Spectra).
   b. With midpoint standard loaded update qualifier ion ratios and retention times (Initial Calibration → Update Levels → Select Update Level and then select Retention Times (Replace) and Replace Qualifier Ion Relative Responses).
   c. If necessary adjust integration parameters prior to processing remaining ICAL points.
4. Quantitate remaining ICAL standards. Review each peak for retention time, integration, and print. Review low level standards for acceptable signal to noise ratios and high level standards for saturation.
5. All responses must be cleared from ICAL before updating (Initial Calibration → Clear All Calibration Responses).
6. Update responses for each standard level (Initial Calibration → Update Levels) or (Initial Calibration → Quick Levels Update). If Quick Levels Update is used do not requant datafiles.
7. Save method.
8. Check Response Factor Report and evaluate whether any points should be dropped following the criteria outlined in this SOP.
9. Save method if any changes are made.
10. Verify calibration files listed on Response Factor Report are correct.
11. Verify file ID, acquisition time, quant time, update time, and last update information is correct on the Calibration Status Report.

11.1.3 Analytical Window If time remains in the tune window after meeting the acceptance criteria for the initial calibration, samples may be analyzed according to the procedure described in this document (see Section 12.3.2). If time does not remain in the analytical window, a new sequence shall commence with the analysis of the instrument performance check compound (BFB) and the continuing calibration verification standard.

11.1.4 Procedure The system should be operated using temperature and flow rate parameters equivalent to those in Section 12.4. Use the standard prepared in accordance with Section 10.2.2 of this SOP. Attach the calibration standard and internal standard/surrogate canisters to the designated inlets on the preconcentrator and open the canister valves. Analyzing different volume aliquots of the calibration standards produces differing concentrations.

Analyte responses (target ion areas) are tabulated and recorded using the Enviroquant program. Quantitation ions for the target compounds are shown in Table 2 and 2A and the primary ion should be used unless interferences are present, in which case the secondary ion may be used, but the reason documented in the initial calibration file and all subsequent quantitations utilizing that ICAL must be performed using the same ion selections. Refer to Section 15.2 for the required calculations and Section 16.4 for the acceptance criteria.

11.1.4.1 Additional Requirements The procedure for performing and generating a new initial calibration method must follow a few additional requirements.

1. If any analyte lacks the appropriate sensitivity (3 to 1 signal to noise ratio) at the low end of the calibration range, this point must be dropped from the curve and the MRL/LOQ raised accordingly.
2. No detector saturation may occur for any compound; the upper calibration level must produce no saturated peaks. Exhibited by:
   - The flattening of the response for the higher concentration standards as shown on the plot;
   - The presence of a reverse tail or rise on the front part of the peak;
   - The observed actual percent ratio of the secondary ion presence is lower than the expected percent ratio; or
   - The presence of a flat topped peak and again by the decline or saturation of the secondary ion compared with the expected % recovery.

11.1.4.2 LOQ Establishment, Verification and Acceptance Criteria

1. The LOQ must be set within the calibration range (≥ low std. of the current passing ICAL) prior to sample analysis.
2. The LOQ for each analyte must be ≥ the analyte's LOD.
3. Initially a passing demonstration of precision and bias must be performed at the LOQ.
4. Run CCV 2 times at LOQ and:
   a. Generate a duplicate report for precision using ±25% as the criteria.
   b. Check the %Rec using laboratory generated control limits.
   c. Check the signal to noise ratio (S/N) using the software. The S/N ratio must be at least 3:1 for each analyte.
   d. All ion abundances must be acceptable per the requirements set forth in this document.
5. If any compounds fail, verify at a higher level and notify reporting. Also, make a note in the ICAL documentation.
6. Turn in all LOQ verification data (quant reports and software reports/checks) to QA (regardless of pass/fail).
7. Verify the LOQ on each instrument quarterly.

11.1.5 Initial Calibration Review Analyst's calculation and assessment along with a peer review of all ICAL data and documentation as stated in Attachment 2 is required before the ICAL may be used to analyze samples. In the case where samples are placed on the autosampler and allowed to run overnight, the sample results may only be reported if the ICAL is reviewed and found to be acceptable. The ICAL checklist in Attachment 2 must be used to document the review and approval process.

Perform a review of specific aspects of the calibration which might compromise data quality such as inappropriate extension of the calibration range with detector saturation and/or a lack of sensitivity for any analyte. Analyte concentrations which do not meet the signal to noise ratio or exhibit saturation are not to be reported and must be eliminated from the initial calibration. These instances should be followed by a short explanation regarding the reason for the omission.

11.1.6 Initial Calibration File An ICAL file is to be created for each initial calibration performed per instrument into which is placed the following ICAL documents. The file shall remain in the laboratory and be filed by instrument and date.

- ICAL Checklist filled out, reviewed and approved
- BFB tune analysis report
- Calibration status report (aka Calibration History)
- Relative Response Factor Report / Percent Relative Standard Deviation
- Quantitation report for each calibration standard (including manual integration documentation – before and after manual integration)
- ICV quantitation report and % recovery report.
- TO-15 Standard Concentration Spreadsheet (exact ICAL level concentrations and ICV concentrations)
- Any manual integration documentation

11.2 Initial Calibration Verification Standard

Verify the initial calibration by analyzing an initial calibration verification standard (ICV). This standard shall be obtained or prepared from materials acquired from a different manufacturer or lot from that of the initial calibration and prepared according to Section 10.2.3.

Analyze 50ng or less (refer to Table 4 for the secondary source standard concentrations) of the ICV standard depending on the dynamic range of a given instrument and refer to Section 15.4 for the required calculations.

12) Sample Preparation/Analysis

12.1 Sample Preparation

The pressure/vacuum is checked and the canister pressurized upon receipt by the laboratory, as needed. When necessary, canisters shall be pressurized with humidified zero grade air. However, if the samples are to be analyzed in accordance with EPA Method 3C then the samples must be pressurized with UHP Helium (refer to Section 12.9 for additional information). The client must be made aware of this in advance and given the option of either submitting two canisters for analysis or receiving a report with qualified results (TO-15 Modified).

Depending on the size of the canister and location of sampling and as specified in the SOP below, samples may be pressurized to approximately 1.0psig to 3.5psig. Additional information may be found in the *SOP for Evaluation and Pressurization of Specially Prepared Stainless Steel Canisters*. Initial and final pressures are recorded in LIMS and should be repeated on the back of the sample tag. The dilution factor created by filling the sample canister is calculated using equation number 12 in Section 15.7.

12.2 Screening

The analyst must screen a sample or subset of samples if the source is of unknown origin. Typically, if the source is known to be indoor or ambient outdoor air, no screening is necessary. However, if screening is required make sure that the instrument is calibrated. A single point calibration is sufficient; however, the instrument may be calibrated utilizing a two point calibration. The ICAL points are recommended to be at approximately 0.5ng, 150ng and/or 600ng spanning the desired dynamic range. Refer to Section 10.2.5 for additional information.

Inject a 1mL or smaller aliquot of each sample into a GC/flame ionization detector (FID) system that has been calibrated with a standard containing a subset of the target analytes. This subset represents the most commonly found compounds in air samples, such as acetone, trichloroethylene, and toluene. Use the results to determine the maximum volume of sample to be analyzed by TO-15 by utilizing the following equation. Dilutions may be prepared as necessary according to Section 12.9.1.

$$I = \frac{C}{H}$$

Where:

I Injection volume (mL)
C Maximum calibration level (ng on column)
H Compound screening concentration (ng/mL)

Example: Select the compound with the highest concentration (toluene = 1.0ng/mL). If the upper calibration level is 100ng on column, then the following calculation determines the maximum injection volume to analyze.

$$\frac{100ng}{1.0ng/mL} = 100mL \text{ maximum injection volume}$$

12.3 Analytical Sequence and Data System Setup

12.3.1 Data System For the Tekmar AUTOCAN, fill in the sequence log of the Teklink program with the appropriate information. Refer to the Section 12.4.1 for the operating parameters.

For HP Chemstation, load the appropriate acquisition method for the GC/MS in the top window of the Chemstation program. Suggested GC/MS operating parameters are given in Section 12.4.2.

12.3.2 Analytical Sequence The analytical sequence must be completed for the analysis of ≤20 (19 samples including dilutions with one laboratory duplicate) field samples. A method blank (MB) shall be run to monitor for laboratory introduced contamination. There must be at a minimum a laboratory duplicate (LD) analyzed in each batch to access batch precision. The following generalized analytical sequence is to be followed:

Analytical Sequence Guideline

With Calibration	Tune Check[1] Calibration Standards (5 Standards Minimum) ICV Standard[2] (Acts as the ICV and LCS) QC Canister Checks[6] MB[7] Sample(s) – 1-19 Laboratory Duplicate[4]
With Continuing	Tune Check[1] CCV Standard[5] QC Canister Checks[6] MB[7] LCS[3] MRL Check Standard[8] Sample(s) – 1-19 Laboratory Duplicate[4]

[1] The instrument performance check solution must be analyzed initially and once per 24 hour (or as specified by the project) time period (sequence / tune window) of operation. All analyses for a sequence must be initiated (injected) prior to the expiration of the tune window.

[2] In this scenario, the ICV may also be evaluated as the LCS (differing acceptance criteria).

[3] An LCS shall be analyzed at a rate of 1 in 20 or fewer samples. The LCS is the second source calibration check standard analyzed at the lower end of the calibration curve (below the midpoint).

[4] A laboratory duplicate must be analyzed at a rate of 1 per 20 or fewer samples. The duplicate must be rotated among clients, whenever possible. Also, a duplicate laboratory control sample may be analyzed to assess precision to meet project requirements or due to sample matrix effects.

[5] A CCV must be analyzed at the beginning of every analytical sequence.

[6] Any number of QC check canisters may be analyzed in the sequence to determine a canister cleaning batch or batches acceptability.

[7] Any of the QC Check Canisters may serve as the method blank as long as the minimum requirements detailed in this document are met. A method blank shall be analyzed at a rate of 1 in 20 or fewer samples.

[8] A MRL check standard may be analyzed with each batch of 20 or fewer samples (when an initial calibration is not analyzed within the same batch). Additional information is included in Section 12.15.

Note: Client project batch specifications may require certain modifications to the analytical sequence; however, a batch may not be more lenient than that which is specified in this document.

12.4 Conditions

12.4.1 Sample Collection Conditions The suggested settings and system parameters are as follows:

Adsorbent Trap

Set Point:	35˚
Sample Volume:	up to 1L
Dry Purge:	300mL
Sampling Rate:	100mL/min (utilize for a sample injection volume of >100mL); 40mL/min (utilize for a sample injection volume of 25-100mL)
Desorb Temp.:	200˚C to 230˚C
Desorb Flow Rate:	8-10mL/min He
Desorb Time:	3.0 minutes

Refocusing Trap

Temperature:	-180˚C
Injection Temp.:	160˚C
Injection Time:	1.0 min

Adsorbent Trap Reconditioning Conditions

Temperature:	265°C

Initial Bakeout: 2 hours or until clean blank is obtained
After each run: 5-8 minutes

Sample Run Time

Each analytical run is approximately 20 minutes long; the total cycle time is about 30 minutes between injections.

12.4.2 GC/MS System

Optimize GC conditions for compound separation and sensitivity.

Item	Condition
Carrier Gas	Helium
Flow Rate	1.0-1.6mL/minute
Temperature Program	Initial Temperature: ~20˚C Initial Hold Temperature: 3 minutes Ramp Rate: 5˚C/min to 80˚C 2nd Ramp: 10˚C/min to 160˚C 3rd Ramp: 20˚C/min to 240˚C for 5 min hold
Detector B (MSD *Interface)*	260˚C
Electron Energy	70 Volts (nominal)
Mass Range (Scan mode)	34 to 280 amu
Mass Range (SIM mode)	Scan masses corresponding to the target analytes
Scan Time	To give at least 10 scans per peak, not to exceed 1 second per scan.

Note: The instrument may be operated in Selective Ion Monitoring (SIM) mode if requested by the client.

12.5 Instrument Performance Check

Since the BFB tuning compound is included in the internal standard and surrogate standard canister and an autosampler is used, it is necessary to establish that a given GC/MS meets tuning and standard mass spectral abundance criteria prior to the reduction and approval of any data collection. The 24-hour time period for GC/MS instrument performance check and standards calibration (initial calibration or continuing calibration verification criteria) begins at the injection of the BFB, which shall be documented in laboratory records. Upon completion of the successful BFB tune, the tune report must be printed and retained on file for future reference.

The mass spectrum of BFB must be acquired in the following manner.

- Inject 50ng or less (on column)
- Three scans (peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged.
- Background subtraction is conducted using a single scan prior to the elution of BFB.
- All ion abundances must be normalized to m/z 95, the nominal base peak, even though the ion abundance of m/z 174 may be up to 120 percent that of m/z 95.
- The ion abundance criteria must not be changed from the requirement stated in this document (TO-15 or TO-14A, as requested).

All subsequent standards, samples and QC samples associated with a BFB analysis must use identical instrument conditions.

12.6 Continuing Calibration Verification Standard

Verify the calibration each working day, where necessary (e.g., an ICAL was not analyzed or the tune window has closed) by analyzing a continuing calibration verification (CCV) standard from the initial calibration standard canister. The concentration of the calibration verification may be varied between the low calibration standard and the midpoint of the calibration range; however, the concentration must be at one of the levels analyzed in the initial calibration. Refer to Table 3 for the standard concentrations. Refer to Section 15.3 for the required calculations.

12.7 Canister Quality Control Check and Method Blank

The method blank must be a sample of a matrix similar to the batch of associated samples that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure, and in which no target or interferences are present at concentrations that impact the analytical results for sample analyses. Prepare a canister that has not left the building by pressuring with humidified zero air. Analyze an aliquot of one liter along with the same volume of internal standard and surrogate as standards and samples. Additionally, a blank must be analyzed whenever a high concentration sample is encountered and carryover is suspected.

A Quality Control (QC) check canister pressurized with humidified zero air may serve as a method blank as long as the analyte concentration requirements stated in the canister quality control check section (Sections 16.7 and 16.8) and other requirements (refer to Section 16.12 for internal standard requirements) are met. Assuming continuing failure, another QC canister or a new canister must be prepared and analyzed in order to verify that no system contamination exists. For tracking purposes the unique laboratory barcode given to a canister shall be the information included in the sample analysis identification.

12.7.1 Sampling Systems Section 7.1 and 8.4 of Method TO-15 describe the setup and certification procedure for a specific sampling apparatus that has been used by the EPA for several of its large air monitoring programs. These systems are rarely used for the types of projects that make up the bulk of the laboratory's work. The vast majority of samples analyzed by the laboratory are taken into Summa canisters either as grab samples or using a simple time integrated sampling device (flow controller), as in Section 8.2.1 of the method, so these procedures are not part of the typical protocol for providing sampling materials to clients. The laboratory has developed an SOP for the cleaning and certification of the materials it provides its clients for obtaining air samples to be analyzed by method TO-15. Refer to the *SOP for Cleaning and Certification of Summa Canisters and Other Specially Prepared Canisters* for additional information.

It is this laboratory's interpretation that the sampler system certification procedure described in Section 8.4.4 of the TO-15 method applies to the specific sampling apparatus described in the method and not to the sampling procedures used by our clients. The laboratory does not maintain a dynamic calibration manifold or canister sampler apparatus as described in the method and thus performance of the relative accuracy certification procedure described in section 8.4.4 is not possible.

12.8 Laboratory Control Sample

The laboratory control sample is a sample matrix, which is free from the analytes of interest and spiked with a standard containing known amounts of analytes. The

laboratory control sample is an injection of the initial calibration verification standard. Inject the LCS (ICV) at concentrations below the midpoint of the calibration curve. Make sure that all of the pertinent information is included on the quantitation report including the sample identification (LCS), concentration, standard used, and analyst.

12.9 Sample Analysis

Prior to analysis, all sample containers (canisters and bags) should be at temperature equilibrium with the laboratory.

- Attach sample canisters to Tekmar AUTOCan using a 9/16" wrench. Bottle Vacs use a proprietary quick connect fitting (Micro-QT, Entech Instruments). Tedlar bags can be connected using soft silicone tubing or a 3/16" fitting with a reusable ferrule.
- Before opening the valve, check for leaking fittings by running the leak check program in the Teklink software. Quick connect fittings must be leak checked before connecting the sample container.
- If system is leak tight, open the canister valves and start the automated preconcentration procedure. Make sure the Chemstation data acquisition software has been readied.
- Maintain the trap at an elevated temperature until the beginning of the next analysis.

Check all target compounds using the QEdit routine in Enviroquant, making sure all extracted ion chromatogram peaks are integrated properly (see Section 12.13).

Note 1: The secondary ion quantitation is only allowed if there is sample matrix interference with the primary ion. If the secondary ion quantitation is performed, document the reasons in the instrument run logbook and/or on the quantitation report (initial and date any notation).

Note 2: Each female Micro-QT fitting must be purged after use to remove any remaining sample residue and prevent contamination from subsequent usage. Connect a male Micro-QT fitting to a source of ultrapure or carbon-filtered gas. Adjust the pressure to about 10 psig using an inline regulator. Connect the female fitting for several seconds, then remove and place in an oven kept at 60ºC until the next use. Do not heat the fitting higher than 80ºC.

SCAN Mode - The instrument is normally operated in the SCAN mode, where the following procedure may be followed.

- Upon sample injection onto the column, the GC/MS system is operated so that the MS scans the atomic range from 34 to 270 amu. At least ten scans per eluting chromatographic peak should be acquired. Scanning allows identification of unknown compounds in the sample through searching of library spectra. See operating conditions in Section 12.4.
- Generate a quantitation report for each run.
- If reporting Tentatively Identified Compounds (TICs), refer to Section 12.9.2 for identification criteria.

SIM Mode - When the client requests SIM mode, select SIM instead of SCAN mode and identify a minimum of two ions per analyte of interest. Also, a minimum of two ions for each internal standard and surrogate compound should be selected.

Helium Pressurization – If a canister is pressurized with helium, a correction factor is applied to sample volumes extracted from the canister via auto sampler. This is due to the difference in thermal properties between helium and air. A correction factor worksheet has been generated to determine the exact volume taken from a canister and may be found at J:\\A-GCMS\Helium Pressurization. Save file, print the sheet and include with the data. Refer to the instruction page in the template for all of the instructions and calculations including backfilled canisters.

AutoCAN Leak Checks – Canisters should be put on at least two different AutoCAN positions to confirm a "leak". In addition, the valve threads should be inspected for defects which may prevent a good seal with the AutoCAN. Once a canister has "failed" the leak check it must be tagged, an NCAR initiated, and the PM notified. Regardless of what the client or PM specifies as the fate of the sample, the canister must be put on maintenance hold to complete a full 24-hour leak check. A yellow sheet is to be completed in addition to, but not in lieu of an NCAR. This is a fixed QA procedure with no allowance for deviation.

12.9.1 Sample Dilution If any target analyte results are above the highest level of the initial calibration, a smaller sample aliquot should be analyzed. The dynamic range of volume aliquots for the automatic cryogenic concentrator is 20cc to 1L. If a volume smaller than 20cc is to be analyzed, a dilution should be made in a Tedlar bag, or the sample directly injected using a gastight syringe. Guidance in performing dilutions and exceptions to this requirement are given below.

- Refer to Section 12.4.1 (Adsorbent Trap Sampling Rate) for the required sampling rate if less than 100mL is to be analyzed.
- Use results of the original analysis to determine the approximate dilution factor required and get the largest analyte peak within the initial calibration range.
- The dilution factor must be documented (and included in the final report) and chosen in such a way as to keep the response of the analyte peak for a reported target compound in the upper half of the initial calibration range of the instrument.

Tedlar bag dilution:

- Make a dilution by filling a Tedlar bag with 1.0 liter of humidified zero air using a one-liter gas syringe.
- Calculate the volume of balance gas needed to obtain the required dilution.
- Remove the difference in the balance gas using a syringe.
- Add the calculated sample amount using a gastight syringe.

Direct injection:

- Make a direct injection by attaching a clean, humidified zero air filled Summa canister to the preconcentrator autosampler using 1/4" stainless steel or teflon tubing with a "tee" septum port. This canister should be the same canister that may be used as the method blank.
- Inject the sample through the septum while the preconcentrator withdraws a 200cc aliquot from the canister.

12.9.2 Tentatively Identified Compounds When requested, a mass spectral library search may be made for the purpose of tentatively identifying sample components not associated with the calibration standards. The necessity to perform this type of identification will be determined by the purpose of the

analyses being conducted. Data system mass spectral library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Certain programs may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification. The following guidelines are used for making tentative identifications.

- Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.
- The relative intensities of the major ions should agree within ±20%. For example, for an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance should be between 30 and 70%.
- Molecular ions present in the reference spectrum should be present in the sample spectrum.
- Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting compounds.
- Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting peaks. Data system library reduction programs can sometimes create these discrepancies.
- The concentration of the tentatively identified compound is estimated by assuming a response factor of 1.0 and comparing the response of the tentatively identified compound to the response of the nearest internal standard.
- If non-target analytes are not Q-deleted from the quant report, the analyst must evaluate whether these compounds should be reported as TICS.

12.10 Duplicate

A duplicate must be analyzed to assess laboratory precision and samples selected for duplicate analysis shall be rotated among client samples, where applicable. Some projects or sample matrix issues may require the analysis of a duplicate laboratory control sample (DLCS).

12.11 Internal Standard (IS)

The concentration of internal standard added to each standard, field sample and QC sample must be consistent from that of each current ICAL standard.

12.12 Surrogates

Internal standards/surrogates must be added at the same volume for every standard, sample and QC sample. Surrogate compound recoveries are requested by a number of clients, but are more appropriately used as system monitoring compounds. This is due to the fact that the compounds are introduced directly into the analytical system and not into the canisters or bags. It is for this reason that they are not considered to be true surrogates and a fixed window is applied. Additionally, surrogates are not included in the ICAL because they are not required by the method and are only system monitoring compounds.

12.13 Manual Integration and Q Deletion

A list of abbreviations (codes) that may be used to give a reason for performing either of these procedures are listed in the *SOP for Data Review and Reporting*.

12.13.1 Manual Integration The integration for each peak must be legally defensible and shall be checked to ensure that it has been integrated properly and consistently between samples, standards and QC samples. All peak reviews and manual integrations must follow the requirements specified in the *SOP for Manual Integration Policy* and the *SOP for Laboratory Ethics and Data Integrity.* The requirements in the above stated procedure include when manual integrations are performed, raw data records shall include a complete audit trail for those manipulations (i.e., chromatograms showing both the integration prior to any manual integrations and those depicting the corresponding manually integrated peaks), and notation of rationale, date, and initials of person performing the manual integration operation. In addition, manual integrations must be reviewed and approved by a second reviewer and the manual integrations maintained in the appropriate job file.

Reporting Requirements Certain project requirements including samples which are submitted under the Department of Defense (DoD) QSM require that the case narrative include an identification of samples and analytes for which manual integration is required. Refer to project requirements to determine if this is necessary.

12.13.2 Q Deletion Q deleting may be performed to either delete a false positive or delete non-target compounds.

12.14 Detection Limits and Limits of Detection

The MDL study shall be performed annually for all target analytes on each instrument (with identical configurations) for which this method is performed. The MDL shall be performed in accordance with the procedure outlined in the *SOP for Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation.* The detection limit shall be used to determine the LOD for each analyte.

Once determined on each instrument, the highest LOD (for each analyte from all instrument determinations) shall be used as the uniform LOD. However, if a lower detection limit is reported, then the samples must have been run on that specific instrument on which the lower LOD was determined.

12.14.1 Performance and Acceptance Criteria

1. The MDL must be <0.5ppbV for each analyte (Method 11.11.1).
2. Perform Limit of Detection (LOD) verification on all instruments (performing this method) immediately following the MDL study. Spike the LOD at 2-4x the MDL; the spike level establishes the LOD.
3. LOD Acceptance
   - Analyte must be detected reliably and identified by the method-specific criteria (i.e, ion confirmation) and produce a signal that is at least 3 times the instrument's noise level (3:1 signal to noise ratio).
   - It is specific to each combination of analyte, matrix, method and instrument configuration.
   - The LOD must be verified quarterly on each instrument (spiked at LOD) using the criteria listed above.
4. If the LOD verification fails (per #3), repeat the detection limit determination and LOD verification at a higher concentration or perform and pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration.
5. The laboratory shall maintain documentation for all detection limit determinations and LOD verifications (regardless of pass or fail).

12.15 Method Reporting Limit Check Standard

It is recommended to analyze a MRL check standard at the current MRL or required MRL for the batch (per client requirements) of twenty or fewer samples if the CCV fails low for any target compound. A MRL check standard may also be required per client specifications.

This check standard can also serve as the LOQ verification if it meets the specific requirements listed in Section 11.1.4.2. Apply the requirements and retain all documentation accordingly. Refer to Attachment 4 for Minnesota specified MRL check standard criteria.

12.16 Method Modifications

Method modifications are not allowed under NELAC\TNI standards; therefore, a statement, however worded, must be included in the final report indicating that data reported does not fall under the laboratory's NELAC certificate of approval. In addition, the following items are considered to be method modifications and must be reported accordingly.

- Sample collection in gas collection bags
- The pressurization of canisters with nitrogen or helium (if EPA Method 3C is requested) refer to Section 12.9.

13) Troubleshooting

13.1 Prepare new standards, check instrument maintenance, prepare a new curve as needed, etc. Refer to the corrective actions listed in Section 16 of this SOP for additional troubleshooting details.

14) Data Acquisition

14.1 Storing Electronic Data

The initial calibration data must be stored in a quantitation method (on the server) using a unique filename and may not be overwritten at any time in order to maintain an accurate audit trail. There are multiple quantitation methods, which are subsets of the compound list in Table 2. Therefore, files will be named with an eight-character notation indicating the compound list and the date of the corresponding initial calibration. In addition, all data files including method blanks, continuing calibration verification, laboratory control samples and client submitted samples files are saved in a unique sub-directory on the server.

14.2 Sufficient raw data records must be retained on file of all laboratory analyses described in this document including passing QC canister checks, tune checks, instrument calibrations, verifications, sample analyses and dilutions, QC checks, and method detection limit studies. The information that is required includes: analysis/calibration date and time, test method, instrument, sample identification, analyte identification, analyst's initials, concentrations and responses, as well as standards used for the analysis and calibrations, all manual calculations including sample dilutions and manual integrations to permit reconstruction of analyses. Information entered and reported on the quantitation report and instrument run log must be complete and accurate. All data shall be obtained following defensible and ethical practices in accordance with the most recent Quality Assurance Manual and the *SOP for Laboratory Ethics and Data Integrity*.

Note: All data records must explicitly connect data to the initial instrument calibration. This includes all samples, continuing calibrations and QC samples.

14.3 The essential information to be associated with analysis, such as computer data files, run logs, etc. shall include: Sample ID code, date and time (if the holding time is 72 hours) of analysis, instrument operating conditions/parameters (or reference to such data), analysis type, all manual calculations including dilutions and manual integrations, analyst's initials, sample preparation (pressure readings and balance gas if pressurized with helium), standard and reagent origin, receipt, preparation, and use, as well as calibration criteria, frequency and acceptance criteria, data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions.

15) Calculation and Data Reduction Requirements

15.1 This method has specific requirements including the use of canisters; any modification must be reported accordingly. All reports that fall under the laboratory's certificate of approval (in accordance with NELAC/TNI standards) must include a statement(s) clarifying any deviations from the scope of this certification. Refer to Section 15.10 for additional information and specific items, which require this clarification.

15.2 Initial Calibration

Tabulate each of the following:

15.2.1 Equation Number 1 - **Relative Response Factor (RRF):**

$$RRF = \frac{A_x C_{is}}{A_{is} C_x}$$ where:

A_x is the area response of the analyte quantitation ion.
A_{is} is the area response of the corresponding internal standard quantitation ion.
C_{is} Internal standard concentration, ng.
C_x Analyte concentration, ng.

Note: The equation above is valid under the condition that the volume of internal standard spiking mixture added in all field and QC samples is the same from run to run.

15.2.2 Equation Number 2 - **Average (or Mean) RRF:**

$$\overline{RRF} = \frac{\sum_{i=1}^{N} RRF_i}{N}$$ where:

RRF_i are the individual RRFs from each concentration level in the initial calibration curve.

N is the number of calibration concentration levels.

15.2.3 Equation Number 3 - **Standard Deviation, SD:**

SD = $\sqrt{\sum_{i=1}^{N} \frac{\left(RRF_i - \overline{RRF}\right)^2}{N-1}}$ where:

RRF_i are the individual RRFs from each concentration level in the initial calibration curve.

$\overline{RRF}$ Average (or Mean) RRF of all concentration levels in the initial calibration curve.

N total number of calibration concentration levels

15.2.4 Equation Number 4 - **Percent Relative Standard Deviation, %RSD:**

%RSD = $\frac{SD}{\overline{RRF}}(100)$ where:

SD Standard Deviation calculated in equation number 3

$\overline{RRF}$ Average or Mean RRF

15.2.5 Equation Number 5 - **Relative Retention Time (RRT):**

$$\mathrm{RRT} = \frac{\mathrm{RT_C}}{\mathrm{RT_{is}}}$$ where:

RT_C Retention time of the target compound, seconds.

RT_{is} Retention time of the internal standard, seconds.

15.2.6 Equation Number 6 - **Mean Relative Retention Time ($\overline{RRT}$):**

$$\overline{RRT} = \sum_{i=1}^{n} \frac{RRT_i}{n}$$ where:

$\overline{RRT}$ Mean relative retention time (seconds) for the target compound for all initial calibration levels.

RRT_i Relative retention time for the target compound in level i.

n Number of calibration levels

15.2.7 Equation Number 7 - **Mean Area Response ($\overline{Y}$):**

$$\overline{Y} = \sum_{i=1}^{n} \frac{Y_i}{n}$$ where:

Y_i Area response for the primary quantitation ion for the internal standard for each initial calibration standard.

n number of calibration concentration levels

15.2.8 Equation Number 8 - **Mean Retention Times ($\overline{RT}$):**

$$\overline{RT} = \sum_{i=1}^{n} \frac{RT_i}{n}$$ where:

$\overline{RT}$ Mean retention time, seconds
RT_i Retention time for the internal standard for each initial calibration standard, seconds.
n number of initial calibration levels

15.3 Continuing Calibration Verification

- Calculate the (RRF) of each target compound using equation number 1.

15.3.1 Equation Number 9 - **Percent Difference, %D:**

$$\%D = \frac{RRFx - \overline{RRF}}{\overline{RRF}}(100)$$ where, for any given analyte:

RRF_x is the RRF from the CCV being evaluated.
$\overline{RRF}$ is the mean RRF from the current calibration curve.

15.4 Percent Recovery – ICV, LCS, Surrogates, MRL Check Standard

15.4.1 Equation Number 10 - **Percent Recovery (%R):**

%R = X/TV x 100

where
X = Concentration of the analyte recovered
TV = True value of amount spiked

15.5 Duplicate Analysis

15.5.1 Equation Number 11 - **Relative Percent Difference (RPD):**

$$\frac{x_1 - x_2}{\overline{x}}(100)$$ where:

x_1 First measurement value
x_2 Second measurement value
$\overline{x}$ Average of the two values

15.6 Internal Standards (IS)

- Calculate the mean area response $\overline{Y}$ for each internal standard using equation number 7.
- Calculate the mean of the retention times for each internal standard using equation number 8.

15.7 Pressure Dilution Factor (PDF)

15.7.1 Equation Number 12 - **PDF**, for samples collected in Summa canisters:

$$PDF = \frac{P_{atm} + P_f}{P_{atm} + P_i}$$ where:

P_{atm} is the ambient atmospheric pressure, 14.7 psi at sea level.
P_f is the final sample canister pressure, in psig.
P_i is the initial sample canister pressure, in psig. This will most often be a negative value (sub-ambient initial pressure).

15.8 Results

If a canister has been pressurized with Helium and the Tekmar AutoCan was utilized, refer to Section 12.9.

15.8.1 Equation Number 13 - For calculating analyte concentrations in a sample, the starting point is the nanogram amount generated by the HP Enviroquant software, which appears on the quantitation report.

$$ng_x = \frac{A_x ng_{is}}{A_{is}\overline{RRF}}$$ where:

ng_x is the nanogram amount of analyte *x*.
A_x is the area response of the analyte's quantitation ion.
A_{is} is the area response of the corresponding internal standard's quantitation ion.
ng_{is} is the internal standard amount, in nanograms.
$\overline{RRF}$ is the average or mean RRFs

15.8.2 Equation Number 14 - The final analyte concentration, C_x, in units of micrograms per cubic meter (µg/m³), is then calculated from the following:

$$C_x = \left(\frac{ng_x PDF}{V}\right)\left(\frac{1\mu g}{1000ng}\right)\left(\frac{1000l}{1m^3}\right)$$ where:

V is the sample volume analyzed, in liters.
PDF is the sample canister pressure dilution factor.

15.8.3 Equation Number 15 - To convert to units of parts per billion volume (ppbv):

$$ppbv = \frac{\mu g/m^3}{MW} x 24.46 \qquad \mu g/m^3 = \frac{ppbv}{24.46} xMW$$ where:

MW is the molecular weight (Table 2) of the analyte, in g/mole.
24.46 is the molar volume of an ideal gas at 298 K (25 °C) and 760 mmHg (1 atm), in liters per mole (l/mol).
C_x the final analyte concentration in micrograms per cubic meter.

15.8.4 Equation Number 16 – Helium Pressurization (Injection Amount)

Applicable to canisters pressurized with helium and injected utilizing the mass flow controller of the AutoCAN. For full instructions and calculations, refer to the 1st tab of the template located at: J:\A-GCMS\Helium Pressurization\MFC_GCF _backfill.

15.9 Data Review

The analyst must review data on a real time basis for all calibration and QC data. The QC data must be evaluated by analytical sequence following the Daily QC review checklist (Attachment 3). The data shall be reviewed and the sample results calculated and assessed by one analyst and reviewed by a second qualified analyst. The Sample Review checklist (Attachment 3) is used to document sample review per service request and once completed, initialed and dated must be filed with each job file.

Initial calibrations must be reviewed in the same manner as QC data with all ICAL documentation retained in a separate file organized by instrument and date. Refer to the initial calibration checklist in Attachment 2 for the review guideline. The ICAL file must contain all the pertinent information stated in Section 11.1.6.

15.10 Reporting

The results of each test shall be reported clearly, unambiguously and objectively, and shall include all the information necessary for the interpretation of the test results and information required by this laboratory's policy, NELAC\TNI standards, DoD Manual (applicable version, see reference section), client projects, and the TO-15 method including modifications, observances, data qualifiers, and certification information.

If the project requires that results be reported below the MRL (LOQ), but above the LOD all of the requirements specified for normal reporting apply (3:1 S/N ratio and ion abundance). This is regardless of the fact that the results will be qualified as estimated.

15.10.1 Analysis Observations / Case Narrative Summary Form

This form, which is included in the *SOP for Laboratory Storage, Analysis and Tracking*, must be generated when there are specific sample composition information or analysis issues and/or observations. In addition, during the analysis, specific identification information or problems, interferences, calibration issues, flags, and additional/expanded explanation of flags should be added to the form. This form may be modified as long as the sections and basic concepts are reserved. All data qualifiers and flags should follow those listed in the most recent Quality Assurance Manual or as defined in any client requirements.

This form is necessary as a means for documentation. This form, among other information, will be reviewed when compiling the final report and case narrative. All information regarding the job shall remain in the file, in order that sufficient documentation is available to recreate the job from sample receipt through analysis, data reduction, and reporting.

15.10.2 NELAC\TNI Requirements

The following items do not comply with NELAC\TNI standard requirements and must be reported accordingly. A statement, however worded, must be

included in the final report indicating that data reported does not fall under the laboratory's NELAC certificate of approval.

- Reporting any compound which is not included in the second source standard (ICV or LCS) does not meet NELAC requirements.
- In addition, a report that contains a compound not included on the NELAC certificate of approval must also include the statement listed above.

15.10.2.1 Modifications

Method modifications are also not allowed under NELAC\TNI standards; therefore, a statement, however worded, must be included in the final report indicating that data reported does not fall under the laboratory's NELAC certificate of approval. In addition, the following items are considered to be method modifications and must be reported accordingly.

- Sample collection in gas collection bags
- The pressurization of canisters with nitrogen or helium (if EPA Method 3C is requested) refer to Section 12.9.

15.10.3 Surrogates

Only report surrogates at the request of the client. If any surrogate is out of control, all samples results (with surrogates requested) associated with the surrogate must be reported with the appropriate data qualifier.

15.10.4 DoD Requirements

Report results with the appropriate data qualifiers, if samples cannot be reanalyzed for any reason. In addition and at a minimum, the following situations are to be noted in the case narrative: manual integrations, CCV out of control, and results exceeding the calibration range.

16) Quality Control, Acceptance Criteria, and Corrective Action

16.1 To the extent possible, samples shall be reported only if all of the quality control measures are acceptable. If a quality control measure is found to be out of control, and the data must be reported, all samples associated with the out of control quality control measure shall be reported with the appropriate data qualifier(s).

16.2 Corrective actions shall follow the procedures outlined in the *SOP for Nonconformance and Corrective Action*, where appropriate. Any maintenance which may alter instrument sensitivity or linearity must result in the re-analysis of the entire sequence including the tune compound, ICAL or CCV or any batch QC.

16.3 Instrument Performance Check

16.3.1 Acceptance Criteria

Refer to Tables 1 and 1A for the required ion abundance criteria.

16.3.2 Corrective Action Perform auto tune or manual tune and then re-analyze BFB. If the BFB acceptance criteria are still not met, the MS must be retuned according to the procedure outlined in the instrument user's manual. Perform necessary maintenance and make notations in the instrument maintenance logbook. It may be necessary to clean the ion source, or quadrupole, or take other necessary actions to achieve the acceptance criteria. An acceptable tune is required for sample results to be calculated and reported.

16.4 Initial Calibration

16.4.1 Acceptance Criteria Refer to the following acceptance criteria for the initial calibration.

- The RRT for each target compound at each calibration level must be within 0.06RRT units of the mean RRT for the compound.
- The calculated %RSD for the RRF for each compound in the calibration standard must be less than 30% with at most two exceptions up to a limit of 40% (this may not be true for all projects).
- For each Internal Standard the area response (Y) at each calibration level must be within 40% of the mean area response $\overline{Y}$ over the initial calibration range.
- The retention time shift for each of the internal standards at each calibration level must be within 20s of the mean retention time over the initial calibration range for each internal standard.
- All of the following information must be retained to permit reconstruction of the initial instrument calibration: calibration date, test method, instrument, analysis date, analyte identification, analyst's initials, concentration and responses, and response factors.
- All initial instrument calibrations must be verified with an acceptable ICV.

16.4.2 Corrective Action Follow the initial calibration requirements detailed in Section 11.1 for information on re-analyzing or dropping points and the restriction of maintenance performed during the analysis of the initial calibration standards.

If the initial calibration results are outside the established acceptance criteria, corrective actions must be performed and all associated samples reanalyzed, if reanalysis of the samples is not possible, data associated with an unacceptable initial calibration shall be reported as estimated with the appropriate data qualifiers.

16.5 Initial Calibration Verification Standard (ICV)

16.5.1 Acceptance Criteria The percent recovery for each compound in the ICV must be between 70%-130% for all analytes except vinyl acetate, which must be within 50-150%. Exceptions to this allowance for the vinyl acetate recovery are project specific requirements and any DoD type project, which shall adhere to the 70-130% requirement for all target compounds.

16.5.2 Corrective Action If the initial calibration verification technical acceptance criteria are not met, reanalyze and if it fails again, prepare a new canister and analyze. If the criteria are still not met inspect the system for possible sources and perform any necessary maintenance and make a notation in the maintenance logbook of any steps taken. It may be necessary to clean the ion source or change the column. Perform a new initial calibration if any performed maintenance has altered instrument linearity and/or sensitivity. Perform another initial calibration or if reanalysis is not possible, data associated with an unacceptable ICAL/ICV shall be reported as estimated with the appropriate data qualifiers.

16.6 Continuing Calibration Verification (CCV)

16.6.1 Acceptance Criteria All compounds must be evaluated prior to rounding. The percent difference for each target analyte must be within plus or minus 30% of the initial calibration average RRFs.

16.6.2 Corrective Action If the continuing calibration verification technical acceptance criteria are not met, reanalyze and if it fails again, prepare a new canister and analyze. If the criteria are still not met inspect the system for possible sources of the problem and perform any necessary maintenance and make a notation in the maintenance logbook of any steps taken. It may be necessary to clean the ion source or change the column.

If any corrective action and/or reanalysis fails to produce continuing calibration verification within acceptance criteria (analyzed immediately following the initial failure), then either two consecutive successful verifications must be performed following corrective action or a new initial calibration must be performed; however, refer to 16.5.1 below.

16.6.2.1 Method Reporting Limit Check Standard

If the MRL check standard is unacceptable for any compound (sensitivity; ratio or %D), reanalyze at the same or higher level within the same batch and report data with the CCV flag and case narrative notes accordingly.

16.6.3 *DOD REQUIREMENT:* If a CCV fails, the laboratory must immediately analyze two additional consecutive CCVs (immediately is defined as within one hour).

- Both of these CCVs must meet acceptance criteria in order for samples to be reported without reanalysis
- If either of these two CCVs fail or if the laboratory cannot immediately analyze two CCVs, the associated samples cannot be reported and must be reanalyzed.
- Corrective action(s) and recalibration must occur if the above scenario fails. All affected samples since the last acceptable CCV must be reanalyzed.
- Flagging data for a failed CCV is only appropriate when the affected samples cannot be reanalyzed. The laboratory must notify the client prior to reporting data associated with a failed CCV.

16.7 Canister Quality Control Check

The actual cleaning procedure, number of cans to select for analysis (to release a cleaning batch) and corrective actions are covered in the *SOP for Cleaning and Certification of Summa Canister and Other Specially Prepared Canisters* and are not covered in this section. However, the procedure for analyzing and certifying a cleaning batch is included. If a canister passes as a QC canister it meets all of the requirements for a method blank (Method, NELAC\TNI, and Department of Defense Quality Systems Manual – DoD QSM, etc.).

16.7.1 Scan Analyses A canister is considered "clean" for normal SCAN analyses if the analysis shows <0.2ppbv of any target analyte (analyte exceptions listed in table below). If a canister passes as a QC canister it meets all of the requirements for a method blank (Method, NELAC\TNI, and Department of Defense Quality Systems Manual - DoD QSM, etc.).

Low Level SCAN Analyses For those analytes with a MRL of 0.1ug/m3, the QC criteria of <MRL is acceptable; otherwise, <0.2ppbV is required (analyte exceptions listed in table below).

SIM Analyses Results <MRL will be acceptable as this complies with the <0.2ppbV method requirement.

ANALYTE EXCEPTION LIST					
Compounds	ppbV	On Column (ng)	Compounds	ppbV	On Column (ng)
Target Analytes	0.2	0.50	Acrylonitrile	0.2	0.43
Chloromethane	0.2	0.41	Acetone	1.5	3.5
1,3-Butadiene	0.2	0.44	Ethanol	1.9	3.5
Acetonitrile	0.2	0.33	Vinyl acetate	0.99	3.5
Acrolein	0.65	1.5	1-Butanol	0.23	0.70
Isopropanol	0.28	0.70	Carbon Disulfide	1.1	3.5
2-Butanone	1.2	3.5			

Document the status of the check in LIMS and return the canister to the canister conditioning room. Additionally, if the check was found to be acceptable, the quantitation report must be kept on file for future reference

16.7.2 Tentatively Identified Compounds (TIC) If the batch of canisters are to be used for tentatively identified compounds (TIC) analysis, any non-target peaks present in the QC check canister analysis must be evaluated and determined to be less than the TIC reporting limit (10% of the internal standard). The concentration is estimated by assuming a RRF of 1.0 and comparing the response of the TIC to the response of the nearest internal standard.

16.8 Method Blank

16.8.1 Acceptance Criteria

- The concentration of a targeted analyte in the blank cannot be at or above the MRL, AND be greater than 1/10 of the amount measured in any associated sample. For any project that requires reported results less than the MRL, all associated measurements found in the MB should result in a qualifier; however, project requirements may differ and must be followed. Refer to DoD requirements listed below.
- The method blank should not contain additional compounds with elution characteristics and mass spectral features that would interfere with identification and measurement of a method analyte.
- For DoD samples, the method blank will be considered to be contaminated if:

  1. The concentration of any target analyte in the blank exceeds 1/2 the reporting limit and is greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater);
  2. The concentration of any common laboratory contaminant (acetone, ethanol, carbon disulfide, and methylene chloride) in the blank exceeds the reporting limit and is greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater); or
  3. The blank result otherwise affects the samples results as per the test method requirements or the project-specific objectives.

The laboratory shall evaluate whether reprocessing of the samples is necessary based on the above criteria.

16.8.2 Corrective Action If the analyte concentration results in the blank do not meet the acceptance criteria repeat analysis with remaining QC canisters until results

are acceptable or prepare a canister per Section 12.7. If the analyte results in the blank still do not meet the acceptance criteria the source of the problem must be investigated and measures taken to eliminate the source. Each method blank must be critically evaluated as to the nature of the interference and the effect on the analysis of each sample within the batch. Determine whether the contamination is from the instrument or due to contamination in the blank container (if results from the new can are not acceptable then the system is probably contaminated). In all cases, the corrective action (reprocessing or data qualifying codes) must be documented. However, the specific corrective action depends on the type of project the blank is utilized for; therefore, refer (below) to the reporting/reprocessing requirements.

DEPARTMENT OF DEFENSE (DoD) QSM PROJECT: Any sample associated with a blank that fails the criteria shall be reprocessed in the same or subsequent analytical batch, except when the sample analysis resulted in a non-detect. If reanalysis is not performed, the results shall be reported with appropriate data qualifier.

OTHER PROJECT TYPE: Appropriate corrective measures must be taken and documented before sample analysis proceeds. However, if this is not a possibility and the results must be reported follow the reporting requirements stated in Section 18.4.

16.9 Laboratory Control Sample (LCS)

16.9.1 Acceptance Criteria Round all results to the nearest whole number prior to determining if the acceptance criteria have been met. The percent recoveries must be within the laboratory-generated limits and are referenced in the electronic TO-15 Method Manual. However, Arizona requires the percent recovery for each compound in the LCS to be 70%-130% (to match the ICV requirement). Therefore, the ICV exception for vinyl acetate stated in Section 16.5 requires the percent recovery for AZ samples to be 50-150%.

Note: Client project requirements, AFCEE and DoD requirements shall take precedence over the AZ requirement for AZ samples. Meaning if a sample is collected for a DoD project in AZ, DoD requirements specified in this document and the project specific QAPP (if supplied) are to be followed.

DoD Requirement: In the absence of client specified LCS reporting criteria, the LCS control limits outlined in the DoD QSM 5.0 Appendix C tables shall be used when reporting data for DoD projects.

16.9.2 Corrective Action If the LCS criteria are not met, determine whether the cause is instrumentation or the result of a poor injection. If the problem is instrumentation, perform maintenance and if the problem is with the injection re-analyze the LCS. DoD considers the same analyte exceeding the LCS control limits two out of three consecutive LCS to be indicative of non-random behavior; therefore, this trend should be monitored and the appropriate corrective action taken when it occurs.

16.10 Sample Results

16.10.1 Acceptance Criteria

- Sample results must be quantitated from the initial instrument calibration and may not be quantitated from any continuing instrument calibration verification.

- The field sample must be analyzed on a GC/MS system meeting the BFB tuning, initial calibration, initial calibration verification technical acceptance criteria described in this document.
- All target analyte peaks must be within the initial calibration range, diluted or reported with the appropriate data qualifier.

16.10.2 Corrective Action

- If the retention time for any internal standard within the sample changes by more than 20 sec from the latest daily calibration or initial calibration mid-point standard, the GC/MS system must be inspected for malfunctions, and maintenance performed as required. Repeat sample analysis as needed.
- If the area for any internal standard changes by more than ±40 percent between the sample and the most recent calibration, check for possible matrix interferences and re-analyze at a greater dilution. If the requirement is still not met and matrix interference is not detected the GC/MS system must be inspected for malfunction and maintenance made where necessary.
- When corrective actions are made, samples analyzed while the instrument was not functioning properly must be re-analyzed or the appropriate data qualifiers must be attached to the results.

  To the extent possible, samples shall be reported only if all of the quality control measures are acceptable. If a quality control measure is found to be out of control, and the data must be reported, all samples associated with the out of control quality control measure shall be reported with the appropriate data qualifier(s).

16.11 Laboratory Duplicate

16.11.1 Acceptance Criteria The relative percent difference must fall within ±25%. This RPD criterion also applies to duplicate laboratory control samples (DLCS).

16.11.2 Corrective Action If the duplicate results do not meet the technical acceptance criteria, perform another duplicate analysis. If the results are still unacceptable and the associated samples are not reanalyzed then all of the sample results in the associated batch must be flagged accordingly.

16.12 Internal Standards

16.12.1 Acceptance Criteria The following acceptance criteria must be applied to each run (except the ICAL – see Section 16.4).

- The area response for each internal standard in the blank must be within ±40 percent of the area response for each internal standard in the most recent valid calibration. (CCV or mid-point from the initial calibration, whichever is most current).
- The retention time for each internal standard must be within ±0.33 minutes of the retention time for each internal standard in the most recent valid calibration. (CCV or mid-point from the initial calibration, whichever is most current).

16.12.2 Corrective Action

- Internal Standard Responses If the problem is with the instrument, perform maintenance. If the problem is with a sample, check for interferences. If the response is high, it is likely that interference is present. In this case, lower the volume or aliquot of the sample and re-analyze. If the problem persists, report the results with the best quality and qualify the results. If

the problem is corrected with the lower volume analysis, report those results.

- Internal Standard Retention Times If the retention time for any internal standard within the sample changes by more than 20 sec from the latest daily calibration or initial calibration mid-point standard, the GC/MS system must be inspected for malfunctions, and maintenance performed as required. Repeat sample analysis where required.

16.13 Surrogates

16.13.1 Acceptance Criteria Since the matrix precludes the use of true surrogates and there is no established method criterion, acceptable surrogate recoveries are based on a fixed window of 70 - 130%. This is the typical requirement from clients. Additionally, these limits are referenced in SW-846 for use as guidance in evaluating recoveries. These limits are sufficient for evaluating the effect indicated for the individual sample results.

16.13.2 Corrective Action Poor surrogate recovery should be followed by re-analyzing a smaller aliquot to mitigate any matrix interferences. Evaluate the out of control surrogate for the effect on individual sample results.

16.14 Method Reporting Limit Check Standard

16.14.1 Acceptance Criteria Per client requirements or if the CCV is biased low for any compound, then evaluate the MRL check standard. Analyte must be detected reliably and identified by the method-specific criteria (i.e, ion confirmation) and produce a signal that is at least 3 times the instrument's noise level (3:1 signal to noise ratio). Also, a percent difference +/-50% is recommended.

16.15 Sample Holding Time Expired

The customer is to be notified that the sample's holding time was missed and the customer is to decide if the sample analysis is to continue. The documentation of missed holding time and the client's decision to proceed must be included in the corresponding job file. A statement dictating all holding time occurrences must accompany the sample results in the final report.

17) Data Records Management

17.1 All data resubmittal forms and job documentation including Service Requests, Chain of Custody forms, Sample Acceptance Check forms and hardcopy electronic mail messages must be filed in the project file. Final reports, revised reports, and final invoices are stored electronically.

17.2 All laboratory and client documentation must be retained for a minimum of five years.

18) Contingencies for Handling Out of Control Data

18.1 The following is specific information on how to report unacceptable data. If the data requires a data qualifier flag, as specified in this SOP, refer to Appendix D of the most recent version of the Quality Assurance Manual for the appropriate data qualifier.

18.2 Initial Calibration and/or Initial Calibration Verification

All results reported with an unacceptable ICAL must be reported as estimated and all data shall be reported using defined qualifiers or flags or explained in the case narrative accordingly.

18.3 Continuing Calibration Verification

All results associated with an unacceptable CCV (other than #1 below) must be reported with the appropriate data qualifier, flag and/or explained in the case narrative.

1. When the acceptance criteria for the continuing calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported without a qualifier.
2. When the acceptance criteria for the continuing calibration verification are exceeded high, i.e., high bias, and there are associated samples with detects, then those detects must be reported with a qualifier, flag and/or explained in the case narrative.
3. If however, the acceptance criteria for the continuing calibration verification are exceeded low, i.e., low bias, and there are associated samples that are non-detects, then those non-detects must be reported with qualifiers, flags and/or explained in the case narrative as having less certainty. However, along with the data qualifiers, the case narrative may include information stating the fact that the results were not significantly affected if:
   a. *An MRL check standard was analyzed and found to be acceptable. The MRL must be the same as that analyzed in the MRL check standard for those analytes that were biased low in the CCV. Adjust MRLs (if required), flag data and state the certainty in the case narrative where the sensitivity of the instrument was demonstrated at the MRL; therefore, results were not significantly affected.*
   b. *With the reporting limit adjusted to the next level in the calibration curve (typically 5 times higher) to prove the nonexistence of a false negative and note procedure in case narrative.*
4. If the acceptance criteria was exceeded (biased high) for the CCV and there were detectable results in a sample, the results may be "qualified" if the results exceeded the regulatory/decision limit (this is to be stated in the case narrative along with the data qualifiers or flags).

18.4 Method Blank

- If an analyte in the blank is found to be out of control and the analyte is also found in associated samples, those sample results shall be "flagged" in the report and the method blank results reported.
- If the analyte is found in the blank but not in the sample then the results for the sample may be reported without a qualifier.

18.5 Laboratory Control Sample

All results associated with an out of control laboratory control sample must be reported with the appropriate data qualifier. An indication of whether the LCS was out high or low should also be included.

18.6 Surrogate

Report sample results with the appropriate data qualifier.

18.7 Laboratory Duplicate

All batch sample results associated with an out of control laboratory duplicate must be flagged with the appropriate data qualifier.

18.8 Internal Standard

All target analytes associated with an out of control internal standard must be flagged with the appropriate data qualifier.

18.9 Estimated Sample Results

18.9.1 Sample Hold Time All occurrences of missed holding times must be included on the final report including those samples received and/or analyzed outside of the specified hold times detailed in this SOP.

18.9.2 Matrix Interference Sample data associated with matrix interference must be flagged with the appropriate data qualifier.

18.9.3 Results Outside Initial Calibration Range All sample results not bracketed by initial calibration standards (within calibration range) must be reported as having less certainty by reporting with the appropriate data qualifier.

19) Method Performance

19.1 An on-going assessment of method performance is conducted in order to ensure that the laboratory is capable of reporting results which are acceptable for its intended use. Validation of the method is confirmed by the examination and provision of objective evidence that these requirements are met.

19.2 Method Detection Limit (MDL)

The procedure used to determine the method detection limits are as stated in the *Code of Federal Regulations* (40 CFR 136 Appendix B) as defined in the *SOP for Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. The MDL concentrations are listed in Tables 2 and 2A for both SCAN and SIM modes and were obtained using spiked canisters prepared with humidified zero air, making at least seven replicate measurements of the compounds of interest, computing the standard deviation, and multiplying this value by the appropriate Student's t value for 99 percent confidence. The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects. All MDLs, regardless of the mode of operation, meet the method performance criteria of <0.5ppbV.

19.3 Accuracy and Precision

Refer to Section 11.4 in the referenced method for information on replicate precision criteria for method performance. Single laboratory accuracy is presented as the second source initial calibration verification standard, which meets the method performance criteria of 30%. Additionally, laboratory generated control limit data for LCSs are presented for the analytes of interest and may be referenced in the electronic TO-15 Method Manual. Refer to Section 11.1.4.2 for the accuracy and precision requirements for concentrations at the LOQ/MRL.

19.4 Selectivity

Mass spectrometry is considered a more definitive identification technique than single specific detectors such as flame ionization detector (FID), electron capture detector (ECD), photoionization detector (PID), or a multidetector arrangement of these (see discussion in Compendium Method TO-14A). The use of both gas chromatographic retention time and the generally unique mass fragmentation patterns reduce the chances for misidentification.

It is necessary to establish that a given GC/MS meets tuning and standard mass spectral abundance criteria prior to initiating any data collection. Upon sample

injection onto the column, the GC/MS system is operated so that the MS scans the atomic mass range from 35 to 300 amu. At least ten scans per eluting chromatographic peak must be acquired. Scanning also allows identification of unknown compounds in the sample by searching through library spectra.

The sample analysis using the GC/MS is based in part on a combination of retention times and relative abundances of selected ions. The retention time of each chromatographic peak should be ±0.10 minutes of the library/reference retention time of the compound. The acceptance level for relative abundance should be set at ±20% of the expected abundance. The data should be manually examined by the analyst to determine the reason for the # flag [(#) = qualifier out of range], if present and whether the compound should be reported as found or if there is matrix interference. A background subtraction may aid in this determination. Manual inspection of the qualitative results should also be performed to verify concentrations outside the expected range.

Specific selectivity information is provided in this section and document (such as relative retention time) as well as in the referenced method. Refer to the method for additional information on selectivity.

- Use NIST Library 98 or newer version
- The *reference spectra updates* must be performed with every new ICAL utilizing the mid-level standard (minimum). If needed, the reference spectra may be updated sooner with the continuing calibration standard.
- *Retention time updates* must be performed using EasyID and not by updating to the method (InitCal \ Update Calibration). Refer to the Help selection of the software.

19.5 Demonstration of Capability

This laboratory has continuously performed this method since before July 1999. Therefore, ongoing demonstration of capable shall be performed and documented; however, the initial demonstration of method capability is not required.

19.6 Proficiency Testing (PT) Program

The laboratory shall participate in an air and emissions PT study for TO-15. The testing shall be performed in accordance with this document and meet the frequency and proficiency requirements detailed in the DoD QSM Version 5.0.

20) Summary of Changes

Table 20.1

Revision Number	Effective Date	Document Editor	Description of Changes
22.0	03/21/15	C. Humphrey	Section 1 – Removed Note 1
			Section 4 – Revised section to include Hazard Assessment table
			Section 12.9 – Added Note 2
			Table 2A – Updated
			Table 3 – Updated
			Table 3A – Updated
			Table 4 – Updated
			Table 4A – Updated
			Attachment 3 – Added MAPH to Daily QC and Sample Review Checklists

21) References and Related Documents

21.1 EPA Method TO-14A, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA/625/R-96/010b, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1997.

21.2 EPA Method TO-15, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA/625/R-96/010b, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1997.

21.3 Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, January 1999.

21.4 Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Addendum, January 17, 2002.

21.5 National Environmental Laboratory Accreditation Conference, *2003 NELAC Standard*, June 5, 2003, EPA 600/R-04/003 and 2009 TNI Standards.

21.6 *Preparation of Gas Phase Standards for Ambient Air Analysis,* Tekmar-DOHRMANN Application Note, Spring 96, Vol. 6.5.

21.7 *Department of Defense Quality Systems Manual for Environmental Laboratories*, Version 5.0, July 2013.

21.8 Arizona Administrative Code, Title 9. Health Services, Chapter 14. Department of Health Services Laboratories, December 31, 2006.

21.9 Florida Department of Environmental Protection, Chapter 62-160.

21.10 Minnesota Department of Health, 4740.2065, *Standard Operating Procedures*, Statutory Authority: MS s 144.97; 144.98; History: 31 SR 446, Posted: October 09, 2006, Revised April 16, 2010.

22) Appendix

22.1 Tables

Table 1: Instrument Tune Check Ion Abundance Criteria (TO-15)

Table 1A: Instrument Tune Check Ion Abundance Criteria (TO-14A)

Table 2: Volatile Organic Compounds, EPA Compendium Method TO-15 (SCAN)

Table 2A: Volatile Organic Compounds, EPA Compendium Method TO-15 (SIM)

Table 3: Standard Concentrations (SCAN) (Primary Sources)

Table 3A: Standard Concentrations (SIM) (Primary Sources)

Table 4: Standard Concentrations (SCAN) (Secondary Sources)

Table 4A: Standard Concentrations (SIM) (Secondary Sources)

22.2 Attachments

Attachment 1 – Training Plan

Attachment 2 – Initial Calibration Checklist

Attachment 3 – Daily QC and Sample Review Checklists

Attachment 4 – State and Project Specific Requirements

TABLE 1

Required BFB Key Ions and
Ion Abundance Criteria for Method TO-15

Mass	Ion Abundance Criteria[1]
50	8.0 to 40.0 percent of m/e 95
75	30.0 to 66.0 percent of m/e 95
95	Base Peak, 100 Percent Relative Abundance
96	5.0 to 9.0 Percent of m/e 95
173	Less than 2.0 Percent of m/e 174
174	50.0 to 120.0 Percent of m/e 95
175	4.0 to 9.0 Percent of m/e 174
176	93.0 to 101.0 Percent of m/e 174
177	5.0 to 9.0 Percent of m/e 176

[1] All ion abundances must be normalized to m/z 95, the nominal base peak, even though the ion abundance of m/z 174 may be up to 120 percent that of m/z 95.

TABLE 1A

Required BFB Key Ions and
Ion Abundance Criteria for Method TO-14A

Mass	Ion Abundance Criteria
50	15 to 40 percent of m/e 95
75	30 to 60 percent of m/e 95
95	Base Peak, 100 Percent Relative Abundance
96	5 to 9 Percent of m/e 95
173	Less than 2 Percent of m/e 174
174	>50 Percent of m/e 95
175	5 to 9 Percent of m/e 174
176	>95 and <101 Percent of m/e 174
177	5 to 9 Percent of m/e 176

Note: The criteria listed in Tables 1 and 1A shall be met or exceeded in order for EPA Compendium Methods TO-15 or TO-14A to be referenced.

TABLE 2 - VOLATILE ORGANIC COMPOUNDS, EPA COMPENDIUM METHOD TO-15 (SCAN)								
Compound[1]	**CAS Number**	**Molecular Weight**	**Density**	**Primary Ion[2]**	**Secondary Ion(s)[2]**	**MRL[3] (µg/m³)**	**MDL[3] (µg/m³)**	**IS[4]**
Bromochloromethane (IS1)	74-97-5	-	-	130	128, 132	-	-	-
Propene	115-07-1	42.08	NA	42	39,41	0.50	0.14	IS1
Dichlorodifluoromethane (CFC 12)	75-71-8	120.9	1.329	85	87, 101, 103	0.50	0.17	IS1
Chloromethane	74-87-3	50.49	0.911	50	52	0.50	0.15	IS1
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	76-14-2	170.9	1.455	135	137	0.50	0.19	IS1
Vinyl Chloride	75-01-4	62.50	0.9106	62	64	0.50	0.17	IS1
1,3-Butadiene	106-99-0	54.09	0.6149	54	39, 53	0.50	0.22	IS1
Bromomethane	74-83-9	94.94	1.6755	94	96	0.50	0.19	IS1
Chloroethane	75-00-3	64.52	0.8902	64	66	0.50	0.17	IS1
Ethanol	64-17-5	46.07	0.7893	45	46	5.0	0.80	IS1
Acetonitrile	75-05-8	41.05	0.7857	41	40	0.50	0.18	IS1
Acrolein	107-02-8	56.06	0.840	56	55	2.0	0.17	IS1
Acetone	67-64-1	58.08	0.7845	58	43	5.0	0.77	IS1
Trichlorofluoromethane	75-69-4	137.4	NA	101	103	0.50	0.17	IS1
Isopropyl Alcohol	67-63-0	60.10	0.7809	45	43	5.0	0.42	IS1
Acrylonitrile	107-13-1	53.06	0.8060	53	52	0.50	0.17	IS1
1,1-Dichloroethene	75-35-4	96.94	1.213	96	61	0.50	0.17	IS1
tert-Butanol	75-65-0	74.12	0.7887	59	57,41,43	1.0	0.33	IS1
Methylene Chloride	75-09-2	84.94	1.3266	84	49	0.50	0.17	IS1
Allyl Chloride	107-05-1	76.53	0.9376	41	76	0.50	0.16	IS1
Trichlorotrifluoroethane	76-13-1	187.38	1.5635	151	101	0.50	0.17	IS1

TABLE 2 (Continued) - VOLATILE ORGANIC COMPOUNDS, EPA COMPENDIUM METHOD TO-15 (SCAN)								
Compound[1]	**CAS Number**	**Molecular Weight**	**Density**	**Primary Ion[2]**	**Secondary Ion(s)[2]**	**MRL[3] (µg/m³)**	**MDL[3] (µg/m³)**	**IS[4]**
Carbon Disulfide	75-15-0	76.14	1.2632	76	78	5.0	0.15	IS1
trans-1,2-Dichloroethene	156-60-5	96.94	1.2565	61	96	0.50	0.19	IS1
1,1-Dichloroethane	75-34-3	98.96	1.1757	63	65	0.50	0.16	IS1
Methyl tert-Butyl Ether	1634-04-4	88.15	0.7402	73	57	0.50	0.17	IS1
Vinyl Acetate	108-05-4	86.09	0.9317	86	43	5.0	0.65	IS1
2-Butanone (MEK)	78-93-3	72.11	0.7999	72	43	5.0	0.21	IS1
cis-1,2-Dichloroethene	156-59-2	96.94	1.2837	61	96	0.50	0.16	IS1
Diisopropyl Ether	108-20-3	102.18	0.7241	87	45,59,43	0.50	0.19	IS1
Ethyl Acetate	141-78-6	88.106	0.9003	61	70	1.0	0.35	IS1
n-Hexane	110-54-3	86.18	0.6548	57	86	0.50	0.15	IS1
Chloroform	67-66-3	119.4	1.4832	83	85	0.50	0.17	IS1
1,2-Dichloroethane-d4(S)	17060-07-0	-	-	65	67	-	-	IS1
Tetrahydrofuran	109-99-9	72.11	0.8892	72	71,42	0.50	0.20	IS1
Ethyl tert-Butyl Ether	637-92-3	102.176	0.7519	87	59,57	0.50	0.18	IS1
1,2-Dichloroethane	107-06-2	98.96	1.2351	62	64	0.50	0.16	IS1
1,4-Difluorobenzene(IS2)	540-36-3	-	-	114	88	-	-	-
1,1,1-Trichloroethane	71-55-6	133.4	1.3390	97	99, 61	0.50	0.17	IS2
Isopropyl acetate	108-21-4	102.13	0.8718	61	87,43	1.0	0.32	IS2
1-Butanol	71-36-3	74.1224	0.8098	56	41	1.0	0.48	IS2
Benzene	71-43-2	78.11	0.8765	78	77	0.50	0.16	IS2
Carbon Tetrachloride	56-23-5	153.8	1.5940	117	119	0.50	0.15	IS2

TABLE 2 (Continued) - VOLATILE ORGANIC COMPOUNDS, EPA COMPENDIUM METHOD TO-15 (SCAN)								
Compound[1]	**CAS Number**	**Molecular Weight**	**Density**	**Primary Ion[2]**	**Secondary Ion(s)[2]**	**MRL[3] (µg/m³)**	**MDL[3] (µg/m³)**	**IS[4]**
Cyclohexane	110-82-7	84.16	0.7739	84	69,56	1.0	0.29	IS2
tert-Amyl Methyl Ether	994-05-8	102.176	0.7703	73	87,55,43	0.50	0.15	IS2
1,2-Dichloropropane	78-87-5	113	1.1560	63	62	0.50	0.16	IS2
Bromodichloromethane	75-27-4	163.8	1.980	83	85	0.50	0.15	IS2
Trichloroethene	79-01-6	131.4	1.4642	130	132	0.50	0.14	IS2
1,4-Dioxane	123-91-1	88.11	1.0337	88	58	0.50	0.16	IS2
Isooctane	540-84-1	114.23	0.6877	57	41	0.50	0.15	IS2
Methyl Methacrylate	80-62-6	100.12	0.944	100	69	1.0	0.31	IS2
n-Heptane	142-82-5	100.2	0.6837	71	57,100	0.50	0.17	IS2
cis-1,3-Dichloropropene	10061-01-5	111	1.224	75	77	0.50	0.14	IS2
4-Methyl-2-Pentanone	108-10-1	100.2	0.7965	58	85	0.50	0.16	IS2
trans-1,3-Dichloropropene	10061-02-6	111	1.217	75	77	0.50	0.16	IS2
1,1,2-Trichloroethane	79-00-5	133.4	1.4397	97	83	0.50	0.16	IS2
Chlorobenzene-d5(IS3)	3114-55-4	-	-	82	117	-	-	-
Toluene-d8(S)	2037-26-5	-	-	98	100	-	-	IS3
Toluene	108-88-3	92.14	0.8669	91	92	0.50	0.17	IS3
2-Hexanone	591-78-6	100.16	0.8113	43	58	0.50	0.16	IS3
Dibromochloromethane	124-48-1	208.3	2.451	129	127	0.50	0.16	IS3
1,2-Dibromoethane	106-93-4	187.9	2.1791	107	109	0.50	0.16	IS3
n-Butyl Acetate	123-86-4	116.16	0.8825	43	56, 73	0.50	0.16	IS3
n-Octane	111-65-9	114.23	0.6986	57	114	0.50	0.18	IS3

TABLE 2 (Continued) - VOLATILE ORGANIC COMPOUNDS, EPA COMPENDIUM METHOD TO-15 (SCAN)								
Compound[1]	**CAS Number**	**Molecular Weight**	**Density**	**Primary Ion[2]**	**Secondary Ion(s)[2]**	**MRL[3] (µg/m³)**	**MDL[3] (µg/m³)**	**IS[4]**
Tetrachloroethene	127-18-4	165.8	1.6227	166	164	0.50	0.14	IS3
Chlorobenzene	108-90-7	112.6	1.1058	112	114	0.50	0.16	IS3
Ethylbenzene	100-41-4	106.2	0.8670	91	106	0.50	0.16	IS3
m-, p-Xylenes	179601-23-1	106.2	0.8642, 0.8611	91	106	1.0	0.30	IS3
Bromoform	75-25-2	252.8	2.899	173	175	0.50	0.15	IS3
Styrene	100-42-5	104.1	0.9060	104	78, 103	0.50	0.15	IS3
o-Xylene	95-47-6	106.2	0.8802	91	106	0.50	0.15	IS3
n-Nonane	111-84-2	128.26	0.7176	43	57, 85	0.50	0.15	IS3
1,1,2,2-Tetrachloroethane	79-34-5	167.9	1.5953	83	85	0.50	0.15	IS3
4-Bromofluorobenzene(S)	460-00-4	-	-	174	176	-	-	IS3
Cumene	98-82-8	120.2	0.8618	105	120	0.50	0.15	IS3
alpha-Pinene	80-56-8	136.24	0.8582	93	77	0.50	0.14	IS3
n-Propylbenzene	103-65-1	120.1938	0.8670	91	120,65	0.50	0.16	IS3
3-Ethyltoluene	620-14-4	120.2	0.8645	105	120	0.50	0.15	IS3
4-Ethyltoluene	622-96-8	120.2	0.8614	105	120	0.50	0.16	IS3
1,3,5-Trimethylbenzene	108-67-8	120.2	0.8652	105	120	0.50	0.16	IS3
alpha-Methylstyrene	98-83-9	118.19	0.9106	118	103,117	0.50	0.15	IS3
2-Ethyltoluene	611-14-3	120.2	0.8807	105	120	0.50	0.15	IS3
1,2,4-Trimethylbenzene	95-63-6	120.2	0.8758	105	120	0.50	0.15	IS3
n-Decane	124-18-5	142.28	0.7300	57	71,85	0.50	0.16	IS3
Benzyl Chloride	100-44-7	126.59	1.1004	91	126	0.50	0.11	IS3

TABLE 2 (Continued) - VOLATILE ORGANIC COMPOUNDS, EPA COMPENDIUM METHOD TO-15 (SCAN)								
Compound[1]	CAS Number	Molecular Weight	Density	Primary Ion[2]	Secondary Ion(s)[2]	MRL[3] (µg/m³)	MDL[3] (µg/m³)	IS[4]
1,3-Dichlorobenzene	541-73-1	147	1.2884	146	148	0.50	0.15	IS3
1,4-Dichlorobenzene	106-46-7	147	1.2475	146	148	0.50	0.14	IS3
sec-Butylbenzene	135-98-8	134.2206	0.8601	105	134,91	0.50	0.16	IS3
p-Isopropyltoluene	99-87-6	134.2206	0.8573	119	134,91	0.50	0.15	IS3
1,2,3-Trimethylbenzene	526-73-8	120.1938	0.8944	105	120	0.50	0.15	IS3
1,2-Dichlorobenzene	95-50-1	147	1.3059	146	148	0.50	0.15	IS3
d-Limonene	5989-27-5	136.24	0.8402	68	93	0.50	0.14	IS3
1,2,Dibromo-3-Chloropropane	96-12-8	236.33	2.093	157	75, 39	0.50	0.099	IS3
n-Undecane	1120-21-4	156.31	0.7402	57	71, 85	0.50	0.15	IS3
1,2,4-Trichlorobenzene	120-82-1	181.5	1.459	180	182, 184	0.50	0.16	IS3
Naphthalene	91-20-3	128.17	1.0253	128	129	0.50	0.18	IS3
n-Dodecane	112-40-3	170.34	0.7487	57	71,85	0.50	0.13	IS3
Hexachlorobutadiene	87-68-3	260.8	1.556	225	227	0.50	0.14	IS3
Cyclohexanone	108-94-1	98.14	0.9478	55	42, 98	0.50	0.12	IS3
tert-Butylbenzene	98-06-6	134.22	0.867	119	134	0.50	0.15	IS3
n-Butylbenzene	104-51-8	134.22	0.867	91	134	0.50	0.17	IS3

(S) = Surrogate (IS1) = Internal Standard 1 (IS2) = Internal Standard 2 (IS3) = Internal Standard 3
NA = Not Available

Note 1: Additional compounds may be reported as long as the minimum requirements of this document are met. The compounds listed in this table are reported using TO-15 SCAN. The Selected Ion Monitoring (SIM) compounds are a subset of this list and are included in Table 2A.

Note 2: These are suggested primary and secondary ions. However, any ions in the analyte spectra that are sufficient enough in response to reach the desired reporting limit and having a limited amount of interference, is acceptable for both the primary and secondary ion selection. Analyst experience should be utilized in determining appropriate ions.

Note 3: The laboratory performs three concentration level analyses (SIM, SCAN and Low Level SCAN). The method reporting limit listed is the standard SCAN limit (at or above lowest concentration in the initial calibration curve), but may change with each new initial calibration performed. Therefore, current reporting limits for the three analysis levels, MRLs in ppbv, and those from the Low Level SCAN should be reviewed in the electronic TO-15 Method Manual.

Note 4: The listing of the internal standard by which the compounds are quantitated is for TO-15 SCAN only. SIM compounds (SCAN subset) and their corresponding ions and internal standards are listed in Table 2A.

Note 5: m/e 101 is ~10% or less of m/e 85 (the base peak) and may not be present for low level results. Retention times must be carefully verified.

Table 2A – Volatile Organic Compounds, EPA Compendium Method TO-15 (SIM)					
Compound	**Primary Ion[1]**	**Secondary Ion[1]**	**MRL[2] (ug/m3)**	**MDL[2] (ug/m3)**	**IS**
Dichlorodifluoromethane	85	87	0.025	0.017	IS1
Chloromethane	52	50	0.025	0.019	IS1
Vinyl Chloride	62	64	0.025	0.0076	IS1
1,3-Butadiene	54	39	0.025	0.014	IS1
Bromomethane	94	96	0.025	0.0093	IS1
Chloroethane	64	66	0.025	0.0085	IS1
Acrolein	56	55	0.20	0.039	IS1
Acetone	58	43	2.5	0.056	IS1
Freon 11	101	103	0.025	0.015	IS1
1,1-Dichloroethene	96	98,61	0.025	0.0086	IS1
Methylene Chloride	84	49	0.10	0.013	IS1
Trichlorotrifluoroethane	151	153	0.025	0.0089	IS1
trans-1,2-Dichloroethene	96	98,61	0.025	0.0073	IS1
1,1-Dichloroethane	63	65	0.025	0.0061	IS1
Methyl tert-Butyl Ether	73	57	0.025	0.0093	IS1
cis-1,2-Dichloroethene	96	98,61	0.025	0.0092	IS1
Chloroform	83	85	0.10	0.018	IS1
1,2-Dichloroethane	62	64	0.025	0.0084	IS1
1,1,1-Trichloroethane	97	99	0.025	0.0059	IS1
Benzene	78	77	0.075	0.020	IS1
Carbon Tetrachloride	117	119	0.025	0.012	IS1
1,2-Dichloropropane	63	62,76	0.025	0.0073	IS2
Bromodichloromethane	83	85	0.025	0.0069	IS2
Trichloroethene	130	132	0.025	0.0085	IS2
1,4-Dioxane	88	58	0.10	0.0085	IS2
cis-1,3-Dichloropropene	75	77,39	0.025	0.0062	IS2
trans-1,3-Dichloropropene	75	77,39	0.025	0.0055	IS2
1,1,2-Trichloroethane	83	97,61	0.10	0.0079	IS2
Toluene	91	92	0.10	0.011	IS2
Dibromochloromethane	129	127	0.025	0.0088	IS3
1,2-Dibromoethane	107	109	0.025	0.0079	IS2
Tetrachloroethene	166	164	0.025	0.0082	IS2
Chlorobenzene	112	114	0.10	0.0092	IS3
Ethylbenzene	91	106	0.10	0.0097	IS3
m-&-p-Xylene	91	106	0.10	0.019	IS3
Styrene	104	103	0.10	0.0074	IS3
o-Xylene	91	106	0.10	0.0089	IS3
1,1,2,2-Tetrachloroethane	83	85	0.025	0.0072	IS3
1,3,5-Trimethylbenzene	105	120	0.10	0.0073	IS3
1,2,4-Trimethylbenzene	105	120	0.10	0.0083	IS3
1,3-Dichlorobenzene	146	148	0.025	0.0085	IS3
1,4-Dichlorobenzene	146	148	0.025	0.0081	IS3
1,2-Dichlorobenzene	146	148	0.025	0.0083	IS3
1,2-Dibromo-3-chloropropane	157	75	0.10	0.0095	IS3
1,2,4-Trichlorobenzene	182	184	0.025	0.013	IS3
Naphthalene	128	129	0.10	0.016	IS3
Hexachlorobutadiene	225	227	0.025	0.0092	IS3

NA = Not Available
(IS1) = Internal Standard 1 (IS2) = Internal Standard 2 (IS3) = Internal Standard 3
Note 1: These are suggested primary and secondary ions. However, any ions in the analyte spectra that is sufficient enough in response to reach the desired reporting limit and having a limited amount of interference, is acceptable for both the primary and secondary ion selection. Analyst experience should be utilized in determining appropriate ions.

Note 2: The method reporting limit listed is the standard SIM limit (lowest concentration in the initial calibration curve; must be higher than MDL), but may change with each new initial calibration performed. Therefore, current reporting limits should be reviewed. MDLs in ppbV may be reviewed in the electronic TO-15 Method Manual.

Table 3
Standard Concentrations (SCAN) (Primary Sources)[1]

Compound Name	0.08ng	0.2ng	0.4ng	1.0ng	5.0ng	25ng	50ng	100ng
Bromochloromethane (IS1)	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**
Propene	0.0792	0.198	0.396	0.99	4.95	24.75	49.5	99
Dichlorodifluoromethane (CFC 12)	0.0760	0.190	0.380	0.95	4.75	23.75	47.5	95
Chloromethane	0.0808	0.202	0.404	1.01	5.05	25.25	50.5	101
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	0.0816	0.204	0.408	1.02	5.10	25.50	51.0	102
Vinyl Chloride	0.0800	0.200	0.400	1.00	5.00	25.00	50.0	100
1,3-Butadiene	0.0832	0.208	0.416	1.04	5.20	26.00	52.0	104
Bromomethane	0.0816	0.204	0.408	1.02	5.10	25.50	51.0	102
Chloroethane	0.0808	0.202	0.404	1.01	5.05	25.25	50.5	101
Ethanol	0.4128	1.032	2.064	5.16	25.80	129.00	258.0	516
Acetonitrile	0.0848	0.212	0.424	1.06	5.30	26.50	53.0	106
Acrolein	0.0904	0.226	0.452	1.13	5.65	28.25	56.5	113
Acetone	0.4368	1.092	2.184	5.46	27.30	136.50	273.0	546
Trichlorofluoromethane	0.0864	0.216	0.432	1.08	5.40	27.00	54.0	108
Isopropyl Alcohol	0.1712	0.428	0.856	2.14	10.70	53.50	107.0	214
Acrylonitrile	0.0848	0.212	0.424	1.06	5.30	26.50	53.0	106
1,1-Dichloroethene	0.0872	0.218	0.436	1.09	5.45	27.25	54.5	109
tert-Butanol	0.1712	0.428	0.856	2.14	10.70	53.50	107.0	214
Methylene Chloride	0.0904	0.226	0.452	1.13	5.65	28.25	56.5	113
Allyl Chloride	0.0872	0.218	0.436	1.09	5.45	27.25	54.5	109
Trichlorotrifluoroethane	0.0872	0.218	0.436	1.09	5.45	27.25	54.5	109
Carbon Disulfide	0.0840	0.210	0.420	1.05	5.25	26.25	52.5	105
trans-1,2-Dichloroethene	0.0848	0.212	0.424	1.06	5.30	26.50	53.0	106
1,1-Dichloroethane	0.0856	0.214	0.428	1.07	5.35	26.75	53.5	107
Methyl tert-Butyl Ether	0.0872	0.218	0.436	1.09	5.45	27.25	54.5	109
Vinyl Acetate	0.4200	1.050	2.100	5.25	26.25	131.25	262.5	525
2-Butanone (MEK)	0.0888	0.222	0.444	1.11	5.55	27.75	55.5	111
cis-1,2-Dichloroethene	0.0880	0.220	0.440	1.10	5.50	27.50	55.0	110
Diisopropyl Ether	0.0880	0.220	0.440	1.10	5.50	27.50	55.0	110
Ethyl Acetate	0.1712	0.428	0.856	2.14	10.70	53.50	107.0	214
n-Hexane	0.0856	0.214	0.428	1.07	5.35	26.75	53.5	107
Chloroform	0.0896	0.224	0.448	1.12	5.60	28.00	56.0	112
1,2-Dichloroethane-d4 (S)	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**
Tetrahydrofuran	0.0888	0.222	0.444	1.11	5.55	27.75	55.5	111
Ethyl tert-Butyl Ether	0.0864	0.216	0.432	1.08	5.40	27.00	54.0	108
1,2-Dichloroethane	0.0864	0.216	0.432	1.08	5.40	27.00	54.0	108
1,4-Difluorobenzene(IS2)	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**
1,1,1-Trichloroethane	0.0840	0.210	0.420	1.05	5.25	26.25	52.5	105
Isopropyl acetate	0.1832	0.458	0.916	2.29	11.45	57.25	114.5	229
1-Butanol	0.1824	0.456	0.912	2.28	11.40	57.00	114.0	228

Table 3 - Continued
Standard Concentrations (SCAN) (Primary Sources)[1]

Compound Name	0.08ng	0.2ng	0.4ng	1.0ng	5.0ng	25ng	50ng	100ng
Benzene	0.0904	0.226	0.452	1.13	5.65	28.25	56.5	113
Carbon Tetrachloride	0.0920	0.230	0.460	1.15	5.75	28.75	57.5	115
Cyclohexane	0.1712	0.428	0.856	2.14	10.70	53.50	107.0	214
tert-Amyl Methyl Ether	0.0856	0.214	0.428	1.07	5.35	26.75	53.5	107
1,2-Dichloropropane	0.0872	0.218	0.436	1.09	5.45	27.25	54.5	109
Bromodichloromethane	0.0872	0.218	0.436	1.09	5.45	27.25	54.5	109
Trichloroethene	0.0864	0.216	0.432	1.08	5.40	27.00	54.0	108
1,4-Dioxane	0.0872	0.218	0.436	1.09	5.45	27.25	54.5	109
Isooctane	0.0856	0.214	0.428	1.07	5.35	26.75	53.5	107
Methyl Methacrylate	0.1712	0.428	0.856	2.14	10.70	53.50	107.0	214
n-Heptane	0.0872	0.218	0.436	1.09	5.45	27.25	54.5	109
cis-1,3-Dichloropropene	0.0840	0.210	0.420	1.05	5.25	26.25	52.5	105
4-Methyl-2-Pentanone	0.0888	0.222	0.444	1.11	5.55	27.75	55.5	111
trans-1,3-Dichloropropene	0.0848	0.212	0.424	1.06	5.30	26.50	53.0	106
1,1,2-Trichloroethane	0.0872	0.218	0.436	1.09	5.45	27.25	54.5	109
Chlorobenzene-d5 (IS3)	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**
Toluene-d8 (S)	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**
Toluene	0.0880	0.220	0.440	1.10	5.50	27.50	55.0	110
2-Hexanone	0.0880	0.220	0.440	1.10	5.50	27.50	55.0	110
Dibromochloromethane	0.0880	0.220	0.440	1.10	5.50	27.50	55.0	110
1,2-Dibromoethane	0.0880	0.220	0.440	1.10	5.50	27.50	55.0	110
n-Butyl Acetate	0.0928	0.232	0.464	1.16	5.80	29.00	58.0	116
n-Octane	0.0848	0.212	0.424	1.06	5.30	26.50	53.0	106
Tetrachloroethene	0.0808	0.202	0.404	1.01	5.05	25.25	50.5	101
Chlorobenzene	0.0888	0.222	0.444	1.11	5.55	27.75	55.5	111
Ethylbenzene	0.0880	0.220	0.440	1.10	5.50	27.50	55.0	110
m- & p-Xylene	0.1728	0.432	0.864	2.16	10.80	54.00	108.0	216
Bromoform	0.0912	0.228	0.456	1.14	5.70	28.50	57.0	114
Styrene	0.0896	0.224	0.448	1.12	5.60	28.00	56.0	112
o-Xylene	0.0848	0.212	0.424	1.06	5.30	26.50	53.0	106
n-Nonane	0.0832	0.208	0.416	1.04	5.20	26.00	52.0	104
1,1,2,2-Tetrachloroethane	0.0840	0.210	0.420	1.05	5.25	26.25	52.5	105
4-Bromofluorobenzene (S)	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**
Cumene	0.0808	0.202	0.404	1.01	5.05	25.25	50.5	101
alpha-Pinene	0.0832	0.208	0.416	1.04	5.20	26.00	52.0	104
n-Propylbenzene	0.0800	0.200	0.400	1.00	5.00	25.00	50.0	100
3-Ethyltoluene	0.0840	0.210	0.420	1.05	5.25	26.25	52.5	105
4-Ethyltoluene	0.0840	0.210	0.420	1.05	5.25	26.25	52.5	105
1,3,5-Trimethylbenzene	0.0848	0.212	0.424	1.06	5.30	26.50	53.0	106
alpha-Methylstyrene	0.0832	0.208	0.416	1.04	5.20	26.00	52.0	104
2-Ethyltoluene	0.0864	0.216	0.432	1.08	5.40	27.00	54.0	108
1,2,4-Trimethylbenzene	0.0872	0.218	0.436	1.09	5.45	27.25	54.5	109

Table 3 - Continued
Standard Concentrations (SCAN) (Primary Sources)[1]

Compound Name	0.08ng	0.2ng	0.4ng	1.0ng	5.0ng	25ng	50ng	100ng
n-Decane	0.0848	0.212	0.424	1.06	5.30	26.50	53.0	106
Benzyl Chloride	0.0912	0.228	0.456	1.14	5.70	28.50	57.0	114
1,3-Dichlorobenzene	0.0912	0.228	0.456	1.14	5.70	28.50	57.0	114
1,4-Dichlorobenzene	0.0848	0.212	0.424	1.06	5.30	26.50	53.0	106
sec-Butylbenzene	0.0872	0.218	0.436	1.09	5.45	27.25	54.5	109
p-Isopropyltoluene	0.0856	0.214	0.428	1.07	5.35	26.75	53.5	107
1,2,3-Trimethylbenzene	0.0848	0.212	0.424	1.06	5.30	26.50	53.0	106
1,2-Dichlorobenzene	0.0888	0.222	0.444	1.11	5.55	27.75	55.5	111
d-Limonene	0.0856	0.214	0.428	1.07	5.35	26.75	53.5	107
1,2-Dibromo-3-Chloropropane	0.0880	0.220	0.440	1.10	5.50	27.50	55.0	110
n-Undecane	0.0832	0.208	0.416	1.04	5.20	26.00	52.0	104
1,2,4-Trichlorobenzene	0.0904	0.226	0.452	1.13	5.65	28.25	56.5	113
Naphthalene	0.0888	0.222	0.444	1.11	5.55	27.75	55.5	111
n-Dodecane	0.0904	0.226	0.452	1.13	5.65	28.25	56.5	113
Hexachlorobutadiene	0.0896	0.224	0.448	1.12	5.60	28.00	56.0	112
Methacrylonitrile	0.0856	0.214	0.428	1.07	5.35	26.75	53.5	107
Cyclohexanone	0.0944	0.236	0.472	1.18	5.90	29.50	59.0	118
tert-Butylbenzene	0.0864	0.216	0.432	1.08	5.40	27.00	54.0	108
n-Butylbenzene	0.0896	0.224	0.448	1.12	5.60	28.00	56.0	112

Note 1: The concentrations detailed in this table may change with each standard purchased or internally prepared. Refer to the appropriate initial calibration file, where necessary for the corresponding concentrations.

Table 3A - Standard Concentrations (SIM) (Primary Sources)[1]

Compound Name	10pg	20pg	50pg	100pg	500pg	1000pg	2500pg	10,000pg	20,000pg	50,000pg
Freon-12	9.50	19.00	47.50	95.0	475	950	2375	9500	19000	47500
Chloromethane	10.10	20.20	50.50	101.0	505	1010	2525	10100	20200	50500
Vinyl Chloride	10.00	20.00	50.00	100.0	500	1000	2500	10000	20000	50000
1,3-Butadiene	10.40	20.80	52.00	104.0	520	1040	2600	10400	20800	52000
Bromomethane	10.20	20.40	51.00	102.0	510	1020	2550	10200	20400	51000
Chloroethane	10.10	20.20	50.50	101.0	505	1010	2525	10100	20200	50500
Acrolein	11.30	22.60	56.50	113.0	565	1130	2825	11300	22600	56500
Acetone	54.60	109.20	273.00	546.0	2730	5460	13650	54600	109200	273000
Freon-11	10.80	21.60	54.00	108.0	540	1080	2700	10800	21600	54000
1,1-Dichloroethene	10.90	21.80	54.50	109.0	545	1090	2725	10900	21800	54500
Methylene Chloride	11.30	22.60	56.50	113.0	565	1130	2825	11300	22600	56500
Freon-113	10.90	21.80	54.50	109.0	545	1090	2725	10900	21800	54500
trans-1,2-Dichloroethene	10.60	21.20	53.00	106.0	530	1060	2650	10600	21200	53000
1,1-Dichloroethane	10.70	21.40	53.50	107.0	535	1070	2675	10700	21400	53500
Methyl tert-Butyl Ether	10.90	21.80	54.50	109.0	545	1090	2725	10900	21800	54500
cis-1,2-Dichloroethene	11.00	22.00	55.00	110.0	550	1100	2750	11000	22000	55000
Chloroform	11.20	22.40	56.00	112.0	560	1120	2800	11200	22400	56000
1,2-Dichloroethane	10.80	21.60	54.00	108.0	540	1080	2700	10800	21600	54000
1,1,1-Trichloroethane	10.50	21.00	52.50	105.0	525	1050	2625	10500	21000	52500
Benzene	11.30	22.60	56.50	113.0	565	1130	2825	11300	22600	56500
Carbon Tetrachloride	11.50	23.00	57.50	115.0	575	1150	2875	11500	23000	57500
1,2-Dichloropropane	10.90	21.80	54.50	109.0	545	1090	2725	10900	21800	54500
Bromodichloromethane	10.90	21.80	54.50	109.0	545	1090	2725	10900	21800	54500
Trichloroethene	10.80	21.60	54.00	108.0	540	1080	2700	10800	21600	54000
1,4-Dioxane	10.90	21.80	54.50	109.0	545	1090	2725	10900	21800	54500
cis-1,3-Dichloropropene	10.50	21.00	52.50	105.0	525	1050	2625	10500	21000	52500
trans-1,3-Dichloropropene	10.60	21.20	53.00	106.0	530	1060	2650	10600	21200	53000
1,1,2-Trichloroethane	10.90	21.80	54.50	109.0	545	1090	2725	10900	21800	54500
Toluene	11.00	22.00	55.00	110.0	550	1100	2750	11000	22000	55000
Dibromochloromethane	11.00	22.00	55.00	110.0	550	1100	2750	11000	22000	55000
1,2-Dibromoethane	11.00	22.00	55.00	110.0	550	1100	2750	11000	22000	55000
Tetrachloroethene	10.10	20.20	50.50	101.0	505	1010	2525	10100	20200	50500
Chlorobenzene	11.10	22.20	55.50	111.0	555	1110	2775	11100	22200	55500
Ethylbenzene	11.00	22.00	55.00	110.0	550	1100	2750	11000	22000	55000
m,p-Xylenes	21.60	43.20	108.00	216.0	1080	2160	5400	21600	43200	108000
Styrene	11.20	22.40	56.00	112.0	560	1120	2800	11200	22400	56000
o-Xylene	10.60	21.20	53.00	106.0	530	1060	2650	10600	21200	53000
1,1,2,2-Tetrachloroethane	10.50	21.00	52.50	105.0	525	1050	2625	10500	21000	52500
1,3,5-Trimethylbenzene	10.70	21.40	53.50	107.0	535	1070	2675	10700	21400	53500
1,2,4-Trimethylbenzene	10.90	21.80	54.50	109.0	545	1090	2725	10900	21800	54500
1,3-Dichlorobenzene	11.40	22.80	57.00	114.0	570	1140	2850	11400	22800	57000
1,4-Dichlorobenzene	10.60	21.20	53.00	106.0	530	1060	2650	10600	21200	53000
1,2-Dichlorobenzene	11.10	22.20	55.50	111.0	555	1110	2775	11100	22200	55500
1,2-Dibromo-3-chloropropane	11.00	22.00	55.00	110.0	550	1100	2750	11000	22000	55000
1,2,4-Trichlorobenzene	11.30	22.60	56.50	113.0	565	1130	2825	11300	22600	56500
Naphthalene	11.10	22.20	55.50	111.0	555	1110	2775	11100	22200	55500
Hexachloro-1,3-butadiene	11.20	22.40	56.00	112.0	560	1120	2800	11200	22400	56000

Note 1: The concentrations detailed in Table 3A may change with each standard purchased or internally prepared. Refer to the appropriate initial calibration file, where necessary for the corresponding concentrations.

Table 4 - Standard Concentrations (SCAN) (Secondary Sources)[1]

Compound Name	25ng	Compound Name	25ng	Compound Name	25ng
Bromochloromethane (IS1)	**25.0**	1,1,1-Trichloroethane	26.00	alpha-Pinene	26.00
Propene	25.00	Isopropyl acetate	54.50	n-Propylbenzene	25.25
Dichlorodifluoromethane (CFC 12)	25.50	1-Butanol	55.75	3-Ethyltoluene	26.50
Chloromethane	24.75	Benzene	27.50	4-Ethyltoluene	26.50
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	25.75	Carbon Tetrachloride	26.75	1,3,5-Trimethylbenzene	26.50
Vinyl Chloride	25.25	Cyclohexane	52.75	alpha-Methylstyrene	26.00
1,3-Butadiene	26.75	tert-Amyl Methyl Ether	26.25	2-Ethyltoluene	26.25
Bromomethane	25.25	1,2-Dichloropropane	26.50	1,2,4-Trimethylbenzene	26.25
Chloroethane	25.25	Bromodichloromethane	27.00	n-Decane	25.75
Ethanol	127.25	Trichloroethene	26.00	Benzyl Chloride	27.25
Acetonitrile	25.50	1,4-Dioxane	27.25	1,3-Dichlorobenzene	27.25
Acrolein	26.75	Isooctane	26.00	1,4-Dichlorobenzene	26.50
Acetone	135.00	Methyl Methacrylate	52.50	sec-Butylbenzene	26.75
Trichlorofluoromethane	24.75	n-Heptane	26.75	p-Isopropyltoluene	25.25
Isopropyl Alcohol	52.50	cis-1,3-Dichloropropene	28.25	1,2,3-Trimethylbenzene	26.25
Acrylonitrile	26.00	4-Methyl-2-Pentanone	27.25	1,2-Dichlorobenzene	26.75
1,1-Dichloroethene	26.75	trans-1,3-Dichloropropene	27.00	d-Limonene	26.25
tert-Butanol	52.75	1,1,2-Trichloroethane	26.50	1,2-Dibromo-3-Chloropropane	25.75
Methylene Chloride	27.00	**Chlorobenzene-d5 (IS3)**	**25.0**	n-Undecane	25.25
Allyl Chloride	27.25	**Toluene-d8 (S)**	**25.0**	1,2,4-Trichlorobenzene	26.25
Trichlorotrifluoroethane	27.00	Toluene	26.50	Naphthalene	24.50
Carbon Disulfide	24.50	2-Hexanone	27.75	n-Dodecane	25.25
trans-1,2-Dichloroethene	26.50	Dibromochloromethane	27.50	Hexachlorobutadiene	26.75
1,1-Dichloroethane	26.00	1,2-Dibromoethane	27.00	Methacrylonitrile	26.00
Methyl tert-Butyl Ether	26.50	Butyl Acetate	28.00	Cyclohexanone	27.75
Vinyl Acetate	128.00	n-Octane	26.00	tert-Butylbenzene	26.50
2-Butanone (MEK)	27.00	Tetrachloroethene	24.75	n-Butylbenzene	27.25
cis-1,2-Dichloroethene	26.75	Chlorobenzene	27.00		
Diisopropyl Ether	27.25	Ethylbenzene	26.50		
Ethyl Acetate	53.50	m- & p-Xylene	52.50		
n-Hexane	26.25	Bromoform	27.00		
Chloroform	27.00	Styrene	27.25		
1,2-Dichloroethane-d4 (S)	**25.0**	o-Xylene	25.75		
Tetrahydrofuran	25.75	n-Nonane	25.50		
Ethyl tert-Butyl Ether	26.50	1,1,2,2-Tetrachloroethane	25.25		
1,2-Dichloroethane	26.25	**4-Bromofluorobenzene (S)**	**25.0**		
1,4-Difluorobenzene(IS2)	**25.0**	Cumene	25.50		

Note 1: The concentrations detailed in this table may change with each standard purchased or internally prepared. Refer to the appropriate initial calibration file, where necessary for the corresponding concentrations.

Table 4A – ICV/LCS Standard Concentrations (SIM) (Secondary Sources)[1]

Compound Name	500pg
Freon-12	510
Chloromethane	495
Vinyl Chloride	505
1,3-Butadiene	535
Bromomethane	505
Chloroethane	505
Acrolein	535
Acetone	2700
Freon-11	495
1,1-Dichloroethene	535
Methylene Chloride	540
Freon-113	540
trans-1,2-Dichloroethene	530
1,1-Dichloroethane	520
Methyl tert-Butyl Ether	530
cis-1,2-Dichloroethene	535
Chloroform	540
1,2-Dichloroethane	525
1,1,1-Trichloroethane	520
Benzene	550
Carbon Tetrachloride	535
1,2-Dichloropropane	530
Bromodichloromethane	540
Trichloroethene	520
1,4-Dioxane*	545
cis-1,3-Dichloropropene	565
trans-1,3-Dichloropropene	540
1,1,2-Trichloroethane	530
Toluene	530
Dibromochloromethane	550
1,2-Dibromoethane	540
Tetrachloroethene	495
Chlorobenzene	540
Ethylbenzene	530
m,p-Xylenes	1050
Styrene	545
o-Xylene	515
1,1,2,2-Tetrachloroethane	505
1,3,5-Trimethylbenzene	530
1,2,4-Trimethylbenzene	525
1,3-Dichlorobenzene	545
1,4-Dichlorobenzene	530
1,2-Dichlorobenzene	535
1,2-Dibromo-3-chloropropane	515
1,2,4-Trichlorobenzene	525
Naphthalene	490
Hexachloro-1,3-butadiene	535

Note 1: The concentrations detailed in this table may change with each standard purchased or internally prepared. Refer to the appropriate initial calibration file, where necessary for the corresponding concentrations.

Attachment 1

Training Plan

Training Plan for Analysis of VOCs by GC/MS

Trainee _____ Trainer _____ Instrument _____ Training Completion Date _____

1. Read SOP *Training Duration* _____ Trainer ____ Trainee ____ Date _____

2. Read Methods TO-14A & TO-15A *Training Duration* _____ Trainer ____ Trainee ____ Date _____

3. Demonstrated understanding of the scientific basis of the analysis Trainer ____ Trainee ____ Date _____
   Whole air sample preconcentration techniques
   Gas chromatography *Training Duration* _____
   Mass spectrometry

4. Demonstrated familiarity with related SOPs Trainer ____ Trainee ____ Date _____
   SOP for Batches and Sequences; Rev. ___
   SOP for Making Entries onto Analytical Records; Rev. ___ *Training Duration* _____
   SOP for Manual Integration Policy; Rev. ____
   SOP for Significant Figures; Rev. ____
   SOP for Nonconformance and Corrective Action; Rev. ____
   SOP for Performing MDL Studies and Establishing Limits of Detection and Quantitation; Rev. ____
   SOP for Cleaning and Certification of Summa Canisters; Rev. ____

5. Observe performance of SOP *Training Duration* _____ Trainer ____ Trainee ____ Date _____
   ___sample preparation/dilution and sample loading and analysis
   ___analytical sequence setup
   ___standard preparation
   ___BFB tuning evaluation
   ___initial calibration (model, calculations, manual integrations)/initial calibration verification
   ___manual integrations
   ___continuing calibration verification
   ___EnviroQuant introduction (recognizing saturation and sensitivity issues)
   ___data reduction and reporting including reporting req. for various agencies, autotexts, documentation
   ___canister and bag handling (including leakers)

6. Perform SOP with supervision *Training Duration* _____ Trainer ____ Trainee ____ Date _____
   ___sample preparation/dilution and sample loading and analysis
   ___analytical sequence setup
   ___standard preparation
   ___BFB tuning evaluation
   ___initial calibration (model, calculations, manual integrations)/initial calibration verification
   ___manual integrations
   ___continuing calibration verification
   ___EnviroQuant use (recognizing saturation and sensitivity issues)
   ___data reduction and reporting including reporting req. for various agencies, autotexts, documentation
   ___canister and bag handling (including leakers)

7. Independent performance of the SOP *Training Duration* _____ Trainer ____ Trainee ____ Date _____
   ___sample preparation/dilution and sample loading and analysis
   ___analytical sequence setup
   ___standard preparation
   ___BFB tuning evaluation
   ___initial calibration (model, calculations, manual integrations)/initial calibration verification
   ___manual integrations
   ___continuing calibration verification
   ___EnviroQuant proficiency (recognizing saturation and sensitivity issues)
   ___data reduction and reporting including reporting req. for various agencies, autotexts, documentation
   ___canister and bag handling (including leakers)
   ___initial demonstration of competency (4 Laboratory Control Samples)

8. Instrument operation and maintenance Trainer ____ Trainee ____ Date _____
   ___autosampler *Training Duration* _____
   ___GC and capillary column installation *Training Duration* _____
   ___mass spectrometer *Training Duration* _____
   ___data system *Training Duration* _____

Attachment 2

Initial Calibration Checklist

Initial Calibration Review Checklist - EPA Compendium Method TO-15

ICAL Date:_____ ICAL ID:_____ LIMS ICAL ID:_____

Instrument: ☐ MS3 ☐ MS8 ☐ MS9 ☐ MS11 ☐ MS13 ☐ MS16 ☐ MS19 ☐ MS21

Mode: ☐ SIM ☐ Scan Scan Low Level (0.1ng): ☐ Yes ☐ No

Analyst		Reviewer
☐	1. Is the required documentation in the ICAL file?	☐
	☐ BFB Tune analysis Report	☐
	☐ Calibration Status Report (aka Calibration History)	☐
	☐ Response Factor Report/Percent RSD	☐
	☐ Quantitation Report for each calibration standard (including manual integration documentation)	☐
	☐ ICV Quantitation Report	☐
	☐ TO-15 Standard Calculation Spreadsheet	☐
☐	2. Was the ICAL performed continuously (not interrupted for maintenance or sample analysis)?	☐
☐	3. Have all the calibration standards been analyzed within 24 hours of each other?	☐
☐	4. Does the BFB tune check standard analysis at the start meet the tune criteria?	☐
☐	5. Are all the analytes in the blank analysis <MRL?	☐
☐	6. Does each analyte's ICAL include a minimum of 5 concentrations at 5 consecutive levels?	☐
☐	7. Were the standards analyzed from low concentration to high concentration?	☐
☐	8. For each analyte, are there no levels skipped?	☐
☐	9. For each analyte, is there only one value used for each calibration level?	☐
☐	10. For each analyte, is the lowest standard's concentration at or below the analyte's MRL?	☐
☐	11. For each analyte, is the corresponding signal to noise ratio at least 3:1 at the lowest point on the curve?	☐
☐	12. For each analyte, are the corresponding upper levels free from saturation?	☐
☐	13. If a calibration level is dropped, are all the responses for each target analyte dropped and is the information noted in the ICAL explaining the reason?	☐
☐	14. Is the average RSD ≤30% for all analytes, with no more than two exceptions ≤40%?	☐
☐	15. Is the response Y at each calibration level within 40% of the mean area response over the initial calibration range for each internal standard?	☐
☐	16. Percent recovery for each analyte in the ICV 70%-130% (50-150% for VA, unless AFCEE or DoD)?	☐
☐	17. Was the RRT for each target compound at each calibration level within 0.06RRT units of the mean RRT for the compound?	☐
☐	18. Is the retention time shift for each of the internal standards at each calibration level within 20s of the mean retention time over the initial calibration range for each standard?	☐
☐	19. If there are any manual integrations, are they performed correctly according to the corresponding SOP? If so, initial and date the appropriate pages.	☐
☐	20. Is the ICAL good at 0.5ng (or 0.1ng)–100ng (Scan) or 10-20000pg (SIM) for all compounds? ☐ Yes ☐ No If not, note exceptions and the corresponding MRLs below – *Specify applicable range...*	☐
☐	21. Are ALL of the peak selections for each analyte correct according to retention time (all RTs must be checked by both the initial and peer reviewer)?	☐

COMMENTS:

Analyst:_____ Date: _____

Secondary Reviewer: _____ Date: _____

Attachment 3

Daily QC and Sample Review Checklists

Daily QC Review Checklist

(Note exceptions in Comments and include Analysis Observations/Case Narrative Summary Form as appropriate)

EPA Compendium Method TO-15

Method: ☐ EPA TO-15 ☐ EPA TO-14A **Analysis Date:** _____

Instrument: ☐ MS3 ☐ MS8 ☐ MS9 ☐ MS13 ☐ MS16 ☐ MS19 ☐ MS21

Mode: ☐ SIM ☐ Scan **Scan Low Level (0.1ng):** ☐ Yes ☐ No **DOD:** ☐ Yes ☐ No

Analyst		Reviewer
☐	1. Is the required documentation present? ☐ CORRECT BFB Tune analysis Report ☐ CCV analysis Quantitation Report & %D Report ☐ LCS analysis Quantitation Report ☐ MB analysis Quantitation Report	☐
☐	2. BFB **tune** check standard analysis meet the tune criteria for the method indicated above?	☐
☐	3. Analyses within the tune's **24-hr window or** ☐ **Client's 12hr window requirement**?	☐
☐	4. Does the **CCV** have a difference ≤30% for all analytes? [Note <u>all</u> outliers biased high and/or low]	☐
☐	5. All **IS** retention times within 20 seconds of the CCV RT or the RT from the midpoint (ICAL)?	☐
☐	6. All **IS** responses within ±40% of CCV or the midpoint in the ICAL?	☐
☐	7. All **surrogate** recoveries (in CCVs, MB, LCSs, etc.) within acceptance limits (70%-130%)	☐
☐	8. All analytes in the **MB** <MRL? (DoD <1/2MRL, except Acetone, MeCl2, EtOH, Carbon Disulfide)?	☐
☐	9. **LCS** %R within the lab control limits for all analytes except AZ samples (70%-130%, VA 50%-150%)?	☐
☐	10. All analytes in the **Lab Duplicate / DLCS** within ±25% or the client specified limits?	☐

COMMENTS:

Air-Phase Petroleum Hydrocarbons

☐	1. Does the **CCV** meet the following criteria? • Percent difference ≤30%. • One compound or range can be >30%, but less than 50%. • No single analyte or range may be >50%. [Note outliers biased high and/or low]	☐
☐	2. Does lab **duplicate** meet an RPD of ≤30% for results >5x MRL? Repeat analysis if:	☐
☐	3. Are the analytes in the **LCS** within 70%-130% recovery?	☐

RPD >30 (where both analyses are >5x RL	1st analysis detect @ >5x MRL, Dup=ND
1st analysis ≤5x RL; Dup=ND (RPD not calculable)	

COMMENTS:

☐ LIMS Run Approval ☐ LIMS Supervisor Approval

Analyst: _____ Secondary Reviewer: _____

Date: _____ Date: _____

Sample Review Checklist
(Note exceptions in Comments and include Analysis Observations/Case Narrative Summary Form as appropriate)

EPA Compendium Method TO-15

Method: ☐ EPA TO-15 ☐ EPA TO-14A **Analysis Date:** _____ **Project #:** _____

Instrument: ☐ MS3 ☐ MS8 ☐ MS9 ☐ MS13 ☐ MS16 ☐ MS19 ☐ MS21

Mode: ☐ SIM ☐ Scan **Scan Low Level (0.1ng):** ☐ Yes ☐ No **DOD:** ☐ Yes ☐ No

Analyst		Reviewer
☐	1. All analyte hits in the samples within the **calibration range** and/or noted?	☐
☐	2. All **peak integrations** acceptable?	☐
☐	3. All **manual integrations** flagged and documented?	☐
☐	4. Have **Q values** been verified for each peak?	☐
☐	6. All **calculations** correct?	☐
☐	7. Has the analyst initialed and dated each **quantitation report**?	☐
☐	8. For **TICs** are the relative intensity and other requirements met?	☐
☐	9. **Auto report** correct?	☐
☐	10. **MRL** = _____ ☐ ng ☐ pg (ethanol, acetone, vinyl acetate = 5.0ng)	☐
☐	11. Pressurized with **Helium**? Is the worksheet completed for all samples?	☐
☐	12. Report to **MDL**? ☐ Yes ☐ No	☐
☐	13. **Global Minimum Detection Limit** = _____ ☐ ng ☐ pg	☐
☐	14. **DOD:** Are **manual integrations** notated in the **case narrative?**	☐

COMMENTS:

Air-Phase Petroleum Hydrocarbons

☐	1. Are all manual **integrations** flagged and documented (except for HC ranges)?	☐
☐	2. Are all peak **integrations** acceptable?	☐
☐	3. Has the analyst initialed and dated each **quantitation report**?	☐
☐	4. Are the associated ICAL responses correct?	☐
☐	5. Are the sample responses entered into the template correctly?	☐
☐	6. Are the TO-15 target compounds entered into the template correctly?	☐
☐	7. Does the lab **duplicate** meet a RPD of ≤30% for results >5x the MRL? Otherwise, repeat analyses if:	☐

RPD >30 (where both analyses are >5x RL	1st analysis detect @ >5x MRL, Dup=ND
1st analysis ≤5x RL; Dup=ND (RPD not calculable)	

COMMENTS:

☐ LIMS Run Approval

Analyst: _____

Date: _____

☐ LIMS Supervisor Approval

Secondary Reviewer: _____

Date: _____

Attachment 4

State and Project Specific Requirements

Minnesota Requirements	
Item	**Criteria**
Holding Time (HT)	14 days
Tedlar bags	Not allowed for sampling or sample dilution
Canisters and flow controllers	Individually certified Individually leak checked before shipment
	Samples with concentrations outside of the calibration curve will have a zero canister analysis performed to check for carryover. If carryover is detected, system bake out shall be performed and documented. Additionally, in instances where the laboratory has evidence on file that a particular compound when present at a high concentration does not exhibit carry-over, the samples will not be reanalyzed. When samples are analyzed that have a higher concentration than the evidence on file, the above requirements must be followed. Also, samples that have hits below the MRL will not be reanalyzed when analyzed after a sample with concentrations over the calibration range.
Method Reporting Verification Check	Analyze a Method Reporting Verification at the beginning of the sequence prior to analyzing samples. Acceptance criteria ±40%.
Duplicates	10 percent laboratory duplicates
Record retention	MN/NELAC 5 years MPCA (Minnesota Pollution Control Agency) compliant samples 10 years
Tier level	TIII

Arizona Requirements	
Item	**Criteria**
LCS	70-130% (vinyl acetate 50-150%)

Department of Toxic Substances Control (DTSC) Requirements	
Item	**Criteria**
Holding Time (HT)	72 hour hold time for canisters

EPA Region 9 Requirements	
Item	**Criteria**
Holding Time (HT)	14 days

ATTACHMENT D

QUALITY CONTROL FORMS

FIELD ASSESSMENT CHECKLIST

		Yes	No	NA	Explain
A	**GENERAL PROCEDURES**				
A1	**PROJECT PLANS**				
	Is a copy of the approved Work Plan (WP) onsite and readily available to field personnel?				
	Is a copy of the approved Accident Prevention Plan (APP) onsite and readily available to field personnel?				
	Is a copy of the approved Quality Assurance Project Plan (QAPjP) onsite and readily available to field personnel?				
	Are field personnel knowledgeable of the project plans?				
A2	**ORGANIZATION, PERSONNEL, AND RESPONSIBILITIES**				
	Does either the WP or the QAPjP include an organizational chart?				
	Does either the WP or the QAPjP include a list of personnel responsibilities?				
	Is a daily meeting held to present the planned activities to the team and provide updates on any health and safety and Quality Control (QC)				
	Do the field personnel understand the chain of command? Discuss with individuals.				
	Have all field personnel reviewed and signed the APP?				
	Do field personnel have certification documentation on hand?				

		Yes	No	NA	Explain
	Is the site secure from unauthorized personnel?				
A3	**SAMPLE DOCUMENTATION AND HANDLING**				
	Is a Sample Manager/Custodian identified? Name:				
	Have all personnel involved with sample handling/shipment received training in all applicable and appropriate procedures?				
	Are all transfers of sample custody documented?				
	Have samples been preserved as specified in the approved QAPjP?				
	Does the identification and packaging of samples include each of the following items:				
	a. Entries in permanent ink of all applicable sample labels and tags, chain-of-custody (COC) forms and seals, and any associated paperwork?				
	b. Legible sample IDs				
	c. Complete and legible sample labels				
	d. Signed and dated COC forms				
	e. Placement of groundwater samples in a clear Ziploc plastic bag (if applicable)				
	Are sample collection logs and shipping records maintained onsite, well organized and accurate? Is any QC performed?				
	Are the coolers packed in a contamination-free area?				

		Yes	No	NA	Explain
A3	**SAMPLE DOCUMENTATION AND HANDLING (continued)**				
	Is there adequate protection against breakage of sample containers (for example packed with sufficient padding material)?				
	Are procedures in place to ensure that samples that need to be maintained at 4 degrees C are kept at that temperature and are not going to freeze or overheat?				
	Are all entries on the COC and associated paperwork (field forms, logbook, air bill) complete, accurate, legible and made in permanent ink where required?				
	Are samples shipped to the appropriate laboratories?				
	Are COC forms placed in a clear waterproof Ziploc plastic bag and taped to the inside of the cooler or box lid?				
	If coolers are shipped, are they properly secured with duct and clear/strapping tape?				
	Are shipping labels filled out properly?				
	Are shipping labels appropriately secured to the outside of the coolers? Additional clear tape is needed to secure self-adhesive air bill envelopes.				
	Are samples shipped to the laboratories in a timely fashion to minimize potential problems with holding times exceedances?				
	Is there a system in place to report sample shipments to the laboratory contact?				
	Is there a system in place to report sample shipments to project personnel not present onsite?				
	Are accurate sample collection logs and shipping records maintained onsite in a well-organized fashion?				

		Yes	No	NA	Explain
A4 FIELD RECORDS					
	Are daily field activity logs used and kept onsite?				
	Are all field activity logs dated and signed?				
	Are all entries in the log made promptly? Is time indicated in military format?				
	Are any blank pages or spaces left in the log? Any blank space in the log as well as the bottom of the last page should be crossed out, signed and dated.				
	Are all field log entries made in indelible ink?				
	Are all corrections indicated by a single-line strikethrough, dated and initialed?				
	Do all logs contain at least the following information on the cover:				
	a. Project name				
	b. Site name				
	c. Weather notes/visitors				
	d. Start and end dates for the field effort				
	e. Names of the individuals that are using the logbook?				
	Do all logs contain at least the following information on the cover:				
	Are entries in the logs adequate to allow a competent person other than the originator to reconstruct the activities?				
	Are sufficient data recorded to allow all field calculation to be replicated (for example total purge calculations for soil-vapor sampling)?				
	Are field calculations accurate? The inspector should verify 10% of the calculations.				
	Are soil-boring logs filled out promptly, accurately, and legibly?				

		Yes	No	NA	Explain
	Does sample collection information include the following items:				
	a. Sampling personnel				
	b. Sample identification				
	c. Sampling location map				
	d. Sample depth				
	e. Sample description				
	f. Collection date				
	g. Collection time (military time)				
	h. Ambient weather conditions				
	i. Analytical suite				
	j. Field data sheets				
	Are sample log sheets or electronic tracking file filled out promptly accurately and legibly?				
A5	**INSTRUMENT MAINTENANCE AND CALIBRATION**				
	Has all analytical and monitoring equipment been calibrated according to the schedule required in the approved WP or QAPjP?				
	Instrument_____ Calibration Personnel _____				
	Instrument_____ Calibration Personnel _____				
	Instrument_____ Calibration Personnel _____				
	Instrument_____ Calibration Personnel _____				
	Instrument_____ Calibration Personnel _____				
	Instrument_____ Calibration Personnel _____				

		Yes	No	NA	Explain
	Are all instruments In use (or that will be used today) within calibration tolerance? Inspector should request that the designated calibration personnel analyze the appropriate standard as an unknown.				
	Instrument_____ Calibration Personnel _____				
	Instrument_____ Calibration Personnel _____				
	Instrument_____ Calibration Personnel _____				
	Instrument_____ Calibration Personnel _____				
	Instrument_____ Calibration Personnel _____				
	Instrument_____ Calibration Personnel _____				
	Are all instruments used properly, as detailed in the FSP or QAPjP and according to SOPs and manufacturer's instructions?				
	Are all instruments appropriately maintained, according to manufacturer's instructions?				
	Additional comments on section A.				
B	**FIELD PROCEDURES**				
B1	Has the inspector reviewed the WP and QAPjP prior to the site visit?				
B2	Do the WP or QAPjP include specific procedural instructions, necessary for the completion of the scheduled field activities?				
B3	Do the WP or QAPjP and SOPs provide sufficient detail and effectively describe the objectives and requirements of the activities?				
B4	Is all equipment necessary to complete the work at hand and in good working condition?				

		Yes	No	NA	Explain
B5	Are daily reports prepared to identify deviations from the approved plans or SOPs?				
B6	Have appropriate authorizations been granted on all the deviations?				
B7	Have all field and QC samples been collected as per the WP or QAPjP and applicable instructions? Inspector should check for proper sample collection order, for example volatile organic compounds (VOC) first, proper containers, no homogenization for samples to be analyzed for VOCs, etc.).				
B8	Were any samples collected in a fashion that may question their integrity; for example, VOCs collected in the vicinity of a running vehicle?				
B9	Additional comments on section B.				
C	**INSPECTION SUMMARY**				
C1	Do the responses to the inspector indicate that the field personnel are aware of the quality assure (QA)/QC and its importance to the success of the projects?				
C2	Do field personnel place positive emphasis on QA/QC procedures?				
C3	Have responses with respect to QA/QC procedures been open and direct?				
C4	Has a cooperative attitude been displayed by the field personnel?				
C5	Are all procedures and documentation performed consistent with the Work Plan or QAPjP? Is there evidence that the field team has corrected deficiencies identified in the previous inspection (if applicable)?				
C6	Additional comments on section C.				
D	**DEFICIENCY REPORT**				
D1	Were any deficiencies identified as a result of the field inspection?				
D2	Were all deficiencies and observations discussed with the field team leader during inspection debriefing?				

		Yes	No	NA	Explain
	Deficiency # _____ Description _____ _____ _____ _____ Corrective Action(s): _____ _____ _____ _____ _____ Implementation Date(s):				
	Deficiency # _____ Description _____ _____ _____ _____ Corrective Action(s): _____ _____ _____ _____ _____ Implementation Date(s):				

		Yes	No	NA	Explain
D	**DEFICIENCY REPORT (continued)**				
D2	Were all deficiencies and observations discussed with the field team leader during inspection debriefing? (continued)				
	Deficiency # _____ Description _____ _____ _____ _____ Corrective Action(s): _____ _____ _____ _____ _____ Implementation Date(s):				
	Deficiency # _____ Description _____ _____ _____ _____ Corrective Action(s): _____ _____ _____ _____ _____ Implementation Date(s):				

		Yes	No	NA	Explain
D	**DEFICIENCY REPORT (Continued)**				
D2	Were all deficiencies and observations discussed with the field team leader during inspection debriefing? (Continued)				
	Deficiency # _____ Description _____ _____ _____ _____ Corrective Action(s): _____ _____ _____ _____ _____ Implementation Date(s):				
	Deficiency # _____ Description _____ _____ _____ _____ Corrective Action(s): _____ _____ _____ _____ _____ Implementation Date(s):				

		Yes	No	NA	Explain
D	**DEFICIENCY REPORT (Continued)**				
D2	Were all deficiencies and observations discussed with the field team leader during inspection debriefing? (Continued)				
	Deficiency # _____ Description _____ _____ _____ _____ Corrective Action(s): _____ _____ _____ _____ _____ Implementation Date(s):				
	Deficiency # _____ Description _____ _____ _____ _____ Corrective Action(s): _____ _____ _____ _____ _____ Implementation Date(s):				

NON-CONFORMANCE REPORT

Project:		RFI No.:		Date:
To:		Contract No:		
		REFERENCES		
Attention:		Drawing/Spec:		
Subject:		Detail/Section:		
		Discipline:		

POTENTIAL IMPACT	ROUTING	DATE SENT	DATE REC'D	COMMENTS
☐ QUALITY/TECHNICAL COMPLETION				
☐ COST				
☐ SCHEDULE				
ACTIVITY:				
	RESPONSE REQUESTED BY:		PRIORITY:	

NONCONFORMANCE	
CORRECTIVE ACTION	

Addressee: Sign and return original to:	**By:**
	Name/ Signature:
	Title:

Quality Assurance Project Plan to be delivered separately.