ENVIRONMENTAL RESTORATION PROGRAM
KIRTLAND AIR FORCE BASE, NEW MEXICO

QUALITY ASSURANCE PROJECT PLAN
FOR THE BULK FUELS FACILITY

June 2010

377 MSG/CEANR
2050 Wyoming Blvd. SE
Kirtland AFB, New Mexico 87117-5670

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JUNE 2010

Prepared For

HQ AFCEE/ERD
Building 171
Environmental Restoration Division
2261 Hughes Ave, Suite 155
Lackland AFB, TX 78236-9853

USAF Contract No. FA8903-08-D-8769,T ask Order No. 178

Prepared By

CH2M HILL, Inc.
4041 Jefferson Plaza NE, Suite 200
Albuquerque, New Mexico 87109

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, Virginia 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, D.C. 20503.			
1. AGENCY USE ONLY	2. REPORT DATE June 2010	3. REPORT TYPE AND DATES COVERED Quality Assurance Project Plan	
4. TITLE AND SUBTITLE Kirtland Air Force Base, New Mexico Quality Assurance Project Plan for the Bulk Fuels Facility			5. FUNDING NUMBERS FA8903-08-D-8769 Task Order No. 178
6. AUTHOR(S) Shane Lowe, Meredith Brislen, and Jeffrey Johnston, CH2M HILL			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) CH2M HILL 4041 Jefferson Plaza NE, Suite 200 Albuquerque, New Mexico 87109			8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Center for Engineering and the Environment (AFCEE) Environmental Restoration Division (AFCEE/ERD) 2261 Hughes Ave, Suite 155 Lackland AFB, TX 78236-9853 COR: Ms. Kristi Doll/Mr. Michael Litman			10. SPONSORING / MONITORING AGENCY REPORT NUMBER
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION/AVAILABILITY STATEMENT			12b. DISTRIBUTION CODE
13. ABSTRACT (Maximum 200 words) This Quality Assurance Project Plan presents the site-specific work planning and procedures that govern all sampling and analysis activities for the Bulk Fuels Facility, Kirtland AFB, New Mexico.			
14. SUBJECT TERMS Quality Assurance Project Plan			15. NUMBER OF PAGES 116 16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION UNCLASSIFIED	20. LIMITATION OF ABSTRACT SAR

NSN 7540-01-280-5500

Standard Form 298 (Rev 2-89)
Prescribed by ANSI Std 239-18 298-102

DOCUMENT CERTIFICATION
June 2010

This document has been approved for public release in accordance with Department of Defense Directives and Air Force Instructions.

KIRTLAND AIR FORCE BASE
377th ABW Public Affairs

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PREFACE

This Quality Assurance Project Plan (QAPP) was prepared to present the project-specific quality assurance/quality control (QA/QC) requirements for the ongoing investigations and remedial operations at the Bulk Fuels Facility on Kirtland Air Force Base (AFB), New Mexico.

This QAPP is an integral part of the site-specific work planning that governs all sampling and analysis activities for the site. The QAPP ensures that data of appropriate quality are collected and meet the project specific requirements. The QAPP is intended for use by CH2M HILL and its subcontractors who provide services associated with the environmental data collection effort. This document was prepared under the authority of the Air Force Center for Engineering and the Environment, Contract Number FA8903-08-D-8769, Task Order 178. Ms. Kristi Doll served as the Contracting Officer's Representative.

Sharon L. Minchak, P.G.
CH2M HILL Program Manager

Jeffrey W. Johnston
CH2M HILL Project Manager

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ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AG	amber glass
ASTM	American Society for Testing and Materials
BFB	Bromofluorobenzene
°C	degrees Celsius
CCC	continuing calibration check
CLP	Contract Laboratory Program
CRQL	contract required quantitation limit
DBCP	1,2-Dibromo-3-chloropropane
DFTPP	Decafluorotriphenylphosphine
DQO	data quality objectives
DRO	diesel range organics
EB	equipment blank
EDB	1,2-Dibromoethane
EICP	extracted ion current profile
EPA	U.S. Environmental Protection Agency
FD	field duplicate
G	glass
GRO	gasoline range organics
G-TLC	glass with Teflon lined cap
HCl	hydrochloric acid
Hg	mercury
ICAL	initial calibration
SIM	selective ion monitoring
ICV	initial calibration verification
IDW	investigation-derived waste
L	liter
LCL	lower control limit
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
MCL	maximum contaminant level
MDL	maximum detection limit
MEK	2-Butanone
µg/kg	micrograms per kilograms
µg/L	micrograms per liter
mg/kg	milligrams per kilograms
mg/l	milligrams per liter

ACRONYMS AND ABBREVIATIONS (Concluded)

mL	milliliter
MS/MSD	matrix spike/matrix spike duplicates
N/A	not applicable
oz	ounce
P	polyethylene
PAH	polycyclic aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, completeness, and comparability
ppbv	parts per billion by volume
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
%R	percent recovery
%RSD	percent relative standard deviation
RF	response factor
RL	reporting limit
RPD	relative percent difference
RRF	relative response factor
SIM	selective ion monitoring
SOP	standard operating procedures
SPCC	system performance check compound
SVOC	semivolatile organic compound
TB	trip blank
TCLP	toxicity characteristic leaching procedure
TPH	total petroleum hydrocarbons
UCL	upper control limit
USAF	United States Air Force
VOC	volatile organic compound

1. INTRODUCTION

This Quality Assurance Project Plan (QAPP) was prepared to present the project-specific quality assurance/quality control (QA/QC) requirements for the ongoing investigations and remedial operations at the Kirtland Air Force Base (AFB) Bulk Fuels Facility, located on Kirtland AFB, New Mexico. This work is being conducted to collect data to assess soil and groundwater quality beneath and adjacent to the Bulk Fuels Facility. The sites addressed by this QAPP include, but are not limited to, ST-106, Spill at Bulk Fuels Facility; and SS-111, Bulk Fuels Facility Phase Separated Hydrocarbon.

This QAPP supplements the requirements presented in the *Base-Wide Plans for the Environmental Restoration Program, 2004 Update,* QAPP (U.S. Air Force [USAF], 2004). This QAPP is an integral part of the site-specific work planning that governs all sampling and analysis activities for the site. The QAPP ensures that data of appropriate quality are collected and meet the project specific requirements. The QAPP is intended for use by CH2M HILL and its subcontractors who provide services associated with the environmental data collection effort.

The QAPP presents the QA/QC requirements designed to ensure that environmental data collected for the site are of the appropriate quality to achieve the project objectives as defined in the *Remediation and Site Investigation Report, April 2009 through September 2009, Bulk Fuels Facility, Kirtland AFB* (USAF, 2009a). The report describes the background of the site, sources of contamination, and information derived from previous investigations. Additionally, the Remediation and Site Investigation Report, along with *the Operations and Maintenance Manual for the Soil Vapor Extraction Systems, Bulk Fuels Facility, Kirtland AFB* (USAF, 2009b) discusses the procedures for sampling, equipment decontamination, handling of investigation-derived wastes (IDW), sample handling and storage, and field QC. The QAPP specifies the requirements for laboratory analyses, data handling, data evaluation and assessment performance evaluations, chain of custody requirements, corrective actions, preventive maintenance of equipment, and additional information regarding sample handling and storage and field QC.

The elements included in this QAPP are consistent with those specified in the U.S. Environmental Protection Agency (EPA) *Requirements for Quality Assurance Project Plans, EPA QA/R-5,* March 2001 (EPA, 2001). The objectives of the QAPP are to:

- Ensure that data collection and measurement procedures are standardized among all participants.
- Monitor the performance of the various measurement systems being used in the program to maintain statistical control and provide rapid feedback, so that corrective measures, if needed, can be taken before the data quality is compromised.
- Periodically assess the performance of these measurement systems and their components.
- Verify that reported data are sufficiently complete, comparable, representative, unbiased, and precise, so that they are suitable for their intended use.

This QAPP supplements the Remediation and Site Investigation Report and any other project-specific documents.

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2. SAMPLING PROCEDURES

2.1 Sampling Design

The number and location of groundwater, soil and soil vapor samples to be collected from the site and the rationale behind the sampling design is discussed in the task-specific Work Plan. The sampling design is a function of the medium sampled, information about the sampling site, the type of data to be collected, and how the data are to be used. The specific protocols for soil and groundwater sampling, equipment decontamination, handling of investigation-derived wastes, and field QC are discussed in the task-specific work plan.

2.2 Sampling Method Requirements

The task-specific work plan presents the sampling methods requirements.

2.3 Field Quality Control Samples

The QC samples will be collected to monitor accuracy, precision, and the presence of field contamination for analytical methods to be performed in the offsite laboratory. The frequency of collection of the QC samples is outlined below.

2.3.1 Field Duplicate Samples

A field duplicate (FD) is an independent sample collected as close as possible to the original sample, from the same source and under identical conditions, and is used to document sampling and analytical precision. The FD samples will be collected at the frequency of one for every 10 environmental samples. The sampling procedures described in the task-specific Work Plan will be followed. The sampling locations for FD samples will be recorded in the field logbook.

The FD samples will be collected simultaneously or in immediate succession to original environmental samples, using identical recovery techniques, and treated identically during storage, transportation, and analysis.

2.3.2 Equipment Blank Samples

Equipment rinsate blank (EB) samples are collected to evaluate field sampling and decontamination procedures by pouring deionized water over the decontaminated equipment. EB's will be collected for each matrix sampled (excluding soil vapor samples), and will be collected at a rate of 1 per 20 samples. The EB samples will be analyzed in the offsite laboratory for the same parameters specified the environmental samples.

2.3.3 Ambient Blank Samples

Ambient blanks for volatile organic compound (VOC) analysis will be collected on a project-specific basis.

2.3.4 Trip Blank Samples

Trip blank (TB) samples are used to monitor for contamination during sample shipping and handling, and for cross-contamination through VOC migration among the collected samples. They are prepared in the laboratory by pouring American Society for Testing and Materials (ASTM) Type II or deionized water into the sample container. They are then sealed, transported to the field, remained sealed while VOC samples are taken, and transported back to the laboratory in the same cooler as the VOC samples. One TB sample will be placed in each cooler that contains VOC samples shipped from the field to the laboratory.

2.3.5 Matrix Spike/Matrix Spike Duplicate Samples

Matrix spike and matrix spike duplicate (MS/MSD) samples are a duplicate pair of samples, collected along with an investigatory sample to which the laboratory adds a spike containing the analytes of concern at known concentrations to assess the effect of the sample matrix on the extraction and analysis method.

For every 20 environmental samples of each matrix collected (excluding soil vapor samples), one location will have sample volume collected in triplicate for each analysis required and designated on the chain of custody form as an MS/MSD. Sampling for the MS/MSD may involve obtaining an independent pair of samples collected as close as possible to the original (parent) sample from the same source under identical conditions. The MS/MSD also may be prepared by the laboratory as part of its QA program from a subsample of an investigatory sample.

Independent MS/MSD samples will be collected simultaneously or in immediate succession, using identical recovery techniques as the parent sample, and treated in identically manner during storage, transportation, and analysis. The sampling locations for the MS/MSD will be documented in the field logbook.

2.4 Sample Documentation and Tracking

Sample containers will be received from the laboratory pre-labeled with the preservative. The sample identification nomenclature and date and time of sampling are entered on the label immediately after collection. The labels must be secured using clear tape to maintain the identification of each sample.

Vital information regarding the collection of each sample will be recorded in a field logbook. The field logbook will be bound with consecutively-numbered pages. All entries will be legibly written in permanent ink and signed and dated by the individual making the entries. Factual and objective language will be used. All entries will be complete and accurate enough to allow reconstruction of each field activity.

3. SAMPLE HANDLING AND CUSTODY

3.1 Containers and Preservatives

The laboratory will provide the required sample containers for all environmental and associated QC samples. All containers will be certified free of the analytes of concern for this project. No sample containers will be reused. The laboratory will add preservatives, if required, prior to shipping the sample containers to the field. The laboratory, upon receipt of the samples, will verify the adequacy of preservation and will add additional preservative, if necessary. The container type, minimum sample quantities, required preservatives, and maximum holding times for the selected analytical parameters are listed in Table 3-1.

Table 3-1. Sample Containers, Preservation, and Holding Times (Page 1 of 2)

Analyte	Method[a]	Matrix	Container and Minimum Quantity	Preservation	Holding Time
Iron.lead and Manganese (Total/ dissolved)	SW846 6010B/SW6020/ SW7000 series	Water	500 mL/P	Add nitric acid to pH<2; chill to 4°C For Dissolved: Field filter, Add nitric acid to pH<2; chill to 4°C	180 days
Volatile Organic Compounds	SW846 8260B	Water	3 x 40-mL /G-TLC		Water: 14 days (preserved); 7 days (unpreserved)
		Soil	3 x 5g Encore or equivalent sampling technique	Chill to 4°C/freeze	Soil: 48 hours from collection to preservation, 14 days to analysis
	TO-15/TO-15 Low Level	Air	1-L Summa Add HCl to pH<2; chill to 4°C	None	30 days
Semivolatile Organic Compounds	SW846 8270C	Water	2 x 1-L/AG	Chill to 4°C	Water: 7 days to extraction; 40 days to analysis
		Soil	1 x 8oz G	Chill to 4°C	Soil: 14 days to extraction; 40 days to analysis
1,2-Dibromoethane (EDB),	SW846 504.1/SW8011	Water	3 x 40-mL/G-TLC	Add $Na_2S_2O_3$ to pH<2; chill to 4°C	Water: 14 days (preserved); 7 days (unpreserved)
Polyaromatic Hydrocarbons	SW846 8310/SW8270 SIM	Water	2 x 1-L/AG	Chill to 4°C	Water: 7 days to extraction; 40 days to analysis
		Soil	1 x 8oz G	Chill to 4°C	Soil: 14 days to extraction; 40 days to analysis

Table 3-1. Sample Containers, Preservation, and Holding Times, (Page 2 of 2)

Analyte	Method[a]	Matrix	Container and Minimum Quantity	Preservation	Holding Time
Gasoline Range Organics (GRO)	SW846 8015B	Water	3 x 40-mL/G-TLC	Add HCl to pH<2; chill to 4°C	Water: 14 days (preserved); 7 days (unpreserved)
		Soil	3x 5g Encore or equivalent sampling technique	Chill to 4°C	Soil: 48 hours from collection to preservation, 14 days to analysis
	8015M	Air	1-L Summa	None	30 days
Diesel Range Organics (DRO)	SW846 8015B	Water	1-L/AG	Chill to 4°C	Water: 7 days to extraction; 40 days to analysis
		Soil	1 x 8oz G	Chill to 4°C	Soil: 14 days to extraction; 40 days to analysis
Nitrate/Sulfate	SW846 300.0/SW9056	Water	500-mL/P	Chill to 4°C	48 hours for Nitrate/ 28 days for sulfate
Alkalinity	EPA 310.1	Water	500-mL/P	Chill to 4°C	14 days
Fixed Gases	SM2720C	Air	1-L Summa	None	30 days

[a]EPA, 1996
°C degrees Celsius
AG amber glass
G glass
G-TLC glass with Teflon lined cap
HCl hydrochloric acid
L liter
mL milliliter
oz ounce
P polyethylene
TCLP toxicity characteristic leaching procedure

3.2 Chain of Custody

Collecting data of known quality begins at the point of sample collection. Legally defensible data are generated by adhering to proven evidentiary procedures. These procedures are outlined in the following sections and must be followed to preserve and ensure the integrity of all samples from the time of collection through analysis. Sample custody records must be maintained both in the field and in the subcontractor laboratory. A sample is considered to be in someone's custody if it is either in his or her physical possession or view, locked up, or kept in a secured and restricted area. Until shipment, sample custody will be the responsibility of the sampling team leader.

Chain of custody records document sample collection and shipment to the laboratory. A chain of custody form will be completed for each sampling event. The original copy will be provided to the laboratory with the sample shipping cooler, and a copy will be retained in the field documentation files. The chain of custody form will identify the contents of each shipment and maintain the custodial integrity of the samples. All chain of custody forms will be signed and dated by the responsible sampling team personnel. The "relinquished by" box will be signed by the responsible sampling team personnel, and the

date, time, and air bill number will be noted on the chain of custody form. The laboratory will return the executed copy of the chain of custody with the hardcopy report.

The shipping coolers containing the samples will be sealed with a custody seal any time the coolers are not in an individual's possession or view before shipping. All custody seals will be signed and dated by the responsible sampling team personnel.

At a minimum, the chain of custody form must contain:

- Site name/Project name;
- Project manager name, telephone number, and fax number;
- Unique sample identification;
- Date and time of sample collection;
- Source of sample (including name, location, sample type, and matrix);
- Number of containers;
- Designation of MS/MSD;
- Preservative used;
- Analyses required;
- Name of sampler;
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratories;
- Bill of landing or transporter tracking number (if applicable);
- Turnaround time;
- Lab name, address, and contact information; and
- Any special instructions.

Erroneous entries on chain of custody records will be corrected by drawing a line through the error and entering the corrected information. The person performing the correction will date and initial each change made on the chain of custody form.

3.3 Laboratory Responsibilities

3.3.1 Chain of Custody

Once the samples reach the laboratory, they will be checked against information on the chain of custody form for anomalies. The condition, temperature, and appropriate preservation of samples will be checked and documented on the chain of custody form. Checking an aliquot of the sample using pH paper is an acceptable procedure to document pH (precautions must be taken to avoid contamination of the sample).

Samples requiring VOC analyses should not undergo preservation verification until the time of analysis. The occurrence of any anomalies in the received samples and their resolution will be documented in laboratory records.

All sample information will then be entered into a tracking system, and unique analytical sample identifiers will be assigned. A copy of this information will be reviewed by the laboratory for accuracy. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Laboratory analyses will be documented on the chain of custody form. Procedures ensuring internal laboratory chain of custody also will be implemented and documented by the laboratory. Ideally, sample custody will be maintained using an internal custody system that requires samples to be kept in a secured and restricted area when not in use and to be checked out and checked back in by the analysts who use the samples.

Internal custody records must be maintained by the laboratory as part of the documentation file for each sample. Specific instructions concerning the analysis specified for each sample will be communicated to the analysts. Analytical batches will be created, and laboratory QC samples will be included with each batch.

The following information will be documented on Sample Receipt Forms by the sample custodian:

- Date samples received;
- CH2M HILL sample identification number;
- Laboratory sample identification number;
- Analytical tests requested for the sample batch;
- Sample matrix;
- Number of samples in the batch;
- Container description and location in the laboratory; and
- Verification of sample preservation.

Standard operating procedures (SOPs) describing sample control and custody will be maintained by the laboratory.

3.3.2 Sample Storage

While samples are stored in the laboratory, they will be stored in limited-access, temperature-controlled areas. Refrigerators, coolers, and freezers will be monitored for temperature 7 days a week. Acceptance criterion for the temperatures of the refrigerators and coolers is 4°C ± 2°C. Acceptance criterion for the temperatures of the freezers will be less than 0°C. Samples for VOC determination will be stored separately from other samples, standards, and sample extracts.

Samples will be stored after analysis for a period of 120 days and then disposed of in accordance with applicable local, state, and federal regulations. Disposal records will be maintained by the laboratory.

When samples that are designated as "HOLD" on the chain of custody are released for analysis by CH2M HILL, an official letter must be submitted to the laboratory, and the chain of custody should be resubmitted to the Data Manager and Project Chemist with relevant release notification. The laboratory also will submit appropriate documentation to the Project Chemist and Data Manager confirming the samples that will be released for analysis.

3.4 Sample Packaging and Transport

The following sections contain guidelines for sample packaging and transport.

3.4.1 Sample Container Preparation

- The labels will be secured to each container with clear tape, if not previously done.
- Container lids will be checked for tightness, and if the container is not full, the outside of the container will be marked with indelible ink at the sample volume level.
- Sample bottles will be double-bagged in heavy-duty plastic. Glass containers will be covered with bubble wrap to prevent breakage.

3.4.2 Shipping Cooler Preparation

- All previous labels used on the sample-shipping cooler will be removed.
- The drain plugs will be sealed with fiberglass tape (outside and inside) to prevent melting ice from leaking.
- A cushioning layer of packing material such as bubble wrap will be placed at the bottom of the cooler (approximately 1-inch thick) to prevent breakage during shipment.

3.4.3 Placing Samples in the Cooler

- The chain of custody form will be placed in a re-sealable plastic bag;
- Samples will be placed in an upright position in the cooler;
- Ice will be placed in re-sealable plastic bags in duplicate to minimize leakage of ice melt into the cooler;
- Ice will be placed on top of and in between samples; and
- Void space between samples will be filled with packing material.

3.4.4 Closing the Cooler

- The cooler lid will be taped with strapping tape, encircling the cooler several times.
- One custody seal will be affixed to the cooler lid to further ensure the integrity of the samples.

3.4.5 Transport

- Sample coolers will be transported to the laboratory (an overnight courier may be used) immediately after sample collection. Intermediate stops will be avoided, with the exception of emergencies only, in which case the situation will be noted in the field logbooks.
- The laboratory will be notified that samples are being shipped.

4. DATA QUALITY OBJECTIVES AND QUALITY ASSURANCE PROGRAM

The data quality objectives (DQOs) for the project were established based upon the EPA *Guidance for the Data Quality Objectives Process* (EPA, 2000) and the Kirtland AFB Base-Wide Plans (USAF, 2004). The DQOs are the basis for the design of the data collection plan. These DQOs specify the type, quality, and quantity of data to be collected and how the data are to be used to make the appropriate decisions for the project. Table 4-1 lists the extraction and digestion methods to be used for the investigation at the Bulk Fuels Facility.

Table 4-1. Extraction and Digestion Methods

Analytical Method [a]	Parameter	Preparatory Methods [b]
SW846 6010B/SW6020/SW7000 series	Iron, Lead and Manganese (Total/Dissolved)	SW3005A,SW3010A
SW846 8260B	Volatiles	SW5030B, SW5035
SW846 8270C	Semivolatile organic compounds	SW3510C, SW3520C,SW3540C, SW3541, SW3545, SW3550B
SW8015B	TPH DRO/GRO	(volatiles) SW5030B, SW5035 (extractables) SW3510C, SW3520C, SW3541, SW3545, SW3550B
SW8310/SW8270 SIM	PAH	SW3510C, SW3520C
E504.1/SW8011	EDB	See analytical method
E300.0/SW9056	Nitrate as N/Sulfate	See analytical method
E310.1	Alkalinity	See analytical method
TO-15/TO-15 Low Level	Volatile	See analytical method
8015M	TPH-GRO (air)	See analytical method
SM2720C	Fixed Gases	See analytical method

[a] EPA, 1996
[b] Standard Methods, 1998
DRO diesel range organics
EDB 1,2-Dibromoethane
GRO gasoline range organics
PAH polycyclic aromatic hydrocarbon
TPH total petroleum hydrocarbons

4.1 Precision, Accuracy, Representativeness, Completeness, and Comparability

Data quality will be evaluated based on their precision, accuracy, representativeness, completeness, and comparability (PARCC).

4.1.1 Precision

Precision is a measure of reproducibility of analytical results. It can be defined as the degree of mutual agreement among individual measurements obtained under similar conditions. Total precision is a function of the variability associated with both sampling and analysis. Precision will be evaluated as the

relative percent difference (RPD) between FD sample results, laboratory control samples (LCS), and laboratory control sample duplicates (LCSD) and/or MS /MSD results.

4.1.2 Accuracy

Accuracy is the degree of agreement between a measured value and the "true" or expected value. It represents an estimate of total error from a single measurement, including either systematic error, or bias, and random error that may reflect variability due to imprecision. Accuracy is evaluated in terms of percent recoveries determined from results of MS/MSD and LCS analyses.

4.1.3 Representativeness

Representativeness is the degree to which sample data accurately reflect the characteristics of a population of samples. It is achieved through a well-designed sampling program and by using standardized sampling strategies and techniques and analytical procedures. Factors that can affect representativeness include site homogeneity, sample homogeneity at a single point, and available information around which the sampling program is designed. Using multiple methods to measure an analyte also can result in non-representativeness of sample data.

4.1.4 Completeness

Completeness is the amount of valid measurements compared to the total amount generated. It will be determined for each method, matrix, and analyte combination. The completeness goals of each project are optimized to meet the DQOs. The completeness goals for this program are 95 percent.

4.1.5 Comparability

Comparability is the confidence with which one data set can be compared to another. It is achieved by maintaining standard techniques and procedures for collecting and analyzing samples and reporting the analytical results in standard units. Results of performance evaluation samples and systems audits will provide additional information for assessing comparability of data among participating subcontractor laboratories.

4.2 Method Detection Limits, Reporting Limits, and Instrument Calibration Requirements

4.2.1 Method Detection Limits

The method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The laboratory will establish the MDL for each method, matrix, and analyte for each instrument that will be used to analyze samples. The MDLs will initially be calculated before analyzing samples and will be recalculated at least once every 12 months.

4.2.2 Reporting Limits

Reporting limits (RL) will be greater than two times the laboratory calculated MDL. The RL used by the laboratory should not be greater than the detection limit objectives listed in Tables 4-2 through 4-11.

When calibrating instruments, a standard at a concentration equal to or less than the reporting limit must be included. Reporting requirements are listed below:

- Analytes at concentrations greater than the laboratory's MDL, but less than the RL, will be flagged as estimated with a "J" qualifier and reported.
- Analytes that are not detected at, or above, the laboratory's MDL will be reported as not detected at the RL and flagged "U."

Table 4-2. Reporting Limit Objectives for Metals by Method SW846 6010B/SW6020/SW7000 Series

Analyte	EPA MCL[a] (mg/L)	Reporting Limits Water (mg/L)
Iron (Total/dissolved)	0.3	0.1
Manganese (Total/dissolved)	0.05	0.01
Lead (Total/dissolved)	0.015	0.015
[a]EPA Maximum Contamination Levels, Secondary Drinking Water Standards mg/L: milligrams per liter		

Table 4-3. Reporting Limit Objectives for TPH (DRO/GRO) by Method SW846 8015B

Total Petroleum Hydrocarbons (TPH)	Reporting Limits Water (µg/L)	Reporting Limits Soil (mg/kg)
TPH-Purgable (GRO)	25	1.2
TPH-Extractable (DRO)	250	4
DRO diesel range organics GRO gasoline range organics mg/kg micrograms per kilograms µg/L micrograms per liter		

Table 4-4. Reporting Limit Objectives for Volatile Organic Compounds by Method SW846 8260B (Page 1 of 2)

Analyte	EPA MCL[a] (µg/L)	NMED SSL[b] (µg/kg)	Reporting Limits Water (µg/L)	Reporting Limits Soils (µg/kg)
1,1,1,2-Tetrachloroethane	--	29,200	1	5
1,1,1-Trichloroethane	200	21,800,000	1	5
1,1,2,2-Tetrachloroethane	--	7,970	1	5
1,1,2-Trichloroethane	5	17,200	1	5
1,1-Dichloroethane	--	62,900	1	5
1,1-Dichloroethene	7	618,000	1	5
1,1-Dichloropropene	--	--	1	5
1,2,3-Trichlorobenzene	--	--	1	5
1,2,3-Trichloropropane	--	915	1	5
1,2,4-Trichlorobenzene	70	143,000	1	5
1,2,4-Trimethylbenzene	--	--	1	5
1,2-Dibromo-3-chloropropane (DBCP)	0.2	194	5	10
1,2-Dibromoethane (EDB)	0.05	574	1	5
1,2-Dichlorobenzene	600	3,010,000	1	5
1,2-Dichloroethane	5	7,740	1	5
1,2-Dichloropropane	5	14,700	1	5
1,3,5-Trimethylbenzene	--	--	1	5
1,3-Dichlorobenzene	--	--	1	5
1,3-Dichloropropane	--	23,500	1	5
1,4-Dichlorobenzene	75	32,100	1	5
2,2-Dichloropropane	--	--	5	5
2-Butanone (MEK)	--	39,600,000	6	20
2-Chlorotoluene	--	156,000	1	5
2-Hexanone	--	--	5	20
4-Chlorotoluene	--	--	1	5
4-Isopropyltoluene	--	--	1	5
4-Methyl-2-pentanone	--	5,950,000	5	20
Acetone	--	67,500,000	10	20
Benzene	5	15,500	1	5
Bromobenzene	--	--	1	5
Bromochloromethane	--	--	1	5
Bromodichloromethane--		5,250	1	5
Bromoform	--	496,000	1	5
Bromomethane	--	22,300	2	10
Carbon disulfide	--	1,940,000	2	5
Carbon tetrachloride	5	4,380	1	5

Table 4-4. Reporting Limit Objectives for Volatile Organic Compounds by Method SW846 8260B (Concluded, Page 2 of 2)

Analyte	EPA MCL[a] (µg/L)	NMED SSL[b] (µg/kg)	Reporting Limits Water (µg/L)	Reporting Limits Soils (µg/kg)
Chlorobenzene	100	508,000	1	5
Chloroethane	--	--	2	10
Chloroform	--	5,720	1	10
Chloromethane	--	35,600	2	10
cis-1,2-Dichloroethene	70	782,000	1	2.5
cis-1,3-Dichloropropene	--	--	1	5
Dibromochloromethane	--	11,300	1	5
Dibromomethane	--	782,000	1	5
Dichlorodifluoromethane	--	481,000	2	10
Ethylbenzene	700	69,600	1	5
Isopropylbenzene	--	321,000	1	5
Methyl tert butyl ether	--	862,000	5	20
Methylene chloride	--	199,000	5	5
m-Xylene & p-Xylene	--	8,290,000	2	2.5
n-Butylbenzene	--	--	1	5
n-Propylbenzene	--	--	1	5
o-Xylene	--	9,550,000	1	2.5
sec-Butylbenzene	--	--	1	5
Styrene	100	8,970,000	1	5
tert-Butylbenzene	--	--	1	5
Tetrachloroethene	5	6,990	1	5
Toluene	1000	5,570,000	1	5
trans-1,2-Dichloroethene	100	273,000	1	2.5
trans-1,3-Dichloropropene	--	--	1	5
Trichloroethene	5	45,700	1	5
Trichlorofluoromethane	--	2,010,000	2	10
Vinyl chloride	2	865	1	5
Xylene (total)	10,000	1,090,000	2	5

[a]EPA Maximum Contaminant Levels
[b]NMED Soil Screening Levels
µg/kg micrograms per kilogram
µg/L micrograms per liter

Table 4-5. Reporting Limit Objectives for Semivolatile Organic Compounds by Method SW846 8270C (Page 1 of 2)

Analyte	EPA MCL[a] (µg/L)	NMED SSL[b] (µg/kg)	Reporting Limits Water (µg/L)	Reporting Limits Soils (µg/kg)
1,2-Diphenylhydrazine (Azobenzene)	--	4,900	10	330
1,3-Dinitrobenzene	--	--	10	330
2,4,5-Trichlorophenol	--	6,110,000	20	660
2,4,6-Trichlorophenol	--	61,100	20	660
2,4-Dichlorophenol	--	183,000	10	660
2,4-Dimethylphenol	--	1,220,000	10	660
2,4-Dinitrophenol	--	122,000	60	3,300
2,4-Dinitrotoluene	--	12,600	20	660
2,6-Dinitrotoluene	--	61,200	20	660
2-Chloronaphthalene	--	6,260,000	10	330
2-Chlorophenol	--	391,000	10	660
2-Methylphenol	--	--	10	660
2-Nitroaniline	--	--	50	3,300
2-Nitrophenol	--	--	20	660
3&4-Methylphenol	--	--	20	660
3,3'-Dichlorobenzidine	--	8,710	20	1,300
3-Nitroaniline	--	--	50	3,300
4,6-Dinitro-2-methylphenol	--	6,110	60	3,300
4-Bromophenyl phenyl ether	--	--	10	660
4-Chloro-3-methylphenol	--	--	20	1,300
4-Chloroaniline	--	--	20	1,300
4-Chlorophenyl phenyl ether	--	--	10	660
4-Nitroaniline	--	--	50	3,300
4-Nitrophenol	--	--	50	3,300
Benzidine	--	**17**	150	3,300
Benzoic acid	--	--	60	3,300
Bis(2-Chloroethoxy)methane	--	--	10	330
Bis(2-Chloroethyl)ether	--	2,560	10	660
Bis(2-Ethylhexyl)phthalate	**6**	280,000	**10**	660
Butyl benzyl phthalate	--	--	20	660
Dibenzofuran	--	--	10	660
Diethyl phthalate	--	48,900,000	20	660
Dimethyl phthalate	--	611,000,000	20	660
Di-n-butyl phthalate	--	6,110,000	20	660
Di-n-octyl phthalate	--	--	20	660
Hexachlorobenzene	1	2,450	10	660

Table 4-5. Reporting Limit Objectives for Semivolatile Organic Compounds by Method SW846 8270C (Concluded, Page 2 of 2)

Analyte	EPA MCL[a] (µg/L)	NMED SSL[b] (µg/kg)	Reporting Limits Water (µg/L)	Reporting Limits Soils (µg/kg)
Hexachlorobutadiene	--	50,300	10	660
Hexachlorocyclopentadiene	50	367,000	10	660
Hexachloroethane	--	61,100	10	660
Nitrobenzene	--	49,400	20	660
N-Nitrosodi-n-propylamine	--	--	20	660
N-Nitrosodiphenylamine	--	800,000	10	660
Pentachlorophenol	1	20,700	60	3,300
Phenol	--	18,300,000	10	660

[a] EPA Maximum Contaminant Level
[b] NMED Soil Screening Level
µg/L micrograms per liter
µg/kg micrograms per kilogram
Reporting limits that do not meet EPA MCL and/or NMED SSL are **bolded.**

Table 4-6. Reporting Limit Objectives for Polyaromatic Hydrocarbons by Method SW846 SW8270 SIM/SW8310

Analyte	EPA MCL[a] (µg/L)	NMED SSL[b] (µg/kg)	Reporting Limits Water (µg/L)	Reporting Limits Soils (µg/kg)
1-Methylnaphthalene	--	--	1	5
2-Methylnaphthalene	--	--	1	5
Acenaphthene	--	3,440,000	1	5
Acenaphthylene	--		1	5
Anthracene	--	17,200,000	0.3	5
Benz(a)Anthracene	--	4,810	0.2	5
Benzo(a)pyrene	0.2	481	0.2	5
Benzo(b)fluoranthene	--	4,810	0.2	5
Benzo(k)fluoranthene	--	48,100	0.1	5
Benzo(g,h,i)perylene	--		0.2	5
Chrysene	--	481,000	0.2	5
Dibenzo(a,h)anthracene	--	481	0.3	5
Fluoranthene	--	2,290,000	0.4	5
Fluorene	--	2,290,000	0.3	5
Indeno(1,2,3-cd)pyrene	--	4,810	0.2	5
Naphthalene	--	45,010	1	5
Phenanthrene	--	1,830,000	0.3	5
Pyrene	--	1,720,000	0.2	5

[a]EPA Maximum Contaminant Levels
µg/L micrograms per liter
[b]NMED Soil Screening Levels
µg/kg micrograms per kilogram

Table 4-7. Reporting Limit Objectives for General Chemistry by Various Methods

Analyte	EPA MCL[a] (mg/L)	Reporting Limits Water (mg/L)
Nitrate as Nitrogen	20	0.5
Sulfate	250	1.0
Alkalinity	N/A	5

[a]EPA Maximum Contaminant Level
mg/L milligrams per liter
N/A not applicable

Table 4-8. Reporting Limit Objectives for EDB by Method 504.1/SW8011

Analyte	EPA MCL[a] (µg/L)	Reporting Limits Water (µg/L)
1,2-Dibromoethane (EDB)	0.05	0.02

[a]EPA Maximum Contaminant Level
µg/L micrograms per liter

Table 4-9. Reporting Limit Objectives for Volatile Organic Compounds by Method TO-15/TO-15 Low Level (Page 1 of 2)

Analyte	EPA Indoor Air Screening Levels (ppbv)	Reporting Limit[a] Indoor Air (ppbv)	Reporting Limit[a] Soil Vapor (ppbv)
1,1,1-Trichloroethane	437.4	0.5	0.5
1,1,2,2-Tetrachloroethane	**0.02**	**0.1**	0.5
1,1,2-Trichloroethane	0.3	0.1	0.5
1,1,2-Trichloro-1,2,2-trifluoroethane	6189.3	0.1	0.5
1,1-Dichloroethane	1.9	0.1	0.5
1,1-Dichloroethene	32.8	0.1	0.5
1,2,4-Trichlorobenzene	0.3	0.1	0.5
1,2,4-Trimethylbenzene	0.4	0.1	0.5
1,2-Dichloroethane	0.1	0.1	0.5
1,2-Dichlorobenzene	21.4	0.1	0.5
1,2-Dichloro-1,1,2,2-tetrafluoroethane	--	0.1	0.5
1,2-Dichloropropane	0.2	0.1	0.5
1,2-Dibromoethane (EDB)	**0.02**	**0.1**	0.5
1,3,5-Trimethylbenzene	0.5	0.1	0.5
1,3-Dichlorobenzene	0.2	0.1	0.5
1,4-Dichlorobenzene	0.3	0.1	0.5
Acetone	5794.4	0.1	1
Benzene	0.4	0.1	0.5
Bromomethane	0.4	0.1	0.5
Carbon tetrachloride	0.2	0.2	0.5
Chlorobenzene	4.8	0.1	0.5

Table 4-9. Reporting Limit Objectives for Volatile Organic Compounds by Method TO-15/TO-15 Low Level (Concluded, Page 2 of 2)

Analyte	EPA Indoor Air Screening Levels (ppbv)	Reporting Limit[a] Indoor Air (ppbv)	Reporting Limit[a] Soil Vapor (ppbv)
Chloroethane	1147.8	0.1	0.5
Chloroform	0.1	0.1	0.5
Chloromethane	7	0.1	0.5
cis-1,2-Dichloroethene	--	0.1	0.5
cis-1,3-Dichloropropene	**0.4**	**0.5**	0.5
Dichlorodifluoromethane	18.8	0.1	0.5
Ethylbenzene	1.1	0.1	0.5
Hexachlorobutadiene	0.1	0.1	0.5
m,p-Xylene	70.2	0.2	0.5
MEK (2-Butanone)	733.4	0.5	1
Methylene chloride	6	0.5	2.5
MTBE (Methyl tert-Butyl Ether)	12.8	1	1
o-Xylene	44.4	0.1	0.5
Styrene	88	0.1	0.5
TCE	1	0.1	0.5
Tetrachloroethene	0.4	0.1	0.5
Toluene	359.7	0.1	0.5
trans-1,3-Dichloropropene	0.5	0.5	0.5
Trichlorofluoromethane	41.1	0.1	0.5
Vinyl chloride	0.3	0.1	0.5

[a] reporting limits are pre-canister dilution (usually 2 x dilution)
ppbv= parts per billion volume
Indoor Air reporting limits that do not meet EPA Indoor Air Screening Levels are bolded.

Table 4-10. Reporting Limit Objectives for TPH-Gasoline by Method SW8015M

Analyte	Reporting Limit Indoor Air/Soil Vapor microgram per liter
Total Petroleum Hydrocarbon - Gasoline	25

Table 4-11. Reporting Limit Objectives for Fixed Gases by Method SM2720C

Analyte	Reporting Limit Indoor Air/Soil Vapor (percent)
Carbon Dioxide	0.5
Carbon Monoxide	0.5
Methane	0.5
Nitrogen	1
Oxygen	0.6

Reporting limits and sample results will be reported to two significant figures if less than 10 and to three significant figures if 10 or greater. Reporting limits will be reported on a dry-weight basis for sediment/soil samples. All QC sample results will reported to three significant figures.

4.2.3 Instrument Calibration

Laboratory instruments will be calibrated by qualified personnel before sample analysis, according to the procedures specified in each method. Initial and continuing calibrations will be performed. Calibration will be verified at method-specified intervals throughout the analysis sequence. The frequency and acceptance criteria for calibration are specified for each analytical method, with supplemental requirements defined below for organic methodologies. When multi-point calibration is specified, the concentrations of the calibration standards should bracket those expected in the samples. Samples will be diluted, if necessary, to bring analyte responses to within the calibration range. Data that exceed the calibration range cannot be reported by the laboratory. The initial calibration curve will be verified as accurate with a standard purchased or prepared from an independent second source. Quantitation based on extrapolation is not acceptable.

4.3 Elements of Quality Control

Laboratory QC checks indicate the state of control that prevailed at the time of sample analysis. QC checks that involve field samples, such as matrix, surrogate spikes, and FD samples, also indicate the presence of matrix effects. Field-originated blanks provide a way to monitor for potential contamination to which field samples are subjected. This QAPP specifies requirements for method blanks, LCSs, surrogate spikes, and MS/MSDs that the laboratory must follow for the data collection effort. Additionally, the Contract Laboratory Program (CLP) statement of work may require additional QC checks and/or not require some of them presented herein. The laboratory will adhere to the applicable CLP statement of work for the analyses performed.

A laboratory QC batch is defined as a method blank, LCS, MS/MSD, or a sample duplicate, depending on the method and 20 or fewer environmental samples of similar matrix that are extracted or analyzed together. For gas chromatography/mass spectrometry volatile analyses, a method blank, LCS, and MS/MSD must be analyzed in each 12-hour time period. The number of environmental samples allowed in the laboratory QC batch is defined by the remaining time in the method-prescribed 12-hour tune period divided by the analytical run time. Each preparation or analytical batch will be identified in such a way as to be able to associate environmental samples with the appropriate laboratory QC samples.

4.3.1 Quality Control Analyses/Parameters Originated by the Laboratory

4.3.1.1 Method Blank

Blanks are used to monitor each preparation or analytical batch for interference and/or contamination from glassware, reagents, and other potential sources within the laboratory. A method blank is an analyte-free matrix (laboratory reagent water for aqueous samples or Ottawa sand, sodium sulfate, or glass beads [metals] for soil samples) to which all reagents are added in the same amount or proportions as are added to the samples. The method blank is processed through the entire sample preparation and analytical procedures along with the samples in the batch. There will be at least one method blank per preparation or analytical batch.

If a target analyte is found at a concentration that exceeds the reporting limit, corrective action must be performed to identify and eliminate the contamination source. All associated samples must be re-prepared and re-analyzed after the contamination source has been eliminated. No analytical data may be corrected for the concentration found in the blank.

4.3.1.2 Laboratory Control Sample

The LCS will consist of an analyte-free matrix such as laboratory reagent water for aqueous samples or Ottawa sand, sodium sulfate, or glass beads (metals) for soil samples spiked with known amounts of analytes that come from a source different than that used for calibration standards. Target analytes specified in the QAPP will be spiked into the LCS. The spike levels will be less than or equal to the mid-point of the calibration range.

If LCS results are outside the specified control limits, corrective action must be taken, including sample re-preparation and re-analysis, if appropriate. If more than one LCS is analyzed in a preparation or analytical batch, the results of all LCSs must be reported. Any LCS recovery outside QC limits affects the accuracy for the entire batch and requires corrective action.

4.3.1.3 Surrogates

Surrogates are organic analytes that behave similarly to the analytes of interest but are not expected to occur naturally in the samples. They are spiked into the standards, samples, and QC samples prior to sample preparation. Recoveries of surrogates are used to indicate accuracy, method performance, and extraction efficiency.

If surrogate recoveries are outside the specified control limits, corrective action must be taken, including sample re-preparation and re-analysis, if appropriate.

4.3.1.4 Matrix Spike/Matrix Spike Duplicate

A sample matrix fortified with known quantities of specific compounds is called a MS. It is subjected to the same preparation and analytical procedures as the native sample. Target analytes specified in the QAPP are spiked into the sample. MS recoveries are used to evaluate the effect of the sample matrix on the recovery of the analytes of interest. An MSD is a second fortified sample matrix. The RPD between the results of the duplicate MS measures the precision of sample results. Only project-specific samples designated on the chain of custody form will be spiked. The spike levels will be less than or equal to the mid-point of the calibration range.

4.3.1.5 *Internal Standards*

Some methods require the use of internal standards to compensate for losses during injection or purging or losses due to viscosity. Internal standards are compounds that have similar properties as the analytes of interest but are not expected to occur naturally in the samples. A measured amount of the internal standard is added to the standards, samples, and QC samples following preparation.

When the internal standard results are outside the control limits, corrective action must be taken, including sample re-analysis, if appropriate.

4.3.1.6 *Laboratory Sample Duplicate*

A sample duplicate selected by the laboratory is called a laboratory sample duplicate. It is subjected to the same preparation and analytical procedures as the native sample. The RPD between the results of the native sample and laboratory sample duplicate measures the precision of sample results. The data collected also may yield information regarding whether the sample matrix is heterogeneous.

4.3.1.7 *Interference Check Samples*

The interference check samples are used in inductively coupled plasma (ICP) analyses to verify background and inter-element correction factors. They consist of two solutions, where one solution contains the interfering analytes, and the second solution contains both the analytes of interest and the interfering analytes. Both solutions are analyzed at the beginning and at the end of each analytical sequence.

When the interference check sample results are outside the control limits, corrective action must be taken, including sample re-analysis, if appropriate.

4.3.1.8 *Retention Time Windows*

Retention time windows for gas and liquid chromatographic analyses must be established by replicate injections of the calibration standard over multiple days, as described in SW846 8000B, analytical method, or appropriate laboratory SOP. The absolute retention time of the calibration verification standard at the start of each analytical sequence will be used as the centerline of the window. For an analyte to be reported as positive, its elution time must be within the retention time window.

4.3.2 Quality Control Analyses Originated by the Field Team

Section 2.3 specifies the type and frequency of QC samples that are originated by the field team.

4.4 Additional Quality Control Requirements

4.4.1 Holding Time

The holding time requirements specified in this QAPP must be met. For methods requiring both sample preparation and analysis, the preparation holding time will be calculated from the time of sampling to the completion of preparation. The analysis holding time will be calculated from the time of completion of preparation to the time of completion of the analysis, including any required dilutions, confirmation analysis, and re-analysis.

For methods requiring analysis only, the holding time is calculated from the time of sampling to completion of the analysis, including any required dilutions, confirmation analysis, and re-analysis.

4.4.2 Confirmation

Confirmation analysis must be carried out as specified for specific methods when the result is at or above the reporting limit. The result designated as the primary result will be reported. All calibration and QC requirements must be met when confirmation analysis is carried out.

4.4.3 Cleanup Procedures to Minimize Matrix Effects

To maintain the lowest possible reporting limits, appropriate cleanup procedures will be employed when it is indicated by the method to remove or minimize matrix interference. Methods and materials for sample cleanup include, but are not limited to, gel permeation chromatography, silica gel, alumina, florisil, mercury (sulfur removal), sulfuric acid, and acid/base partitioning. Method blanks, MS/MSDs, and LCSs must be subjected to the same cleanup procedures performed on the samples to monitor the efficiencies of these procedures.

4.4.4 Sample Dilution

Dilution of a sample results in elevated reporting limits and ultimately affects the usability of data related to potential actions at the sampling site. It is important to minimize dilutions and maintain the lowest possible reporting limits. When dilutions are necessary because of high concentrations of target analytes, lesser dilutions also should be reported to fully characterize the sample for each analyte. The level of the lesser dilution will be such that it will provide the lowest possible reporting limits without having a lasting deleterious effect on the analytical instrumentation.

When a sample exhibits characteristics of matrix interference that are identified through analytical measurement or visual observation, appropriate cleanup procedure(s) must be proven ineffective or inappropriate before proceeding with dilution and analysis.

4.4.5 Standard Materials and Other Supplies and Consumables

Standard materials must be of known high purity and traceable to an approved source. Pure standards must not exceed the manufacturer's expiration date or 1 year following receipt, whichever comes first. Solutions prepared by the laboratory from the pure standards must be used within the expiration date specified in the laboratory's SOP. All other supplies and consumables must be inspected prior to use to ensure that they meet the requirements specified in the appropriate SOP. The laboratory's inventory and storage system should ensure their use within the manufacturer's expiration date and that the supplies are stored under proper conditions.

4.4.6 Manual Integration

The laboratory is required to provide all analysts performing methods that rely on interpretation of chromatographic data with training on appropriate software or manual integration practices. The laboratory also will make every effort to minimize the use of manual integration of data. If manual integration is needed to correct a software auto-integration error, the manual integration will be clearly identified in the instrument data. Before- and after-enlargements of the region of the chromatogram where the manual integration was performed will be provided on an appropriate scale to allow an

independent reviewer to evaluate the need and quality of the manual integration. The analyst also will document the reason for the manual integration on the chromatogram along with the date and his/her initials. The laboratory manager or designee will approve the manual integration by dating and initialing the chromatogram.

4.4.7 Laboratory Quality Assurance Program

The laboratory will maintain a Quality Assurance Manual or equivalent document. The Quality Assurance Manual will define the laboratory's internal QA/QC procedures, including:

- QA policies, objectives, and requirements;
- Organization and personnel;
- Document control;
- SOPs (analytical methods and administrative);
- Data generation;
- Software verification;
- QC policies, objectives, and requirements;
- Nonconformance/corrective action procedures; and
- Data review.

4.4.7.1 Laboratory Standard Operating Procedures

The laboratory will maintain SOPs for all analytical methods and laboratory operations. The format for SOPs will generally conform to the following references:

- *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods, SW-846, 3rd Edition, Update III, Section 1* (EPA, 1996);
- *Standard Methods for the Examination of Water and Wastewater, 20th Edition (1998);* and
- *Good Laboratory Practices in Principles and Guidance to Regulations for Ensuring Data Integrity in Automated Laboratory Operations* (EPA, 1995).

All SOPs must have a unique identification number that is traceable to previous revisions of the same document.

4.4.7.2 Demonstration of Capability

Laboratory QA personnel will maintain records documenting the ability of each analyst to perform applicable method protocols. Documentation will include annual checks for each method and analyst. In addition, internal, blind performance evaluation samples for each method and matrix, demonstrating overall laboratory performance, must be submitted annually. The laboratory may receive additional blind performance evaluation samples in conjunction with this program.

4.5 Reporting Limits and Analytical Requirements

Tables 4-2 through 4-11 presented lists of target analytes, methods to be used, and the reporting limit objectives specific to this project. The laboratory will adhere to the requirements specified within these tables. The reporting limits included herein reflect quantifiable levels that are attainable with a specified degree of confidence using the specified methods. The accuracy and precision limits are listed in Table 4-12 through 4-21. Calibration and QC requirements are specified in Tables 4-22 through 4-32.

Table 4-12. Accuracy and Precision Limits for Metals by Method SW846 6010B

Analytes	LCS Accuracy Water (% R)	LCS Precision Water (RPD)	MS/MSD Water Accuracy (% R)	MS/MSD Precision Water (RPD)
Iron (Total/dissolved)	80-120	20	80-120	20
Manganese (Total/dissolved)	80-120	20	80-120	20
Lead (Total/dissolved)	80-120	20	80-120	20

LCS laboratory control sample.
MS/MSD matrix spike/matrix spike duplicate.
%R = percent recovery
RPD= relative percent difference.

Table 4-13. Accuracy and Precision Limits for TPH (DRO/GRO) by Method SW846 8015B

Analyte	LCS/MS/MSD Accuracy Water (% R)		Precision Water (RPD)	LCS/MS/MSD Accuracy Soil (% R)		Precision Soil (RPD)
	LCL	UCL		LCL	UCL	
TPH–Gasoline	70	130	30	70	130	50
Surrogate:(choose one)						
a,a,a-Trifluorotoluene	50	150	--	50	150	--
Chlorobenzene	50	150	--	50	150	--
TPH–Diesel	70	130	30	70	130	50
Surrogate:						
Ortho-Terphenyl	50	150	--	50	150	--
Triacontane	50	150	--	50	150	--

LCL lower control limit.
LCS laboratory control sample.
MS/MSD matrix spike/matrix spike duplicate.
%R percent recovery
RPD relative percent difference.
UCL upper control limit.

Table 4-14. Accuracy and Precision Limits for Volatile Organic Compounds by Method SW846 8260B (Page 1 of 3)

Analyte	LCS/MS/MSD Accuracy Water (% R)		Precision Water (RPD)	LCS/MS/MSD Accuracy Soil (% R)		Precision Soil (RPD)
	LCL	UCL		LCL	UCL	
1,1,1,2-Tetrachloroethane	80	130	30	75	125	30
1,1,1-Trichloroethane	65	130	30	70	135	30
1,1,2,2-Tetrachloroethane	65	130	30	55	130	30
1,1,2-Trichloroethane	75	125	30	60	125	30
1,1-Dichloroethane	70	135	30	75	125	30
1,1-Dichloroethene	70	130	30	65	135	30
1,1-Dichloropropene	75	130	30	70	135	30
1,2,3-Trichlorobenzene	55	140	30	60	135	30
1,2,3-Trichloropropane	75	125	30	65	130	30
1,2,4-Trichlorobenzene	65	135	30	65	130	30
1,2,4-Trimethylbenzene	75	130	30	65	135	30
1,2-Dibromo-3-chloropropane (DBCP)	50	130	30	40	135	30
1,2-Dibromoethane (EDB)	80	120	30	70	125	30
1,2-Dichlorobenzene	70	120	30	75	120	30
1,2-Dichloroethane	70	130	30	70	135	30
1,2-Dichloropropane	75	125	30	70	120	30
1,3,5-Trimethylbenzene	75	130	30	65	135	30
1,3-Dichlorobenzene	75	125	30	70	125	30
1,3-Dichloropropane	75	125	30	75	125	30
1,4-Dichlorobenzene	75	125	30	70	125	30
2,2-Dichloropropane	70	135	30	65	135	30
2-Butanone (MEK)	30	150	30	30	160	30
2-Chlorotoluene	75	125	30	70	130	30
2-Hexanone	55	130	30	45	145	30
4-Chlorotoluene	75	130	30	75	125	30
4-Isopropyltoluene	75	130	30	75	135	30
4-Methyl-2-pentanone	60	135	30	45	145	30
Acetone	40	140	30	20	160	30
Benzene	80	130	30	75	125	30
Bromobenzene	75	125	30	65	120	30
Bromochloromethane	65	130	30	70	125	30
Bromodichloromethane	75	120	30	70	130	30
Bromoform	70	130	30	55	135	30
Bromomethane	30	145	30	30	160	30

Table 4-14. Accuracy and Precision Limits for Volatile Organic Compounds by Method SW846 8260B (Page 2 of 3)

Analyte	LCS/MS/MSD Accuracy Water (% R)		Precision Water (RPD)	LCS/MS/MSD Accuracy Soil (% R)		Precision Soil (RPD)
	LCL	UCL		LCL	UCL	
Carbon disulfide	35	160	30	45	160	30
Carbon tetrachloride	65	140	30	65	135	30
Chlorobenzene	80	120	30	75	125	30
Chloroethane	60	135	30	40	155	30
Chloroform	65	135	30	70	125	30
Chloromethane	40	125	30	50	130	30
cis-1,2-Dichloroethene	70	125	30	65	125	30
cis-1,3-Dichloropropene	70	130	30	70	125	30
Dibromochloromethane	60	135	30	65	130	30
Dibromomethane	75	125	30	75	130	30
Dichlorodifluoromethane	30	155	30	35	135	30
Ethylbenzene	75	125	30	70	130	30
Isopropylbenzene	75	125	30	75	125	30
Methyl tert butyl ether	65	125	30	55	140	30
Methylene chloride	55	140	30	75	130	30
m-Xylene & p-Xylene	75	130	30	70	130	30
n-Butylbenzene	70	135	30	55	140	30
n-Propylbenzene	70	130	30	80	125	30
o-Xylene	80	120	30	65	140	30
sec-Butylbenzene	70	125	30	65	135	30
Styrene	65	135	30	75	125	30
tert-Butylbenzene	70	130	30	65	130	30
Tetrachloroethene	45	150	30	75	125	30
Toluene	75	120	30	65	130	30
trans-1,2-Dichloroethene	60	140	30	65	140	30
trans-1,3-Dichloropropene	55	140	30	70	125	30
Trichloroethene	70	125	30	65	135	30
Trichlorofluoromethane	60	145	30	65	125	30
Vinyl chloride	70	145	30	75	125	30

Table 4-14. Accuracy and Precision Limits for Volatile Organic Compounds by Method SW846 8260B (Concluded, Page 3 of 3)

Analyte	LCS/MS/MSD Accuracy Water (% R)		Precision Water (RPD)	LCS/MS/MSD Accuracy Soil (% R)		Precision Soil (RPD)
	LCL	UCL		LCL	UCL	
Surrogates						
4-Bromofluorobenzene	75	120	--	85	120	--
1,2-Dichloroethane-d4	70	120	--	58	140	--
Dibromofluoromethane	85	115	--	75	121	--
Toluene-d8	85	120	--	85	115	--

LCL= lower control limit.
LCS= laboratory control sample.
MS/MSD= matrix spike/matrix spike duplicate.
%R= percent recovery
RPD= relative percent difference.
UCL= upper control limit.

Table 4-15. Accuracy and Precision Limits for Semivolatile Organic Compounds by Method SW846 8270C (Page 1 of 3)

Analyte	LCS/ MS/MSD Accuracy Water (% R)		Precision Water (RPD)	LCS/ MS/MSD Accuracy Soil (% R)		Precision Soil (RPD)
	LCL	UCL		LCL	UCL	
1,2-Diphenylhydrazine (Azobenzene)	55	115	30	39	122	30
1,3-Dinitrobenzene	50	110	30	50	110	30
2,4,5-Trichlorophenol	50	110	30	50	110	30
2,4,6-Trichlorophenol	50	115	30	45	110	30
2,4-Dichlorophenol	50	105	30	45	110	30
2,4-Dimethylphenol	30	110	30	30	105	30
2,4-Dinitrophenol	15	140	30	15	130	30
2,4-Dinitrotoluene	50	120	30	50	115	30
2,6-Dinitrotoluene	50	115	30	50	110	30
2-Chloronaphthalene	50	105	30	45	105	30
2-Chlorophenol	35	105	30	45	105	30
2-Methylphenol	40	110	30	40	105	30
2-Nitroaniline	50	115	30	45	120	30
2-Nitrophenol	40	115	30	40	110	30
3&4-Methylphenol	30	110	30	40	105	30

Table 4-15. Accuracy and Precision Limits for Semivolatile Organic Compounds by Method SW846 8270C (Page 2 of 3)

Analyte	LCS/ MS/MSD Accuracy Water (% R)		Precision Water (RPD)	LCS/ MS/MSD Accuracy Soil (% R)		Precision Soil (RPD)
	LCL	UCL		LCL	UCL	
3,3-Dichlorobenzidine	20	110	30	10	130	30
3-Nitroaniline	20	125	30	25	110	30
4,6-Dinitro-2-methylphenol	40	130	30	30	135	30
4-Bromophenyl phenyl ether	50	115	30	45	115	30
4-Chloro-3-methylphenol	45	110	30	45	115	30
4-Chloroaniline	15	110	30	10	95	30
4-Chlorophenyl phenyl ether	50	110	30	45	110	30
4-Nitroaniline	35	120	30	35	115	30
4-Nitrophenol	20	125	30	50	110	30
Benzidine	20	125	30	50	110	30
Benzoic acid	20	125	30	20	110	30
Bis(2-Chloroethoxy)methane	45	105	30	45	110	30
Bis(2-Chloroethyl)ether	35	110	30	40	105	30
Bis(2-Ethylhexyl)phthalate	40	125	30	45	125	30
Butyl benzyl phthalate	45	115	30	50	125	30
Dibenzofuran	55	105	30	50	105	30
Diethyl phthalate	40	120	30	50	115	30
Dimethyl phthalate	25	125	30	50	110	30
Di-n-butyl phthalate	55	115	30	50	110	30
Di-n-octyl phthalate	35	115	30	40	130	30
Hexachlorobenzene	50	110	30	45	120	30
Hexachlorobutadiene	25	105	30	40	115	30
Hexachlorocyclopentadiene	30	115	30	45	135	30
Hexachloroethane	30	95	30	35	110	30
Nitrobenzene	45	110	30	40	115	30
N-Nitrosodi-n-propylamine	35	130	30	40	115	30
N-Nitrosodiphenylamine	50	110	30	50	115	30
Pentachlorophenol	40	115	30	25	120	30

Table 4-15. Accuracy and Precision Limits for Semivolatile Organic Compounds by Method SW846 8270C (Concluded, Page 3 of 3)

Analyte	LCS/ MS/MSD Accuracy Water (% R)		Precision Water (RPD)	LCS/ MS/MSD Accuracy Soil (% R)		Precision Soil (RPD)
	LCL	UCL		LCL	UCL	
Phenol	20	115	30	40	100	30
Surrogates						
2,4,6-Tribromophenol	40	125	--	35	125	--
2-Fluorobiphenyl	50	110	--	45	105	--
2-Fluorophenol	20	110	--	35	105	--
Nitrobenzene-d5	40	110	--	35	100	--
Phenol-d5	20	115	--	40	100	--
Terphenyl-d14	50	135	--	30	125	--

LCL= lower control limit.
LCS= laboratory control sample.
MS/MSD= matrix spike/matrix spike duplicate.
%R= percent recovery
RPD= relative percent difference.
UCL= upper control limit.

Table 4-16. Accuracy and Precision Limits for Polyaromatic Hydrocarbons by Method SW846 8270C SIM/SW8310 (Page 1 of 2)

Analyte	LCS/ MS/MSD Accuracy Water (% R)		Precision Water (RPD)	LCS/ MS/MSD Accuracy Soil (% R)		Precision Soil (RPD)
	LCL	UCL		LCL	UCL	
1-Methylnaphthalene	50	115	30	50	115	30
2-Methylnaphthalene	50	110	30	50	110	30
Acenaphthene	35	105	30	35	110	30
Acenaphthylene	35	115	30	35	115	30
Anthracene	40	110	30	45	125	30
Benz(a)Anthracene	50	110	30	50	105	30
Benzo(a)pyrene	45	115	30	40	135	30
Benzo(b)fluoranthene	50	110	30	55	120	30
Benzo(k)fluoranthene	50	110	30	50	120	30
Benzo(g,h,i)perylene	35	120	30	55	115	30
Chrysene	50	115	30	55	120	30

Table 4-16. Accuracy and Precision Limits for Polyaromatic Hydrocarbons by Method SW846 8270C SIM/SW8310 (Concluded, Page 2 of 2)

Analyte	LCS/ MS/MSD Accuracy Water (% R)		Precision Water (RPD)	LCS/ MS/MSD Accuracy Soil (% R)		Precision Soil (RPD)
	LCL	UCL		LCL	UCL	
Dibenzo(a,h)anthracene	20	110	30	45	115	30
Fluoranthene	50	115	30	40	135	30
Fluorene	35	105	30	45	105	30
Indeno(1,2,3-cd)pyrene	45	110	30	55	135	30
Naphthalene	35	105	30	50	110	30
Phenanthrene	40	120	30	55	125	30
Pyrene	50	110	30	50	115	30
Surrogate						
Terphenyl-d14	50	135	--	30	125	--

LCL= lower control limit.
LCS= laboratory control sample.
MS/MSD= matrix spike/matrix spike duplicate.
%R= percent recovery
RPD= relative percent difference.
UCL= upper control limit.

Table 4-17. Accuracy and Precision Limits for General Chemistry Parameters by Various Methods

Analyte	LCS/ MS/MSD Accuracy Water (% R)		Precision Water (RPD)
	LCL	UCL	
Nitrate	90	110	10
Sulfate	90	110	10
Alkalinity	80	120	25

LCL= lower control limit
LCS = laboratory control sample.
MS/MSD= matrix spike/matrix spike duplicate.
%R = percent recovery
RPD= relative percent difference.
UCL= upper control limit

Table 4-18. Accuracy and Precision Limits for EDB by Methods 504.1/SW8011

Analyte	LCS/ MS/MSD Accuracy Water (% R)		Precision Water (RPD)
	LCL	UCL	
1,2-Dibromoethane (EDB)	70	130	30
Surrogate			
1,2-dibromopropane	70	130	--

LCL= lower control limit
LCS = laboratory control sample.
MS/MSD= matrix spike/matrix spike duplicate.
%R = percent recovery
RPD= relative percent difference.
UCL= upper control limit

Table 4-19. Accuracy and Precision Limits for Volatile Organic Compounds by Method TO-15/TO-15 Low Level (Page 1 of 2)

Analyte	LCS/ LCSD Accuracy Air (% R)		Precision Air (RPD)
	LCL	UCL	
1,1,1-Tetrachloroethane	70	130	25
1,1,2,2-Tetrachloroethane	70	130	25
1,1,2-Tetrachloroethane	70	130	25
1,1,2-Trichloro-1,2,2-trifluoroethane	70	130	25
1,1-Dichloroethane	70	130	25
1,1-Dichloroethene	70	130	25
1,2,4-Trichlorobenzene	70	130	25
1,2,4-Trimethylbenzene	70	130	25
1,2-Dichloroethane	70	130	25
1,2-Dichlorobenzene	70	130	25
1,2-Dichloro-1,1,2,2-tetrafluoroethane	70	130	25
1,2-Dichloropropane	70	130	25
1,2-Dibromoethane (EDB)	70	130	25
1,3,5-Trimethylbenzene	70	130	25
1,3-Dichlorobenzene	70	130	25
1,4-Dichlorobenzene	70	130	25
Acetone	70	130	25
Benzene	70	130	25
Bromomethane	70	130	25
Carbon tetrachloride	70	130	25
Chlorobenzene	70	130	25
Chloroethane	70	130	25

Table 4-19. Accuracy and Precision Limits for Volatile Organic Compounds by Method TO-15/TO-15 Low Level (Concluded, Page 2 of 2)

Analyte	LCS/ LCSD Accuracy Air (% R)		Precision Air (RPD)
	LCL	UCL	
Chloroform	70	130	25
Chloromethane	70	130	25
cis-1,2-Dichloroethene	70	130	25
cis-1,3-Dichloropropene	70	130	25
Dichlorodifluoromethane	70	130	25
Ethylbenzene	70	130	25
Hexachlorobutadiene	70	130	25
m,p-Xylene	70	130	25
MEK (2-Butanone)	70	130	25
Methylene chloride	70	130	25
MTBE (Methyl tert-Butyl Ether)	70	130	25
o-Xylene	70	130	25
Styrene	70	130	25
TCE	70	130	25
Tetrachloroethene	70	130	25
Toluene	70	130	25
trans-1,3-Dichloropropene	70	130	25
Trichlorofluoromethane	70	130	25
Vinyl chloride	70	130	25
Surrogates			
4-Bromofluorobenzene	60	140	--
Toluene-d8	60	140	--

LCL= lower control limit
LCS = laboratory control sample.
LCSD= laboratory control sample duplicate.
%R = percent recovery
RPD= relative percent difference.
UCL= upper control limit

Table 4-20. Accuracy and Precision Limits for TPH-Gasoline by Method SW8015M

Analyte	LCS/ LCSD Accuracy Air (% R)		Precision Air (RPD)
	LCL	UCL	
TPH-Gasoline	70	130	25

LCL= lower control limit
LCS = laboratory control sample.
LCSD= laboratory control sample duplicate.
%R = percent recovery
RPD= relative percent difference.
UCL= upper control limit

Table 4-21. Accuracy and Precision Limits for Fixed Gases by Method SM2720C

Analyte	LCS/ LCSD Accuracy Air (% R)		Precision Air (RPD)
	LCL	UCL	
Carbon Dioxide	80	120	20
Carbon Monoxide	80	120	20
Methane	80	120	20
Nitrogen	80	120	20
Oxygen	80	120	20

LCL= lower control limit
LCS = laboratory control sample.
LCSD= laboratory control sample duplicate.
%R = percent recovery
RPD= relative percent difference.
UCL= upper control limit

Table 4-22. Calibration and Quality Control Requirements for Metals by Method SW846 6010B/SW6020 (Page 1 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
Initial calibration (a blank and at least one standard)	Before initial sample analysis, every 24 hours, whenever modifications are made to the analytical system, or when continuing calibration verification fails	If more than one standard is used, correlation coefficient must be >0.995	Not applicable.
Initial calibration verification	Immediately following each initial calibration	All analytes within ±10% of expected value	Correct problem and repeat initial calibration
Calibration blank	After every calibration verification (initial calibration verification and continuing calibration verification)	No analytes detected at or above the reporting limit	Correct the problem, then re-analyze previous 10 samples
Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within ±10% of expected value	Re-calibrate and re-analyze all samples since the last acceptable continuing calibration verification
Method blank	At least one per analytical batch	No analytes detected at or above the reporting limit	Correct the problem and re-prep and re-analyze all associated samples
Interference check standard	At the start and end of each analytical sequence or twice during an 8-hour period, whichever is more frequent	All analytes within ±20% of expected value	Correct the problem, re-calibrate, re-analyze ICS and all affected samples
Matrix spike/ matrix spike duplicate (MS/MSD)	One set per 20 project-specific samples	All analytes within limits specified in accuracy and precision tables	None
Laboratory control sample (LCS)	At least one per analytical batch	All analytes within limits specified in accuracy and precision tables	Correct the problem, and re-prep and re-analyze the LCS and all samples in the analytical batch
Internal Standard (SW6020 only)	Each sample and quality control sample, method blank, matrix spike/matrix spike duplicate and laboratory control sample	Response within 60-125% of the calibration blank	Verify response, then re-analyze affected samples at 2x dilution
Dilution test	Each new sample matrix	Result from 1:5 dilution must be within ±10% of the undiluted sample result (applies only if undiluted sample result is at least 25 times the reporting limit)	Perform post-digestion spike addition

Table 4-22. Calibration and Quality Control Requirements for Metals by MethodSW846 6010B/6020 (Concluded, Page 2 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
Low level calibration check standard (after one point ICAL)	Once per analytical batch, prior to sample analysis	All analytes within +20% of expected value	Correct problem then re-analyze the low level check standard and all samples in the analytical batch
Method detection limit (MDL) study	Once per 12 month period	Detection limits established shall be at least one half the reporting limits in Table 4-2 through 4-6.	None
Linear range calibration check standard	Once per quarter	All analytes within +10% of expected value	Correct problem then re-analyze or re-set linear range
Post-digestion spike addition	When dilution test fails	Recovery within 75-125% of expected value	None

Table 4-23. Calibration and Quality Control Requirements for Metals by MethodSW846 7000 Series (Page 1 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
Multi-point initial calibration (a blank and at least five standards)	Before initial sample analysis, every 24 hours, whenever modifications are made to the analytical system, or when continuing calibration verification fails.	Correlation coefficient of linear regression is ≥ 0.995.	Correct the problem and repeat the initial calibration.
Second-source calibration verification	Immediately following each initial calibration.	All analytes within ±20% of expected value.	Correct the problem and repeat initial calibration.
Calibration blank	After every second-source or continuing calibration verification analysis.	No analytes detected at or above the reporting limit.	Correct the problem, then reanalyze previous 10 samples.
Continuing calibration verification	After every 10 samples and at the end of the analysis sequence.	All analytes within ±20% of expected value.	Recalibrate and reanalyze all samples since the last acceptable continuing calibration verification.
Method blank	At least one per analytical batch.	No analytes detected at or above the reporting limit.	Correct the problem and re-prep and reanalyze all associated samples.
MS/MSD	One set per 20 project-specific samples. MSD is optional if a laboratory sample duplicate is performed.	All analytes within limits specified in accuracy and precision table.	None.

Table 4-23. Calibration and Quality Control Requirements for Metals by MethodSW846 7000 Series (Concluded, Page 2 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
Laboratory sample duplicate	Once per analytical batch if MSD not performed.	Concentration of reported analytes are > 5 times the reporting limit in either sample and RPD >20%. One sample result < the reporting limit and a difference of ±2 times the reporting limit.	None.
LCS	At least one per analytical batch.	All analytes within limits specified in accuracy and precision table.	Correct the problem, and re-prep and reanalyze the LCS and all samples in the analytical batch.
Dilution test	Each new sample matrix.	Result from 1:5 dilution must be within ±10% of the undiluted sample result (applies only if undiluted sample result is at least 25 times the reporting limit).	Perform recovery test.
Recovery test	When dilution test fails.	Recovery within 85-115% of expected value.	Analyze all samples by MSA.

Table 4-24. Calibration and Quality Control Requirements for TPH (DRO/GRO) by Method SW846 8015B/8015M (Page 1 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
Multi-point initial calibration (minimum five points)	Prior to sample analysis, or when calibration verification fails	If the %RSD is ≤20%, the average RRF may be used for quantitation; otherwise use calibration curve with coefficient of correlation or determination ≥0.99. Air: r ≥0.995	Correct the problem and repeat the initial calibration.
Second Source Calibration Verification	Immediately following ICAL	Analytes within ±20% of expected value Air: ±30%	Correct the problem, then re-analyze ICV.
Continuing calibration verification	At the start of each analytical sequence and after every 10 samples, and at the end of the sequence	Analytes within ±20% of expected value Air: ±25%	Correct the problem, then recalibrate and re-analyze all samples since the last acceptable continuing calibration verification.

Table 4-24. Calibration and Quality Control Requirements for TPH (DRO/GRO) by Method SW846 8015B/8015M (Concluded, Page 2 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
Method Blank	At least one per analytical batch	No analytes detected at or above the reporting limit	Correct the problem and re-prep and re-analyze all associated samples
Surrogate spike (soil/groundwater only)	Every standard, sample, method blank, MS/MSD, and LCS	All surrogates in samples, method blank, MS/MSD, and LCS within limits specified in Accuracy and Precision table	Correct the problem and re-analyze (re-prep if necessary).
MS/MSD (soil/groundwater only)	One set per 20 samples	Within limits specified in Accuracy and Precision table	None
LCS/LCSD	At least one per analytical batch	Within limits specified in Accuracy and Precision table	Correct the problem, and re-prep and re-analyze the LCS and all samples in the analytical batch.
Laboratory duplicate (air)	Once per day or every 20 samples	±25%	None.

Table 4-25. Calibration and Quality Control Requirements for Volatile Organic Compounds by Method SW846 8260B (Page 1 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
BFB tuning	Prior to initial calibration and calibration verification (every 12 hours)	Refer to criteria listed in the method	Re-tune instrument and verify
Multi-point initial calibration (minimum five points)	Prior to sample analysis, or when calibration verification fails	SPCCs average RF ≥0.30[a] and %RPD for RFs for CCCs ≤30% and one option below: Option 1: Mean %RSD for all analytes ≤15% with no individual analyte RSD >30%, if using average RRFs Option 2: Least squares regression r ≥0.990	Correct the problem and repeat the initial calibration
Second-source calibration verification	Once for each multi-point initial calibration	All analytes within ±20% of expected value	Correct the problem and repeat initial calibration
Continuing calibration verification	At the start of each analytical sequence, after every 12 hours or 10 samples, whichever is more frequent, and at the end of the sequence	SPCCs average RF ≥0.30[c] and %D for RFs for CCCs ≤ 20% All other analytes within ±20% of expected value	Correct the problem, then re-calibrate and re-analyze all samples since the last acceptable continuing calibration verification

Table 4-25. Calibration and Quality Control Requirements for Volatile Organic Compounds by Method SW846 8260B (Concluded, Page 2 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
Retention time window calculated for each analyte	Each analyte	Relative retention time of each analyte within ± 0.06 relative retention time units of the midpoint of ICAL	Not applicable (used for identification of analyte)
Internal standards	Each sample and quality control sample, method blank, matrix spike/matrix spike duplicate and laboratory control sample	Retention time within ±30 seconds from retention time of the midpoint of ICAL EICP area within –50% to +100% of the initial calibration verification standard	Inspect mass spectrometer and gas chromatograph for malfunctions; reanalyze all affected samples
Method blank	At least one per analytical batch	No analytes detected at or above the reporting limit	Correct the problem, then re-prep and re-analyze all associated samples
Surrogate spike	Every standard, sample, method blank, MS/MSD and LCS	All surrogates in samples, method blank and laboratory control sample within limits specified in accuracy and precision table	Correct the problem and re-analyze (re-prep if necessary)
Matrix spike/ matrix spike duplicate (MS/MSD)	One set per 20 project-specific samples	Within limits specified in accuracy and precision table	None
Laboratory control sample (LCS)	At least one per analytical batch	Within limits specified in accuracy and precision table	Correct the problem, then re-prep and re-analyze the LCS and all samples in the analytical batch

[a] Spill prevention, control, and countermeasures (SPCC) average response factor (RF) ≥0.10 for bromoform, chloromethane, 1,1-dichloroethane

BFB = Bromofluorobenzene

Table 4-26. Calibration and Quality Control Requirements for Semivolatile Organic Compounds by Method SW846 8270C

Quality Control Check	Frequency	Criteria	Corrective Action
DFTPP tuning	Prior to initial calibration and calibration verification (every 12 hours)	Refer to criteria listed in the method	Re-tune instrument and verify
Multi-point initial calibration (minimum five points)	Prior to sample analysis, or when calibration verification fails	SPCCs average RF ≥0.050 and %RSD for FRFs for CCCs ≤30% and one option below: Option 1: Mean %RSD for all analytes ≤15% with no individual analyte RSD >30%, if using average RFs Option 2: Least squares regression r ≥0.990	Correct the problem and repeat the initial calibration
Second-source calibration verification	Once for each multi-point initial calibration	All analytes within ±20% of expected value	Correct the problem and repeat initial calibration
Continuing calibration verification	At the start of each analytical sequence, after every 12 hours or 10 samples, whichever is more frequent, and at the end of the sequence	SPCCs average RF ≥0.050 and %D for RRFs for CCCs ≤20% All other analytes within ±20% of expected value.	Correct the problem, then re-calibrate and re-analyze all samples since the last acceptable continuing calibration verification
Retention time window calculated for each analyte	Each analyte	Relative retention time of each analyte within ±0.06 relative retention time units of the midpoint of ICAL	Not applicable (used for identification of analyte)
Internal standards	Each sample and quality control sample, method blank, matrix spike/matrix spike duplicate and laboratory control sample	Retention time within ±30 seconds from retention time of the midpoint of the ICAL. EICP area within –50% to +100% of the daily continuing calibration verification standard	Inspect mass spectrometer and gas chromatograph for malfunctions; re-analyze all affected samples
Method blank	At least one per analytical batch	No analytes detected at or above the reporting limit	Correct the problem, then re-prep and re-analyze all associated samples
Surrogate spike	Every standard, sample, method blank, matrix spike/matrix spike duplicate and laboratory control sample	At least two surrogates per fraction in samples, method blank and laboratory control sample within limits specified in accuracy and precision table	Correct the problem and re-analyze (re-prep if necessary)
Matrix spike/ matrix sample duplicate (MS/MSD)	One set per 20 project-specific samples	Within limits specified in accuracy and precision table	None
Laboratory control sample (LCS)	At least one per analytical batch	Within limits specified in accuracy and precision table	Correct the problem, then re-prep and re-analyze the laboratory control sample and all samples in the analytical batch

Table 4-27. Calibration and Quality Control Requirements for Polyaromatic Hydrocarbons by Method SW846 8270 SIM, Facility (Page 1 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
DFTPP Tuning	Prior to initial calibration and calibration verification (every 12 hours).	Refer to criteria listed in the method.	Retune instrument and verify.
Multi-point initial calibration (minimum five points)	Prior to sample analysis, or when calibration verification fails.	SPCCs average RF ≥0.050 and %RSD for RFs for CCCs ≤30% and one option below:	Correct the problem and repeat the initial calibration.
		Option 1: Mean %RSD for all analytes ≤ 15% with no individual analyte RSD >30%, if using average RRFs.	
		Option 2: Least squares regression r ≥0.990.	
Second-source calibration verification	Once for each multi-point initial calibration.	All analytes within ±30% of expected value.	Correct the problem and repeat initial calibration.
Continuing calibration verification	At the start of each analytical sequence and every 12 hours thereafter.	All CCC compounds within 20%D of expected value, all others within 30%D of expected value.	Correct the problem, then recalibrate and reanalyze all samples since the last acceptable continuing calibration verification.
Retention time window calculated for each analyte	Each analyte.	Relative retention time of each analyte within ±0.06 relative retention time units of the midpoint of ICAL.	Not applicable (used for identification of analyte).
Internal Standards	Each sample and quality control sample, method blank, MS/MSD and LCS.	Retention time within ±30 seconds from retention time of the midpoint of ICAL. EICP area within –50% to +100% of the daily continuing calibration verification standard.	Inspect mass spectrometer and gas chromatography for malfunctions; reanalyze all affected samples.
Method Blank	At least one per analytical batch.	No analytes detected at or above the reporting limit.	Correct the problem, then re-prep and re-analyze all associated samples.

Table 4-27. Calibration and Quality Control Requirements for Polyaromatic Hydrocarbons by Method SW846 8270 SIM (Concluded, Page 2 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
Surrogate spike	Every standard, sample, method blank, MS/MSD and LCS.	Within limits specified in accuracy and precision table.	Correct the problem and reanalyze (re-prep if necessary).
MS/MSD	One set per 20 project-specific samples.	Within limits specified in accuracy and precision table.	None.
LCS	At least one per analytical batch.	Within limits specified in accuracy and precision table.	Correct the problem, then re-prep and re-analyze the LCS and all samples in the analytical batch.

CCC = calibration check compounds.
DFTTP = Decafluorotriphenylphosphine
EICP = extracted ion current profile.
RF = response factor.
RRF = relative response factor.
SPCC = system performance check compounds.

Table 4-28. Calibration and Quality Control Requirements for Polyaromatic Hydrocarbons by Method SW846 8310 (Page 1 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
Multi-point initial calibration (minimum five points)	Prior to sample analysis, or when calibration verification fails	If the percent relative standard deviation (%RSD) is ≤20%, the average RRF may be used for quantitation; otherwise use calibration curve with coefficient of correlation or determination ≥0.99.	Correct the problem and repeat the initial calibration.
Continuing calibration verification	At the start of each analytical sequence and after every 10 samples, and at the end of the sequence	Analytes within ±15% of expected value	Correct the problem, then recalibrate and re-analyze all samples since the last acceptable continuing calibration verification.
Method Blank	At least one per analytical batch	No analytes detected at or above the reporting limit	Correct the problem and re-prep and re-analyze all associated samples
Surrogate spike	Every standard, sample, method blank, MS/MSD, and LCS	All surrogates in samples, method blank, MS/MSD, and LCS within limits specified in Accuracy and Precision table	Correct the problem and re-analyze (re-prep if necessary).
MS/MSD	One set per 20 samples	Within limits specified in Accuracy and Precision table	None
LCS	At least one per analytical batch	Within limits specified in Accuracy and Precision table	Correct the problem, and re-prep and re-analyze the LCS and all samples in the analytical batch.

Table 4-28. Calibration and Quality Control Requirements for Polyaromatic Hydrocarbons by Method SW846 8310 (Concluded, Page 2 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
Second detector or second column confirmation	All samples with results above the reporting limit objectives must be confirmed within the holding time.	Confirmation to be done using a second detector or second column of dissimilar phase and retention characteristics (or gas chromatography/mass spectrometry if sample concentration is sufficiently high). All calibration and QC acceptance criteria specified for primary analysis must be met in the confirmation analysis.	Failure to perform confirmation will result in potential re-sampling and analysis at no cost to the project.

Table 4-29. Calibration and Quality Control Requirements for General Chemistry Parameters by Various Methods (Page 1 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
Multi-point initial calibration (a blank and at least five standards)	Before initial sample analysis, every 24 hours, whenever modifications are made to the analytical system, or when continuing calibration verification fails	Correlation coefficient of linear regression is ≥0.995	Correct the problem and repeat the initial calibration.
Second-source calibration verification	Immediately following each initial calibration	Analytes within ±10% of expected value	Correct the problem and repeat initial calibration.
Calibration blank	After every Second-source or Continuing calibration verification analysis	No analytes detected at or above the reporting limit	Correct the problem, then re-analyze associated samples.
Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	Within ±10% of expected value	Re-calibrate and re-analyze all samples since the last acceptable continuing calibration verification
Method Blank	At least one per analytical batch	No analytes detected at or above the reporting limit	Correct the problem and re-prep and re-analyze all associated samples
MS/MSD	One set per 20 project-specific samples. MSD is optional if a laboratory sample duplicate is performed	All analytes within limits specified n Accuracy and Precision table	None

Table 4-29. Calibration and Quality Control Requirements for General Chemistry Parameters by Various Methods (Concluded, Page 2 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
Laboratory sample duplicate	Once per analytical batch if MSD not performed	Concentration of reported analytes are >5 times the reporting limit in either sample and RPD >20%. One sample result <RL and a difference of ±2 times the reporting limit	None
LCS	At least one per analytical batch	All analytes within limits specified in Accuracy and Precision table	Correct the problem, and re-prep and reanalyze the LCS and all samples in the analytical batch
Retention time windows (Method SW9056)	Once per calibration	Window set using midpoint of ICAL. On days ICAL not analyzed, window set using initial calibration standard.	NA

Table 4-30. Calibration and Quality Control Requirements for 1,2-Dibromoethane (EDB) by Methods 504.1/SW8011

Quality Control Check	Frequency	Criteria	Corrective Action[a]
Five-point initial calibration for all analytes	Initial calibration prior to sample analysis	If the %RSD is ≤20%, the average RRF may be used for quantitation; otherwise use calibration curve with coefficient of correlation or determination ≥0.99	Correct problem then repeat initial calibration.
Second Source calibration verification	Once per initial calibration	Analytes within ±15% of expected value	Correct problem then repeat initial calibration.
Retention window calculated for each analyte	Each sample	Retention within ±0.05 minimum of most recent calibration check	Correct problem then repeat all samples analyzed since last retention time check (latest mid-level cal check).
Calibration verification	Daily, before sample analysis and every 12 hours of analysis time	Analytes within ±15% of expected value	Correct the problem, then re-calibrate and re-analyze all samples since the last acceptable continuing calibration verification
Method blank	One per analytical batch	No analytes detected at or above the reporting limit	Correct the problem and re-prep and re-analyze all associated samples
Laboratory control sample (LCS)	1 per analytical batch	All analytes within limits specified in accuracy and precision tables	Correct the problem, and re-prep and re-analyze the LCS and all samples in the analytical batch.
Matrix spike/matrix spike duplicate (MS/MSD)	One MS/MSD per 20 samples	All analytes within limits specified in accuracy and precision tables	None.
Confirmation (Second Source/second column)	All Detects must be confirmed	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ≤40%.	Apply J-flag if RPD >40%. Discuss in the case narrative.

Table 4-31. Calibration and Quality Control Requirements for TO-15

Quality Control Check	Frequency	Criteria	Corrective Action
BFB Tune Check	Once per 24 hour tune window	Must meet the method tune criteria	Re-tune
Multi-point initial calibration (minimum five points)	Prior to sample analysis, or when calibration verification fails	%RSD of ≤30%, with up to two analytes ≤40%	Reanalyze one point or two points if six points are included in the initial calibration. Correct the problem and repeat the initial calibration.
Initial Calibration Verification (ICV)	Once following each initial calibration	Analytes within ±30% of expected value	Re-analyze. If still unacceptable, correct the problem and repeat the initial calibration.
Continuing Calibration Verification (CCV)	At the start of each analytical sequence	Analytes within ±30% of expected value	Re-analyze. Correct the problem, then recalibrate and reanalyze all samples.
Method Blank	At least one per analytical batch	No analytes detected at or above the RL	Re-analyze. If still unacceptable, reanalyze the blank and all samples in the analytical batch. If still unacceptable, flag all associated data in the analytical batch.
Surrogate spike	Every standard, sample, method blank, and LCS	All surrogates in samples, method blank, and LCS within 70-130% recovery	Re-analyze. If still unacceptable, flag all associated data in the analytical batch.
LCS	At least one per analytical batch	Within limits specified in Accuracy and Precision table	Re-analyze. If still unacceptable, correct the problem and reanalyze the LCS and all samples in the analytical batch. If still unacceptable, flag all associated data in the analytical batch.
Lab Duplicate	At least one per analytical batch	Relative percent difference (RPD) ±25%	Re-analyze. If still unacceptable, flag all associated data in the analytical batch.

Table 4-32. Calibration and Quality Control Requirements for Fixed Gases by Method SM2720C (Page 1 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
Multi-point initial calibration (minimum five points)	Prior to sample analysis, or when calibration verification fails	Least Squares Regression, r≥0.995	Correct the problem and repeat the initial calibration.
Initial Calibration Verification (ICV)	Once following each initial calibration	Analytes within ±30% of expected value	Re-analyze. If still unacceptable, correct the problem and repeat the initial calibration.
CCV	At the start of each analytical sequence and every 12hrs	Analytes within ±20% of expected value	Re-analyze. Correct the problem, then recalibrate and reanalyze all samples.
Method Blank	At least one per analytical batch	No analytes detected at or above the RL	Re-analyze. If still unacceptable, re-analyze the blank and all samples in the analytical batch. If still unacceptable, flag all associated data in the analytical batch.

Table 4-32. Calibration and Quality Control Requirements for Fixed Gases by Method SM2720C (Concluded, Page 2 of 2)

Quality Control Check	Frequency	Criteria	Corrective Action
LCS	At least one per analytical batch	Recovery within Laboratory QC Limits	Re-analyze. If still unacceptable, correct the problem and reanalyze the LCS and all samples in the analytical batch. If still unacceptable, flag all associated data in the analytical batch.
Lab Duplicate	At least one per analytical batch	Relative percent difference (RPD) +\-20%	None
Field Duplicate	At least one per analytical batch	Relative percent difference (RPD) +\-20%	None
Canister Pressure (not applicable to Grab Samples)	NA	Pressure should be between 28-30" Hg prior to sampling (30" Hg=fully evacuated)	If <28" Hg—do not use the canister. If need to analyze, data will be qualified as estimated with a low bias.
		Pressure should be between 2-10"Hg after sampling commences (5"Hg is ideal)	If >10" Hg—Sampling time may be extended, if DQO's allow, to appropriate level. If sampling time cannot be extended, sample will be diluted by laboratory. • If only slight change in pressure (20-27"), qualify data as estimated. • If no change in pressure—do not analyze sample. Reject all data if analyzed.
Canister Checks (Batch/Individual)	Prior to sampling	Batch Certification (soil vapor)—Canisters must be certified to ½ RL Individual Certification (Indoor Air)-Individual canisters certified to ½ RL	NA

5. CALIBRATION PROCEDURES AND FREQUENCY

5.1 Field Calibration Procedures

Field equipment will be calibrated before the start of work and at the end of the sampling day. Any instrument drift from prior calibration will be recorded in the field notebook. Calibration will be in accordance with procedures and schedules outlined in the particular instrument's operations manual and the information included within the Operations and Maintenance Manual.

Calibrated equipment will be uniquely identified by using either the manufacturer's serial number or other means. A label with the identification number and the date when the next calibration is due will be physically attached to the equipment. If this is not possible, records traceable to the equipment (that is, showing the equipment identification) will be readily available for reference. In addition, the results of calibrations and records of repairs will be recorded in the logbook.

Scheduled periodic calibration of testing equipment does not relieve field personnel of the responsibility of using properly functioning equipment. If an individual suspects an equipment malfunction, the device will be removed from service, tagged so that it is not inadvertently used, and the appropriate personnel notified so that a recalibration can be performed or substitute equipment can be obtained.

Equipment that fails calibration or becomes inoperable during use will be removed from service and either segregated to prevent inadvertent use or tagged to indicate it is out of calibration. Such equipment will be repaired and satisfactorily recalibrated. Equipment that cannot be repaired will be replaced.

5.2 Laboratory Calibration Procedures

Qualified personnel will appropriately calibrate laboratory instruments prior to sample analysis. The requirements specified in each method and the appropriate CLP statement of work will be followed. Only certified standards of known purity may be used for calibration. Calibration will be verified at specified intervals throughout the analysis. The frequency and acceptance criteria for calibration are specified for each analytical method in Tables 4-22 through 4-31 or the appropriate CLP statement of work.

When multi-point calibration is specified, the concentrations of the calibration standards should bracket those expected in the samples. Samples must be diluted, if necessary, to bring analyte responses within the calibration range. The laboratory may only report those data that result from quantitation within the demonstrated working calibration range. Quantitation based on extrapolation is not acceptable. The applicable CLP statement of work discusses initial and continuing calibration requirements in greater detail.

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6. DATA REDUCTION, VALIDATION, AND REPORTING

6.1 Laboratory Data Management

Data reduction will be performed manually or by using appropriate application software. Quantitation procedures specified for each method must be followed. If data reduction is performed manually, the documentation must include the formulas used. Any application software used for data reduction must have been verified previously by the laboratory for accuracy. Documentation of the software's verification must be maintained on file in the laboratory. All documentation of data reduction must allow recreation of the calculations.

All data will undergo a minimum of three levels of review at the laboratory before release. The analyst performing the tests will initially review 100 percent of the data. After the analyst's review has been completed, 100 percent of the data will be reviewed independently by a senior analyst or by the section supervisor for accuracy; compliance with calibration, QC requirements, and holding times; and completeness. Analyte identification and quantitation must be verified. Calibration and QC results will be compared with the applicable control limits. Reporting limits will be reviewed to make sure they meet the project objectives. Results of multiple dilutions will be reviewed for consistency.

Any discrepancies must be resolved and corrected. Laboratory qualifiers will be applied when there are nonconformance's that potentially affect data usability. These qualifiers must be properly defined as part of the deliverables. All issues that are relevant to the quality of the data must be described in a case narrative. The laboratory QC manager will review a minimum of 10 percent of data or deliverables generated for this program against the project-specific requirements. A final data review will be conducted by the Laboratory Manager or Client Service Representative to ensure that all required analyses was performed on all samples and that all documentation is complete.

The hardcopy and electronic laboratory reports for all samples and analyses will contain the information necessary to perform data evaluation. All hardcopy deliverables for this project will be **Level 3** data packages. **Level 4** data packages will be provided via CD.

Following is a brief synopsis of when it is appropriate to use each deliverable:

- **Level 1** – Appropriate for screening sample results. Noncritical project decisions are made using these data.
- **Level 2** – Appropriate for investigative samples results that will be replaced with confirmatory data or results used for disposal purposes. Less-critical project decisions are made using these data.
- **Level 3** – Appropriate for investigative, confirmatory, or closure results. Critical project decisions may be made using these data.
- **Level 4** – Appropriate for investigative, confirmatory, or closure results. Critical decisions may be made using these data and will be used for projects that require a high degree of confidence in the accuracy of the data.

Hardcopy deliverables will be CLP-like forms. Reporting formats similar to those specified in the latest versions of the EPA CLP statement of work for Organics and Inorganics Analyses are preferred (EPA 1999; 2002). The laboratory data report will be organized in format that easily enables identification and retrieval of data. Alternative reporting formats require approval from the Project Chemist. The required Level 4 data report will include, at a minimum (when applicable):

- Cover letter complete with:
  - Title of report and laboratory unique report identification (Sample Delivery Group Number);
  - Project name and location;
  - Name and location of laboratory and second-site or subcontracted laboratory;
  - Client name and address; and
  - Statement of authenticity and official signature and title of person authorizing report release.
- Table of contents;
- Summary of samples received that correlates field sample identifications (IDs) with the laboratory IDs;
- Laboratory qualifier flags and definitions;
- Field ID number;
- Date received;
- Date prepared;
- Date analyzed (and time of analysis if the holding time is less than or equal to 48 hours);
- Preparation and analytical methods;
- Result for each analyte (dry-weight basis for soils);
- Percent solids results for soil samples;
- Dilution factor (provide both diluted and undiluted results when available);
- Sample-specific reporting limit adjusted for sample size, dilution/concentration;
- Sample-specific MDL adjusted for sample size, dilution/concentration (when project objectives require reporting less than the reporting limit); and
- Units.
- Case narrative that describes the following information, at a minimum:
  - Sample receipt discrepancies, such as bubbles in volatile organic analysis (VOA) samples and temperature exceedances;
  - All nonconformances in the sample receipt, handling, preparation, and analytical and reporting processes, and the corrective action taken in each occurrence; and
  - Identification and justification for sample dilution.
- Surrogate percent recoveries;

- MS/MSD and LCS spike concentrations, native sample results, spiked sample results, percent recoveries, and RPDs between the MS and MSD results; associated QC limits also must be provided;
- Method blank results;
- Analytical batch reference number that cross references samples to QC sample analyses;
- Executed chain of custody and sample receipt checklist;
- Analytical sequence or laboratory run log that contains sufficient information to correlate samples reported in the summary results to the associated method quality control information, such as initial and continuing calibration analyses;
- Confirmation results;
- Calibration blank results for inorganic analyses (required in hardcopy format only);
- ICP interference check sample true and measured concentrations and percent recoveries (required in hardcopy format only);
- Method of standard addition results (if applicable; required in hardcopy format only);
- Post-digestion spike recoveries (if applicable; required in hardcopy format only);
- Internal standard recovery and retention time information, as applicable;
- Initial calibration summary, including standard concentrations, response factors, average response factors, RSDs or correlation coefficients, and calibration plots or equations, if applicable (required in hardcopy format only);
- Continuing calibration verification summary, including expected and recovered concentrations and percent differences (required in hardcopy format only);
- Instrument tuning and mass calibration information for gas chromatography/mass spectrometry and ICP/mass spectrometry analyses; and
- Any other method-specific QC sample results.
- Sample preparation logs that include the following information:
  - Preparation start and end times; and
  - Beginning and ending temperatures of water baths and digestion blocks.
- Example calculation for obtaining numerical results from at least one sample for each matrix analyzed (provide algorithm).
- Reconstructed total ion chromatograms or selected ion current profiles for each sample (or blank) analyzed and mass spectra(s) for each compound identified, including:
  - Raw compound spectra;
  - Enhanced or background spectra; and
  - Laboratory-generated library spectra (for tentatively identified compounds provide the reference mass spectra(s) from software spectra library.
- Ion ratio information for dioxin/furan methods.

6.1.1 Hardcopy and Electronic Deliverables

All electronic data files will match the final hardcopy results. CH2M HILL requires receipt of final hardcopy results in conjunction with submittal of electronic files.

All raw data will be maintained on file in the laboratory and will be available on request by CH2M HILL. Complete documentation of sample preparation and analysis and associated QC information will be maintained in a manner that allows easy retrieval in the event that additional validation or information is required. All data generated using gas chromatography/mass spectrometry must be maintained electronically and will be made available to CH2M HILL upon request. All documentation must be retained for a minimum of 10 years after data acquisition.

The primary responsibility for the implementation of these procedures within the laboratory will reside with the Laboratory Manager or equivalent. The Laboratory Manager will approve laboratory reports before transferring the information to CH2M HILL.

6.2 Data Validation and Verification

The analytical results of the data collection effort will be validated by CH2M HILL. In general, four levels of validation correspond to the reports described in Section 6.1. Levels 1 and 2 may be performed by the Project Chemist or other program team members. Levels 3 and 4 validation will always be performed by the Project Chemist or his/her designee.

- **Level 1** – Verification that samples were analyzed for the methods requested and review of the data for outliers and anomalies.
- **Level 2** – Verification that samples were analyzed for the methods requested, review of the laboratory case narrative for events in the laboratory that affect the accuracy or precision of the data, review of QC indicator data and a "reasonableness" review of the data.
- **Level 3** – Validation of the analytical data as described below without review of any raw data or analyte verification.
- **Level 4** – Validation of the analytical data will be performed as described below, including review of the analytical raw data.

6.2.1 Levels 2, 3, and 4 Validation Procedures

Personnel involved in data validation will be independent of any data generation effort. The Project Chemist will be responsible for oversight of data validation. Data validation will be carried out when the data packages are received from the laboratory. It will be performed on an analytical batch basis using the summary results of calibration and laboratory QC, as well as those of the associated field samples. Data packages will be reviewed for all constituents of concern. Raw data will be reviewed for approximately 10 percent of the data packages or as deemed necessary by the Project Chemist. Validation will be performed using the following procedures and those referenced for Level 3 or 4 as appropriate:

- A review of the data set narrative to identify any issues that the lab reported in the data deliverable;
- A check of sample integrity (sample collection, preservation, and holding times);

- An evaluation of basic QC measurements used to assess the accuracy, precision and representativeness of data, including QC blanks, LCSs, MS/MSD, surrogate recovery when applicable, and field or laboratory duplicate results;
- A review of sample results, target compound lists, and detection limits to verify that project analytical requirements are met;
- Initiation of corrective actions, as necessary, based on the data review findings; and
- Qualification of the data using appropriate qualifier flags, as necessary, to reflect data usability limitations.

Level 3 validation procedures also will include reviewing the evaluation of calibration and QC summary results against the project requirements and other method-specific QC requirements.

Level 4 validation will include reviewing sample chromatograms and verification of analyte identification and calculations for at least 10 percent of the data.

Data validation will be patterned after the EPA *Contract Laboratory National Functional Guidelines for Inorganic Data Review* (EPA, 2004) and *Contract Laboratory National Functional Guidelines for Organic Data Review* (EPA, 1999), substituting the calibration and QC requirements specified in this QAPP for those specified in the guidelines. The flagging criteria in Tables 6-1 and 6-2 will be used. The qualifier flags are defined in Table 6-3.

Qualifier flags, if required, will be applied to the electronic sample results. If multiple flags are required for a result, the most severe flag will be applied to the electronic result. The hierarchy of flags from the most severe to the least severe will be as follows: R, UJ, U, and J.

Any significant data quality problems will be brought to the attention of the Project Chemist.

Table 6-1. Flagging Conventions for Organic Methods (Page 1 of 4)

Quality Control Check	Evaluation	Flag	Samples Affected
Holding Time	Holding time exceed for extraction or analysis	J positive results	affected samples
	by a factor of two	R non-detects	
Temperature	temperature exceedance >10°C if received within 24 hr)	UJ non-detects or professional judgment	
	temperature exceedance >6°C if received >24 hr)	UJ non-detects, J positive results or professional judgment	
Sample preservation (volatiles)	Sample preservation requirements not met	J positive results	affected samples
	if preservation not performed in the field, but performed in the laboratory upon receipt, no flagging is required	R non-detects	
Sample Integrity (volatiles)	Professional Judgment on sample condition	J positive results/professional judgment	affected samples
	Example: Bubbles in volatile organic analysis (VOA) vial used for analysis	R non-detects/professional judgment	
Gas Chromatograph/ Mass Spectrometry (GC/MS) Instrument Performance Check	Mass assignment in error and laboratory cannot reprocess data	R all results	all samples in batch
	Ion abundance criteria not met	R all results if critical ions involved, use judgment otherwise	all samples in batch
Initial Calibration GC/MS Methods	RRF <0.050	J positive results	analyte in associated samples
		UJ non-detects	
	%RSD >30% and no calibration curve used or linear calibration curve used and R < 0.990	J positive results	analyte in associated samples
		UJ non-detects	
Initial Calibration GC Methods see Note 1.	%RSD >20% and no calibration curve used or linear calibration curve used and R <0.990	J positive results	analyte in associated samples
		UJ non-detects	
Calibration Verification GC/MS Methods (Second Source and CCV)	RRF <0.050	J positive results	analyte in associated samples
		UJ non-detects	
	% difference or % drift >25% with high recovery	J positive results	analyte in associated samples
	% difference or % drift >25% with low recovery	J positive results	analyte in associated samples
		UJ non-detects	

Table 6-1. Flagging Conventions for Organic Methods (Page 2 of 4)

Quality Control Check	Evaluation	Flag	Samples Affected
Calibration Verification GC Methods (Second Source and CCV)	% difference or % drift >15% with high recovery	J positive results	analyte in associated samples
	% difference or % drift >15% with low recovery	J positive results UJ non-detects	analyte in associated samples
Laboratory Control Sample (LCS)	%Recovery (%R) > Upper Control Limit (UCL)	J positive results	analyte in associated samples
	%R < Lower Control Limit (LCL) but ≥10%	J positive results UJ non-detects	analyte in associated samples
	%R <LCL but ≤10%	J positive results R non-detects	analyte in associated samples
Method Blank (MB) <RL	Convert blank to soil units if necessary, multiply highest blank value by 5 (by 10 for common lab contaminants, acetone, methylene chloride, MIBK, cyclohexane, phthalates)	U positive results <5x highest blank oncentration (<10x for common contaminants)	all associated samples in batch
Equipment Blank (FB) <RL	Convert blank to soil units if necessary, multiply highest blank value by 5 (by 10 for common lab contaminants, acetone, methylene chloride, methyl isobutyl ketone (MIBK), cyclohexane, phthalates)	U positive results <5x highest blank concentration (<10x for common contaminants)	all associated samples in batch
Trip Blank (TB) <RL	Convert blank to soil units if necessary, multiply highest blank value by 5 (by 10 for common lab contaminants, acetone, methylene chloride, MIBK, cyclohexane, phthalates)	U positive results <5x highest blank concentration (<10x for common contaminants)	all associated samples in batch
Matrix Spike/Matrix Spike Duplicate (MS/MSD) does not apply if sample result is greater than four times the spike value.	%R >UCL	J positive results	parent sample
	%R <LCL but ≥10%	J positive results UJ non-detects	parent sample
	%R <LCL but ≤10%	J positive results R non-detects	parent sample
	Relative percent difference (RPD) >UCL	J positive results	parent sample
Surrogates - SW8260/SW8270 SIM/SW8015B	%R >UCL	J positive results	parent sample
	%R <LCL but ≥10%	J positive results UJ non-detects	parent sample
	%R <LCL but ≤10%	J positive results R non-detects	parent sample

Table 6-1. Flagging Conventions for Organic Methods (Page 3 of 4)

Quality Control Check	Evaluation	Flag	Samples Affected
Surrogates - SW8270	2 or more surrogates with %R >UCL	J positive results	parent sample
	2 or more surrogates with %R <LCL but ≥10%	J positive results UJ non-detects	parent sample
	2 or more surrogates with %R <LCL but ≤10%	J positive results R non-detects	parent sample
Surrogates - GC Methods	%R >UCL	J positive results	parent sample
	%R <LCL but ≥10%	J positive results UJ non-detects	parent sample
	%R <LCL but ≤10%	J positive results R non-detects	parent sample
Internal Standards -50% to +100% recovery	Area > UCL	J positive results	associated analytes in sample
	Area < LCL	J positive results UJ non-detects	associated analytes in sample
Laboratory Duplicates ± 25% precision	Both sample results >5 times RL and relative percent difference (RPD)>UCL	J positive results	Laboratory duplicate pair
	One or both samples <5 times RL and a difference between results of ±2 times RL	J positive results UJ non detects	Laboratory duplicate pair
Field Duplicates ±50% precision for soil ±30% precision for aqueous	Both sample results >5 times RL and relative percent difference (RPD) >UCL	J positive results	Field duplicate pair
	One or both samples <5 times RL and a difference between results of ±2 times RL for water and ±3.5 times RL for soil	J positive results UJ non detects	Field duplicate pair
Confirmation ±40% precision	Relative percent difference (RPD) >40% if lab reports higher of two results and coelution is suspected, reviewer can replace higher result with lower	J positive results	affected analytes
	Confirmation analysis not performed	J positive results	affected analytes

Table 6-1. Flagging Conventions for Organic Methods (Concluded, Page 4 of 4)

Quality Control Check	Evaluation	Flag	Samples Affected
Canister Pressure (not applicable to Grab Samples)	If <28" Hg—do not use the canister. If need to analyze, data will be qualified as estimated with a low bias.	Apply J to detects and UJ to nondetects	affected analytes
	If >10" Hg—Sampling time may be extended, if DQO's allow, to appropriate level. If sampling time cannot be extended, sample will be diluted by laboratory. • If only slight change in pressure (20-27"), qualify data as estimated. • If no change in pressure—do not analyze sample. Reject all data if analyzed.	If slight change in pressure, Apply J to detects and UJ to nondetects. If not change in pressure, Apply R to all data.	affected analytes
	If < 2"Hg—Sampling time cannot be verified. Qualify data as estimated.	Apply J to detects and UJ to nondetects	affected analytes
Canister Checks (Batch/Individual)	Batch Certification (soil vapor)—Canisters must be certified to ½RL. Individual Certification (Indoor Air)-Individual canisters certified to ½RL	Apply U to all results for the specific analyte(s) in all samples in the associated analytical batch whose concentration is less than 5 times blank concentration or 10 times for common contaminants.	affected analytes

1. Initial calibration should be based on average response factors or a linear regression equation. Laboratories will need Project Chemist approval to use a non linear calibration curve.

Table 6-2. Flagging Conventions for Inorganic Methods (Page 1 of 4)

Quality Control Check	Evaluation	Flag	Samples Affected
Holding Time cool to 4°C (except metals) metals hold 180 days	**Holding time exceed for digestion or analysis** Temperature exceedance >10°C if received within 24 hr) Temperature exceedance >6°C if received >24 hr)	J positive results UJ nondetects	affected samples
mercury hold 28 days	**Holding time exceed for digestion or analysis by a factor of two**	J positive results for all analytes R nondetects for all analytes	affected samples
Sample preservation Follow guidelines in Quality Assurance Project Plan (QAPP) or follow U.S. Environmental Protection Agency (EPA)	**Sample preservation requirements not met** if preservation not performed in the field, but performed in the laboratory upon receipt, no flagging is required	J positive results for all analytes R nondetects for all analytes	affected samples
Initial Calibration	**Correlation coefficient ≤0.995**	J positive results UJ nondetects	analyte in associated samples
Initial Calibration Verification (ICV) 90-110% accuracy	**% Recovery (%R) >Upper control Limit (UCL)** **%R <Lower Control Limit (LCL)**	J positive results UJ nondetects J positive results UJ nondetects	analyte in associated samples analyte in associated samples
Continuing Calibration Verification (CCV) 90-110% accuracy	**%R >UCL** **%R <LCL**	J positive results UJ nondetects J positive results UJ nondetects	analyte in associated samples analyte in associated samples

Table 6-2. Flagging Conventions for Inorganic Methods (Page 2 of 4)

Quality Control Check	Evaluation		Flag	Samples Affected
Interference Check Sample metals only 80-120% accuracy	**If interference present and %R >UCL**		J positive results	analyte in associated samples
	If interference is present and %R <LCL		J positive results UJ nondetects	analyte in associated samples
Laboratory Control Sample 75-125% accuracy	%R >UCL		J positive results	analyte in associated samples
	%R <LCL but ≥30%		J positive results UJ non-detects	analyte in associated samples
	%R <LCL but ≤30%		J positive results R nondetects	analyte in associated samples
Calibration Blank (Initial or continuing calibration blank) Convert to soil units if necessary	**Blank Result**	**Sample Result**		all associated samples in batch
		Non-detect	No action	
		≥ MDL but ≤ CRQL	Report result at CRQL and "U" flag	
	≥ MDL but ≤ CRQL	> CRQL	Use professional judgment	
		≥ MDL but ≤ CRQL	Report result at CRQL and "U" flag	
		>CRQL but < Blank Result	Report result at blank concentration and "U" flag R nondetects	
	> CRQL	> Blank result	Use professional judgment	
	≤ (-MDL) but ≥ (-CRQL)	≥ MDL or nondetect	Use professional judgment	
	< (-CRQL)	< 10x the CRQL	J results >CRQL UJ nondetects	

Table 6-2. Flagging Conventions for Inorganic Methods (Page 3 of 4)

Quality Control Check	Evaluation		Flag	Samples Affected
Method Blank (MB)	**Blank Results**	**Sample Results**		all associated samples in batch
Equipment Blank		Non-detect	No action	
(EB)		≥ MDL but ≤ CRQL	Report result at CRQL and "U" flag	
<RL	**≥ MDL but ≤ CRQL**	> CRQL	Use professional judgment	
	> CRQL	≥ MDL but ≤ CRQL	Report result at CRQL and "U" flag	
		>CRQL but < 10x the blank result	R nondetects J positive results	
		≥ 10x the blank result	No action	
	< (-CRQL)	< 10x the CRQL	J results >CRQL UJ nondetects	
Matrix spike/matrix spike duplicate (MS/MSD)	**%R >UCL**		J positive results	parent sample
does not apply if sample result is greater	**%R <LCL but ≥30%**		J positive results	parent sample
than four times the spike value			UJ non-detects	
	%R <LCL but ≤30%		J positive results	parent sample
75-125% accuracy			R nondetects	
± 25% precision	**Relative percent difference (RPD) >UCL**		J positive results	parent sample
Dilution Test	**If concentration is >50 times the method detection limit (MDL) and %**		J positive results	All samples from same site as
metals only	**difference is >UCL**		UJ nondetects	parent sample
± 30% precision				

Table 6-2. Flagging Conventions for Inorganic Methods (Concluded, Page 4 of 4)

Quality Control Check	Evaluation	Flag	Samples Affected
Post-Digestion Spike metals only perform if dilution test fails 75-125% accuracy	%R >UCL	J positive results	all samples in digestion batch
	%R <LCL but ≥30%	J positive results UJ nondetects	all samples in digestion batch
	%R <LCL but ≤30%	J positive results R nondetects	all samples in digestion batch
Internal Standards	%R>UCL	J positive results	All affected samples
	%R<LCL	J positive results, UJ non-detects	
Method of Standard Additions metals only perform if post-digestion spike fails	R <0.995	J positive results	analyte in sample
Laboratory Duplicates ± 25% precision	Both sample results >5 times RL and relative percent difference (RPD) >UCL	J positive results	Laboratory duplicate pair
	One or both samples <5 times RL and a difference between results of ± 2 times RL	J positive results UJ nondetects	Laboratory duplicate pair
Field Duplicates ± 50% precision for solids ± 30% precision for aqueous	Both sample results >5 times RL and relative percent difference (RPD) >UCL	J positive results	Field duplicate pair
	One or both samples <5 times RL and a difference between results of ± 2 times RL for water and ± 3.5 times RL for soil	J positive results UJ nondetects	Field duplicate pair

Table 6-3. Qualifier Flag Definitions

Flag	Definition
J	Analyte was present but reported value may not be accurate or precise.
R	This result has been rejected.
U	This analyte was analyzed for but not detected at the specified detection limit.
UJ	The analyte was not detected above the detection limit objective. However, the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

7. PERFORMANCE EVALUATIONS

To assess sample and data collection procedures, performance evaluations will be conducted and will consist of technical systems audits and performance audits.

7.1 Technical Systems Audits

7.1.1 Laboratory Audits

The laboratory participating in the data collection effort will be prequalified by CH2M HILL. Laboratory prequalification and the surveillance audits also may be undertaken by the regulatory agencies. Laboratory prequalification audits may be performed as either onsite audits, desk audits, or a combination of both.

7.1.2 Field Audits

Field audits will be performed once a year to verify the proper execution of field procedures. Procedures to be evaluated include:

- Sample containers and preservatives handling;
- Sample collection and identification procedures;
- Sample custody, handling, and shipping procedures;
- Equipment decontamination procedures;
- Calibration of field instruments and performance of field tests; and
- Documentation of field activities, maintenance of field records, and document control.

7.2 Performance Audits

7.2.1 Performance Evaluations

Laboratories are required to participate in a performance evaluation program. Any method or analyte failure in a performance evaluation program that affects the certification status of the laboratory with the National Environmental Laboratory Accreditation Program must be immediately communicated to the Program Chemist.

7.2.2 External Audits

Announced and unannounced audits of the field operations and of the laboratories may be conducted during any stage of the project.

7.2.3 Internal Audits

Annual audits of the laboratory will be conducted by the laboratory's Quality Assurance Officer. The audits will verify, at a minimum, that written SOPs are being followed; standards are traceable to certified sources; documentation is complete; data review is being performed effectively and is properly documented; and data reporting, including electronic and manual data transfer, is accurate and complete. All audit findings will be documented in QA reports to laboratory management. Necessary corrective actions will be taken within a reasonable timeframe. The Quality Assurance Officer will verify that such actions are effective and complete and will document their implementation in an audit closeout report to laboratory management.

8. PREVENTIVE MAINTENANCE

The primary objective of a preventive maintenance program is to promote the timely and effective completion of a measurement effort. The maintenance program will be designed to minimize the downtime of crucial sampling and/or analytical equipment from expected or unexpected component failure. In implementing this program, efforts will be focused on:

- Establishing maintenance responsibilities;
- Establishing maintenance schedules for major and/or critical instrumentation and apparatus; and
- Establishing an adequate inventory of critical spare parts and equipment.

8.1 Maintenance Responsibilities

Laboratory instrument maintenance is the responsibility of the participating laboratory. Generally, the Laboratory Manager or Supervisor is responsible for the instruments in his or her work area. This responsible person will establish maintenance procedures and schedules for each instrument.

Maintenance responsibilities for field equipment are assigned to the Field Team Leader for specific sampling tasks. However, the field team using the equipment is responsible for checking the status of the equipment before using it and reporting any problems encountered. The field team also is responsible for ensuring that critical spare parts are included as part of the field equipment checklist. Non operational field equipment will be removed from service, and a replacement will be obtained. All field instruments will be properly protected against inclement weather during the field investigation.

8.2 Maintenance Schedules

The effectiveness of any maintenance program depends, to a large extent, on adherence to specific maintenance schedules for each piece of equipment. Other maintenance activities are conducted as needed. Manufacturers' recommendations should provide the primary basis for establishing maintenance schedules. Manufacturers' service contracts may be used for implementing scheduled maintenance.

An instrument logbook will be assigned for each analytical instrument. All maintenance activities will be documented in this logbook. For each instrument, the logbook should contain to following information:

- Date of service;
- Person performing service;
- Type of service performed and reason for service;
- Replacement parts installed (if appropriate);
- Date of next scheduled service; and
- Any other useful information.

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9. DATA ASSESSMENT

All data generated for this project will be evaluated according to the QA acceptance criteria specified in Tables 4-9 through 4-22. Limitations on data usability will be assigned, if appropriate, as a result of the validation process described in Section 6.2.

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10. CORRECTIVE ACTION

Corrective action may be required as a result of deviations from field or analytical procedures. Deficiencies identified in audits and data quality evaluations also may call for corrective action. All project personnel have the responsibility, as part of the normal work duties, to identify, report, and solicit approval of corrective actions for conditions adverse to data quality.

This QAPP has specified the corrective actions to be taken when deviations from calibration and QC acceptance criteria occur in Tables 4-9 through 4-22. Field and laboratory staff may encounter conditions requiring immediate corrective action that are not covered in the work plan or QAPP. These personnel will document conditions and the results of corrective actions in a field logbook or laboratory nonconformance report and communicate their actions as soon as feasible to the Field Team Leader, Laboratory Supervisor, and if necessary, the Project Chemist, for immediate input.

A mechanism must be established to allow for supervisory review and/or CH2M HILL input for all deviations or deficiencies. A corrective action reporting system that requires immediate documentation of deviations or deficiencies and for supervisory review of the actions taken to correct them will be established. At a minimum, the corrective action report should include the following:

- The type of deviation or deficiency;
- The date of occurrence;
- The impact of the deviation or deficiency, such as samples affected;
- The corrective action taken; and
- Documentation that the process has been returned to control.

The only time that a corrective action report may be waived is when a deviation or deficiency is immediately corrected and its impact is precluded. An example would be an unacceptable initial calibration that is correctly calibrated before samples are analyzed.

Each corrective action report must be reviewed and approved by a person of authority, such as the Field Team Leader or Laboratory Supervisor. The ultimate responsibility for the laboratory corrective action process is the Quality Control Manager, who must ensure that proper documentation, approval, and closeout of all out-of-control or nonconformance events are performed. A nonconformance report will summarize each nonconformance condition. Corrective action reports that potentially affect data quality must be brought to the attention of the Project Chemist. Report disposition will be the responsibility of the Project Chemist. The Project Manager may be notified about a particular report at the Project Chemist's discretion. Copies of corrective action reports must be maintained in the laboratory or field project files.

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11. QUALITY ASSURANCE REPORTS

A QA report will be submitted by the Project Chemist to the Project Manager at the end of each sampling interval. The report will summarize the results of the data validation and the data assessment. The results will be presented in a manner that enables decision making. For example, temporal data may be more effectively presented if supplemented by a time plot. Any significant quality problems and recommended solutions will be included in the report. Limitations on data usability that were identified during data validation will be highlighted. The results of data assessment will be reconciled with the project objectives.

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12. DATA MANAGEMENT

The electronic data will be used to generate validation reports, risk assessment calculations, data summary tables, maps, and other figures. Data users will have simple procedures to rapidly access stored data; ensure consistency among all field activities; provide methods of data entry with known accuracy and efficiency; apply well-documented validation procedures to an electronic database; manage sample data using unique sample identification numbers; establish a sample inventory of new data collected and provide methods of sample inventory reconciliation; store and provide sample-specific attributes, including location identifiers, sample type and media, and sample date; and provide reporting and delivery formats to support data analysis and reduction.

12.1 Archiving

Hardcopy and electronic versions will be archived in project files and in electronic archives for the duration of the project, 5 years, or as specified in contractual agreements.

12.2 Data Flow and Transfer

The data flow from the laboratory and field to the project staff and data users will be sufficiently documented to ensure that data are properly tracked, reviewed, and validated before use.

12.3 Recordkeeping

In addition to the data management procedures outlined in Section 6.1 for analytical data, the laboratory will ensure that electronic and hardcopy records sufficient to recreate each analytical event are maintained. The minimum records the laboratory will keep contain the following:

- Raw data, including instrument printouts, bench worksheets, and/or chromatograms with compound identification and quantitation reports;
- Laboratory-specific written SOPs for each analytical method and QA/QC function in place at the time of analysis of project samples; and
- Recordkeeping requirements for non-analytical data are included in the work plan.

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REFERENCES

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USAF, 2009b. *Operations and Maintenance Manual for the Soil Vapor Extraction Systems, Bulk Fuels Facility, Kirtland AFB, New Mexico.* August.

USAF, 2004. *Base-Wide Plans for the Environmental Restoration Program, 2004 Update.*

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APPENDIX

QUALITY ASSURANCE PROJECT PLAN
CROSSWALK TECHNICAL MEMORANDUM

SUMMARY

This document is a Crosswalk between the Uniform Federal Policy for Quality Assurance Project Plans and the Quality Assurance Project Plan for the Bulk Fuels Facility at Kirtland Air Force Base (AFB), New Mexico.

INTRODUCTION

This technical memorandum was prepared to demonstrate that the Quality Assurance Project Plan for the Bulk Fuels Facility (BFF QAPP) meets the required content guidelines of the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) as documented in the Intergovernmental Data Quality Task Force UFP-QAPP, Evaluating, Assessing and Documenting Environmental Data Collection and Use Program (EPA, 2005).

Table 1 presents the cross reference between the required UFP-QAPP elements and where they can be found in the BBF QAPP and/or its supplemental documents. Required elements that are not included in the BFF QAPP or the supplemental documents are discussed in the text of this document.

The following supplemental documents are referenced as part of this cross reference exercise:

- *Bulk Fuels Facility Health and Safety Plan* (HSP [USAF, 2009a]);
- *Remediation and Site Investigation Report for the Bulk Fuels Facility, April through September 2009* (RI [USAF, 2009b]);
- *Operations and Maintenance Manual for the Soil Vapor Extraction Systems, Bulk Fuels Facility* (O&M [USAF, 2009c]);
- *Stage 2 Abatement Plan* (S2AP [USAF, 2007]); and
- *Base-Wide Plans for Investigations under Environmental Restoration Program* (BWP ERP [USAF, 2004]).

Table 1. Cross Reference between the Kirtland AFB Bulk Fuels Facility QAPP Sections and Associated UFP Worksheets (Page 1 of 4)

UFP QAPP Sections	Elements	Required Information	BFF QAPP Sections and/or Supplemental Documents	Associated UFP Worksheets
Project Management Objectives				
2.1	Title and Approval Page	Title and Approval Page	Title Page	#1
2.2	Document Format and Table of Contents	Table of Contents QAPP Identifying Information	Pages v-viii; Section 1	#2
2.2.1	Document Control Format			
2.2.2	Document Control Numbering System			
2.2.3	Table of Contents			
2.2.4	QAPP Identifying Information			
2.3	Distribution List and Project Personnel Sign Off Sheet	Distribution List Projet Personnel Sign Off Sheet	*Outlined Herein;* Preface	#3, #4
2.3.1	Distribution List			
2.3.2	Project Personnel Sign Off Sheet			
2.4	Project Organization		*Outlined Herein*	#5, #6, #7, #8
2.4.1	Organization Chart	Project Organizational Chart		
2.4.2	Communication Pathways	Communcation Pathways	Section 3.2 of BFF HSP (USAF, 2009a)	
2.4.3	Personnel Responsibilities and Qualifications	Personnel Responsibilities and Qualifications; Special Personnel Training Requirements Table	Section 3.1 USAF, 2009a; Appendix D of BWP ERP (USAF, 2004)	
2.4.4	Special Training Requirements and Certification			
2.5	Project Planning and Problem Definition	Project Planning Session Documentation (including Data Needs Table)	Historical n/a	#9, #10
2.5.1	Project Planning (Scoping)			
2.5.2	Problem Definition, Site History and Background	Problem Definition, Site History and Background. Site Maps (historical and current)	Section 1.1 of the RI (USAF, 2009b); Pages 1-3 of USAF, 2009a; USAF, 2004; and the O&M (USAF, 2009c)	

Table 1. Cross Reference between the Kirtland AFB Bulk Fuels Facility QAPP Sections and Associated UFP Worksheets (Page 2 of 4)

UFP QAPP Sections	Elements	Required Information	BFF QAPP Sections and/or Supplemental Documents	Associated UFP Worksheets
Project Management Objectives				
2.6 2.6.1	Project Quality Objectives and Measurement Performance Criteria Development of Project Quality Objectives Using the Systematic Planning Process	Site Specific Project Quality Objectives	USAF, 2009b; S2AP (USAF, 2007)	#11, #12
2.6.2	Measurement Performance Criteria	Measurement Performance Criteria Table	BFF QAPP Sections 2 through 4, Section 12, and Tables 4-2 through 4-31	
2.7	Secondary Data Evaluation	Sources of Secondary Data and Information and Secondary Data Criteria and Limitations Table	USAF, 2009b and USAF, 2007	#13
2.8	Project Overview and Schedule	Summary of Project Tasks	USAF, 2009b USAF, 2009a USAF, 2007 and subsequent addendums	#14, #15, #16
2.8.1	Project Overview	Reference Limits and Evaluation Table	BFF QAPP Section 4 Tables 4-2 through 4-21	
2.8.2	Project Schedule	Project Schedule and Timeline Table	*Outlined Herein*	
Measurement and Data Acquisition				
3.1	Sampling Tasks	Sampling Design and Rationale	USAF, 2009b; USAF, 2009c; Appendix A of USAF, 2004	#17, #18, #19, #20, #21, #22
3.1.1	Sampling Process Design and Rationale	Sample Location Map		
3.1.2	Sampling Procedures and Requirements	Sampling Locations and Methods/SOP Requirements Table	BFF QAPP Table 3-1	
3.1.2.1	Sampling Collection Procedures			
3.1.2.2	Sample Containers, Volume, and Preservation			
3.1.2.3	Equipment and Sample Containers Cleaning and Decontamination Procedures	Analytical Methods and SOP Requirements Table	BFF QAPP Table 3-1 and *Outlined Herein*	
3.1.2.4	Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures	Field Quality Control Sample Summary Table	BFF QAPP Section 2.3 and *Outlined Herein*	
3.1.2.5	Supply Inspection and Acceptance Procedures	Sampling SOPs and Project Sampling SOP Reference Table	Appendix B of USAF, 2007	
3.1.2.6	Field Documentation Procedures	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	BFF QAPP Section 5 and Appendix A of USAF, 2004	

Table 1. Cross Reference between the Kirtland AFB Bulk Fuels Facility QAPP Sections and Associated UFP Worksheets (Page 3 of 4)

UFP QAPP Sections	Elements	Required Information	BFF QAPP Sections and/or Supplemental Documents	Associated UFP Worksheets
Measurement and Data Acquisition				
3.2	Analytical Tasks	Analytical SOPs, and Analytical SOP Reference Table	Available upon request from the laboratory; *Outlined Herein*	#23, #24, #25
3.2.1	Analytical SOPs			
3.2.2	Analytical Instrument Calibration Procedures	Analytical Instrument Calibration Table	Section 4 Tables 4-22 through 4-31	
3.2.3	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	BFF QAPP Sections 5 and 8	
3.2.4	Analytical Supply Inspection and Acceptance Procedures			
3.3	Sample Collection Documentation, Handling, Tracking and Custody Procedures	Sample Collection Documentation, Handling, Tracking and Custody SOPs; Sample Container Identification	BFF QAPP Sections 2.4, 3.2-3.4, Attachment 2 and Appendix A and B of USAF, 2004, and *Outlined Herein*	#26, #27
3.3.1	Sample Collection Documentation	Sample Handling Flow Diagram, and Example Chain-of-Custody Forms		
3.3.2	Sample Handling and Tracking System			
3.3.3	Sample Custody			
3.4	Quality Control (QC) Samples	QC Samples Table	BFF QAPP Section 4 Tables 4-22 through 4-31, and Appendix A of USAF, 2004	#28
3.4.1	Sampling QC Samples			
3.4.2	Analytical Quality Control Samples			
3.5	Data Management Tasks	Project Documents and Records Table	BFF QAPP Sections 6 and 12; USAF, 2009a, USAF, 2009c, and Appendix A and D of USAF, 2004, and *Outlined Herein*	#29, #30
3.5.1	Project Doumentation and Records			
3.5.2	Data Package Deliverables			
3.5.3	Data Reporting Formats			
3.5.4	Data Handling and Management	Analytical Services Table		
3.5.5	Data Tracking and Control			
Assessment/Oversight				
4.1	Assessments and Response Actions	Planned Project Assessments Table	BFF QAPP Sections 6, 7, and 10	#31, #32
4.1.1	Planned Assessments	Audit Checklists		
4.1.2	Assessment Findings and Corrective Action Responses	Assessment Findings and Corrective Action Responses Table		
4.2	QA Management Reports	QA Management Reports Table	BFF QAPP Section 11	#33
4.3	Final Project Report			

Table 1. Cross Reference between the Kirtland AFB Bulk Fuels Facility QAPP Sections and Associated UFP Worksheets (Page 4 of 4)

UFP QAPP Sections	Elements	Required Information	BFF QAPP Sections and/or Supplemental Documents	Associated UFP Worksheets
Overview				
5.1	Overview	Verification (Step I) Process Table Validation (Steps IIa and IIb) Summary Table Usability Assessment	BFF QAPP Section 4 and 6 Tables 4-22 through 4-31 and Tables 6-1 and 6-2	#34, #35, #36, #37
5.2	Data Review Steps			
5.2.1	Step I: Verification			
5.2.2	Step II: Validation			
5.2.2.1	Step IIa: Validation Activities			
5.2.2.2	Step IIb: Validation Activities			
5.2.3	Step III: Usability Assessment			
5.2.3.1	Data Limitations and Actions from Usability Assessment			
5.2.3.2	Activities			
5.3	Streamlining Data Review		Not addressed	
5.3.1	Data Review Steps to be Streamlined			
5.3.2	Criteria for Streamlining Data Review			
5.3.3	Amounts and Types of Data Appropriate for Streamlining			
BFF	Bulk Fuels Facility			
BWP	Base-Wide Plan			
ERP	Environmental Restoration Program			
HSP	Health and Safety Plan			
n a	Not Applicable			
O&M	Operations and Maintenance (manual)			
QA	Quality Assurance			
QAPP	Quality Assurance Project Plan			
QC	Quality Control			
RI	Remediation Investigation			
S2AP	Stage 2 Abatment Plan			
SOP	Standard Operating Procedures			
UFP	Uniform Federal Policy			

Distribution List

Mark Holmes/Kirtland AFB
2050 Wyoming Blvd SE Suite 124
Kirtland AFB, NM 87117-5270
(505) 846-9005
mark.holmes@kirtland.af.mil

Michael Litman/AFCEE
2261 Hughes Ave.
Building 171, Suite 155
Lackland AFB, TX 78236-9853
michael.litman@us.af.mil

Sharon Minchak/CH2M HILL
4041 Jefferson Plaza NE Suite #200
Albuquerque, NM 87109
(505) 884-1682 x35740
Sharon.Minchak@ch2m.com

Jeffrey Johnston/CH2M HILL
4041 Jefferson Plaza NE Suite #200
Albuquerque, NM 87109
(505) 884-1682 x35727
Jeffrey.Johnston@ch2m.com

Project Organization

Kirtland AFB Project Manager
Mark Holmes, KAFB project manager, has overall responsibility for meeting KAFBs objectives. Oversees the projects occurring on-site.

CH2M HILL Site Manager
Sharon Minchak, CH2M HILL's site manager (SM), is responsible for implementing the projects. She is authorized to commit the resources necessary to meet project objectives and requirements. The SM has the following responsibilities:

- Defining site specific project objectives and developing detailed work plans and schedules;
- Establishing project policy and procedures to address the specific needs of the projects as a whole, as well as the particular objectives of each task;
- Reviewing and analyzing overall task performance with regard to schedule and budget;
- Reviewing external reports (deliverables) before their submission to AFCEE; and
- Representing the project team at meetings and public hearings.

CH2M HILL Project Manager

Jeff Johnston, CH2M HILL's project manager, have overall responsibility for all phases of the investigation at the site. Specific responsibilities include the following:

- Oversee and monitor performance of staff and subcontractors;
- Plan the activities of and coordinate field personnel on specific assignments;
- Serve as a liaison between USACE, field, laboratory staff, and any other subcontractors;
- Effectively carry out the Quality Control Plan (QCP) and this QAPP;
- Ensure completion of corrective actions, as needed ;
- Maintain and track project schedule and budget; and
- Coordinate and prepare all required plans, proposals, and reports.

CH2M HILL Project Chemist

Shane Lowe, CH2M HILL's project chemist, is responsible for tracking data, overseeing the data evaluation, and data management tasks. Her specific responsibilities include the following:

- Approve and maintain adherence to QA/QC requirements specified in this QAPP;
- Provide guidance regarding environmental analytical chemistry methods and QC procedures applicable to environmental analytical chemistry;
- Manage project tasks associated with the coordination of sample collection and analysis with the Field Team Lead (FTL); act as the liaison between the FTL and laboratories;
- Manage sample tracking, sample analysis, and data reporting from each laboratory;
- Coordinate or perform validation of the analytical data;
- Perform quality audits and surveillance, prepare QA reports, implement QC activities, and suggest corrective actions, as necessary;
- Evaluate data usability;
- Communicate QA/QC issues to the Project Manager and the FTL;
- Recommend resolution for any anomalies or out-of-control events that arise during the analysis of samples;
- Coordinate with the FTL to facilitate data transfer into the project database; and
- Coordinate the output of data from the database to the data users (for example, PM and technical staff) and provide QC for all data outputs.

CH2M HILL Health and Safety Lead

Stephanie DeWitt, CH2M HILL's Health and Safety lead, is responsible for the development of the Health and Safety Plan (HSP) for the Fuels Facility.

CH2M HILL Project Team

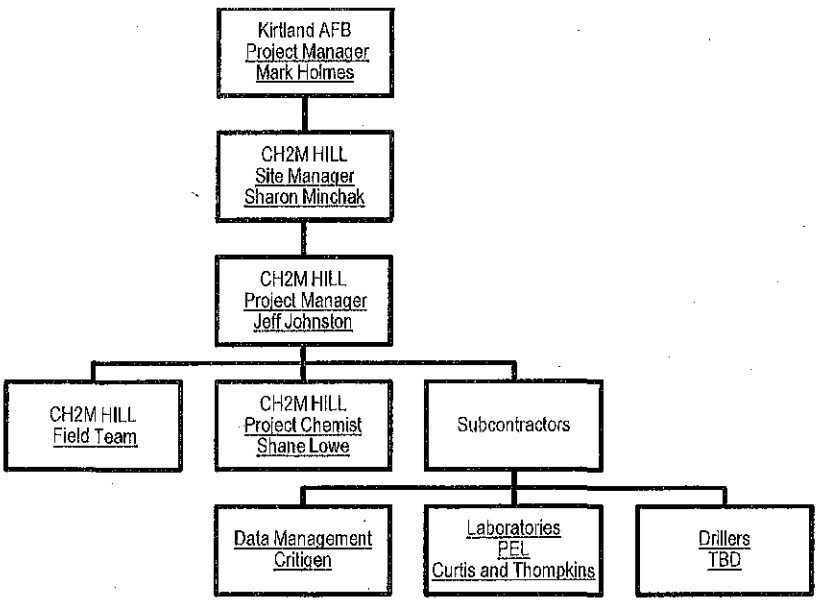
Field staff and analysts are responsible for executing their work assignments in strict conformance to documented procedures and for immediately identifying any conditions adverse to the quality performance of the work or work products. They are responsible for acquainting themselves with the technical requirements of any work assigned and seeking training or guidance as necessary to comply with those requirements. They are responsible for documenting their activities according to applicable Standard Operating Procedures (SOPs) and reviewing their own work and the work of others presented to them for peer review. They will immediately cause work to cease on any activity that, in their judgment, does not meet applicable quality and safety standards, will appropriately document and report such conditions to management, and will be active in the resolution of any such conditions. Specific responsibilities include the following:

- Ensure that all work is performed according to the applicable specifications;
- Ensure that QC measures are being carried out and documented;
- Ensure the quality of work and work products; and
- Communicate QA/QC and safety concerns to management.

Subcontractors/Vendors

CH2M HILL will be responsible as prime contractor for overall program and project management, administration, and reporting. CH2M HILL personnel will manage all field components of the project. Laboratory chemical analysis, data management, and drilling services will be performed under CH2M HILL supervision by separate vendors.

The PM will maintain ultimate control and accountability for the project by means of formal subcontract and purchase agreements and through directives and communication with the respective firms' project management staff. CH2M HILL will purchase services for this project as discussed in the following sections. Each agreement will require conformance to these project plans without deviation.



Project Schedule

Air and water samples will be collected on a quarterly schedule; however, there may be instances where additional sampling occurs outside the schedule due to changes in project scope. Soil samples are collected periodically throughout the year. The proposed numbers of samples to be collected quarterly at each site are presented in Table 2. The sampling schedule is presented in Table 3.

Table 2. Number of Samples per Quarter

Parameter	Method	Number of Samples	Rinsate	Field Duplicates	MS	MSD	Trip Blanks	Total Number of Samples
Air Samples								
VOCs	TO15	9	NA	1	NA	NA	NA	10
TPH-Gasoline	SW8015M	9	NA	1	NA	NA	NA	10
Fixed Gases	SM2720C	9	NA	1	NA	NA	NA	10
Water Samples								
VOCs	SW8260B	75	4	8	4	4	TBD[a]	95
1,2-dibromoethane (EDB)	SW8011/E504.1	75	4	8	4	4	TBD	95
Gasoline Range Organics (GRO)	SW8015B	38	2	4	4	4	NA	52
Diesel Range Organics (DRO)	SW8015B	38	2	4	4	4	NA	52
SVOCs	SW8270C	38	2	4	4	4	NA	52
PAH	SW8310/SW8270 SIM	38	2	4	4	4	NA	52
Dissolved Fe/Mn	SW8260	38	2	4	4	4	NA	52
Nitrate/Sulfate	SW9056/E300.0	38	2	4	4	4	NA	52
Alkalinity	E310.1	38	2	4	4	4	NA	52
Soil Samples								
VOCs	SW8260B	TBD	TBD	TBD	TBD	TBD	TBD	TBD
SVOCs	SW8270C	TBD	TBD	TBD	TBD	TBD	NA	TBD
PAHs	SW8310/SW8270 SIM	TBD	TBD	TBD	TBD	TBD	NA	TBD
GRO	SW8015B	TBD	TBD	TBD	TBD	TBD	TBD	TBD
DRO	SW8015B	TBD	TBD	TBD	TBD	TBD	NA	TBD

[a] TBD To be determined in the field

VOC Volatile organic compounds
SVOC Semivolatile organic compounds
PAH Polyaromatic hydrocarbons

TABLE 3. Sampling Schedule 2010

Matrix	Q1	Q2	Q3	Q4
Air	February	May	August	November
Water	January	April	July	October
Soil[a]	TBD	TBD	TBD	TBD
[a] Soil samples are collected periodically throughout the year.				

Analytical SOPs

Samples will be analyzed by one or more of the analytical SOPs listed in Table 4 and are available upon request. Analytical methods not addressed in the QAPP will be documented in a Statement of Work to the laboratory.

Supplemental Information

The works cited throughout this document are referenced in Attachment 1.

Chain of Custody

Examples of the laboratories Chain of Custody forms are presented in Attachment 2.

Table 4. Analytical Standard Operating Procedures (Page 1 of 2)

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data [a]	Analytical Group	Instrument	Laboratory	Modified for Project Work? (yes/no)
1	ICP/GFAA Prep	Definitive	Metals	ICP/GFAA	PEL	No
2	ICP by 6010	Definitive	Metals	ICP	PEL	No
3	SW3510C Separatory Funnel Extraction	Definitive	SVOCs/PAH	GC/HPLC	PEL	No
4	Pressurized Fluid extraction method 3545 and 3545A	Definitive	SVOCs	GC/HPLC	PEL	No
5	Semivolatiles by 8270	Definitive	SVOCs	GC/MS	PEL	No
6	PAHs by SW8310	Definitive	PAHs	HPLC	PEL	No
7	GC/MS Volatile Organics (SW8260B)	Definitive	VOCs	GC/MS	PEL	No
8	Alkalinity, Titrimetric SM 2320B / 310.1	Definitive	Wet Chemistry	NA	PEL	No
9	GC Volatile Organics GRO Method (SW-846 8015C)	Definitive	VOC	GC	PEL	No
10	Sample Analysis for 1,2-Dibromoethane & 1,2-Dibromo-3-Chloropropane by Microextraction and Gas Chromatography (SW-846 8011)	Definitive	VOC	GC	PEL	No
11	Sample Preparation: EDB - Extraction by Method 8011	Definitive	VOC	GC	PEL	No
12	Analysis of Aqueous and Soil Samples for Diesel Range Organics by Gas Chromatography by Method 8015	Definitive	SVOC	GC	PEL	No
13	Sample analysis: Common Anions by Ion Chromatography (Method 300.1)	Definitive	Wet Chemistry	IC	PEL	No
14	Sample analysis; 8310 HPLC Semi-Volatile Organics	Definitive	PAH	HPLC	PEL	No
15	Anions Ion Chromatography Method EPA 300.0	Definitive	Wet Chemistry	IC	Curtis and Thompkins, LTD	No
16	Total Extractable Hydrocarbons by SW8015B/D	Definitive	SVOC	GC	Curtis and Thompkins, LTD	No
17	TVH and MBTEX	Definitive	VOCs	GC/FID-PID	Curtis and Thompkins, LTD	No
18	PAH and 1,4-dioxane by SW8270 SIM	Definitive	PAH/SVOC	GC/MS	Curtis and Thompkins, LTD	No
19	Base/Neutrals and acids by SW8270	Definitive	SVOC	GC/MS	Curtis and Thompkins, LTD	No
20	Alkalinity, SMWW 18:2320B/EPA 310.1	Definitive	Wet Chemistry	NA	Curtis and Thompkins, LTD	No

Table 4. Analytical Standard Operating Procedures (Page 2 of 2)

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data [a]	Analytical Group	Instrument	Laboratory	Modified for Project Work? (yes/no)
21	ICP Metals	Definitive	Metals	ICP-AES	Curtis and Thompkins, LTD	No
22	VOCs by GCMS	Definitive	VOC	GC/MS	Curtis and Thompkins, LTD	No
23	Analytical Method for the Determination of Volatile Organics in Air by method TO-14A / TO-15 using canisters and GC/MS in SCAN or SIM mode	Definitive	VOC	GC/MS	Applied Sciences	No
24	Standard Operating Procedure for the Determination of Total Volatile Hydrocarbons as Gasoline Range Organics in Air by SW 8015M, and/or EPA TO-3M	Definitive	VOC	GC/FID	Applied Sciences	No
25	Standard Operating Procedure for the Determination of Atmospheric Gases in ambient air by Gas Chromatography/Thermoconductivity Detection (GC/TCD)	Definitive	Fixed Gas	GC/TCD	Applied Sciences	No

[a] Definitive= generated using approved EPA reference methods. Data are analyte-specific, and both identification and quantitation are confirmed. Screening= generated by rapid methods of analysis with less rigorous sample preparation, calibration and/or QC requirements as definitive data.

ATTACHMENT 1

Supplemental Documents

Supplemental Documents Referenced

USAF, 2009a. *Health and Safety Plan, Bulk Fuels Facility.* U.S. Air Force, Kirtland Air Force Base. February 2009.

USAF, 2009b. *Remediation and Site Investigation Report for the Bulk Fuels Facility, April through September 2009.* U.S Air Force, Kirtland Air Force Base. December.

USAF, 2009c. *Operations and Maintenance Manual for the Soil Vapor Extraction Systems, Bulk Fuels Facility(O&M).* U.S. Air Force, Kirtland Air Force Base. August 2009.

USAF, 2007. *Stage 2 Abatement Plan Modification Bulk Fuels Facility (ST106).* U.S. Air Force, Kirtland Air Force Base. August 2007.

USAF, 2004. *Base-Wide Plans for Investigations under the Environmental Restoration Program (ERP) Update.* U.S. Air Force, Kirtland Air Force Base. April 2004.

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ATTACHMENT 2

Sample Chain-of-Custody Forms

PEL

CHAIN OF CUSTODY RECORD

Page _____ of _____

Special Handling:
TAT- Indicate Date Needed: _____
- All TATs subject to laboratory approval
- Min. 24-hour notification needed for rushes.
- Samples disposed of after 60 days unless otherwise instructed.

Report To: _____

Project Mgr.: _____

Invoice To: _____

P.O. No.: _____ RQN: _____

Project No.: _____

Site Name: _____

Location: _____ State: _____

Sampler(s): _____

1=Na_2S2O_3 2=HCl 3=H_2SO_4 4=HNO_3 5=NaOH 6=Ascorbic Acid 7=CH3OH
8=$NaHSO_4$ 9= 10= 11=

List preservative code below:

DW-Drinking Water GW-Groundwater WW-Wastewater
O/Oil SW-Surface Water SO-Soil SL-Sludge A-Air
X1 _____ X2 _____ X3 _____

G=Grab C=Composite

Lab Id:	Sample Id:	Date:	Time:	Type	Matrix	# of VOA Vials	# of Amber Glass	# of Clear Glass	# of Plastic	Analyses:	

Containers:

Notes:

QA/QC Reporting Level
☐ Level I ☐ Level II
☐ Level III ☐ Level IV
☐ Other

State specific reporting standards: _____

☐ E-mail to _____

EDD Format _____

Condition upon receipt: ☐ Iced ☐ Ambient ☐ °C _____

Relinquished by:	Received by:	Date:	Time:

8405 Benjamin Road, Suite A • Tampa, Florida 33634 • 813-888-9507 • FAX 813-889-7128 • www.pelab.com

CH2MHILL Applied Sciences Lab
CVO 2300 NW Walnut Boulevard
Corvallis, OR 97330-3538
(541) 768-3120 FAX (541) 752-0276

*CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES*

COC # ____________

Project # or Purchase Order #	
Project Name	
Company Name	
Project Manager or Contact & Phone #	Report Copy to:

Turnaround Time: ☐ 24 Hours ☐ 48 Hours ☐ 72 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days

Drinking Water? Yes ☐ No ☐

Sample Disposal: Dispose ☐ Return ☐

TOTAL # OF CONTAINERS

Requested Analytical Method #

THIS AREA FOR LAB USE ONLY

Lab #	Page	of

Preservative

EPA Tier QC Level: 1 (Screening) 2 3 4

Sampling: Date	Time	Type: COMP	GRAP	Matrix: WATER	SOIL	AIR	CLIENT SAMPLE ID	TOTAL # OF CONTAINERS	UNPRES.	H_2SO_4	HNO_3	HCl	NaOH	ZnAc/NaOH				Alternate Description	Lab ID

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Volatile Contaminants/Odorous ☐ Biohazard ☐ Other ____________

Relinquished By	Date/Time	Received By		Date/Time
Sampled By and Title (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)		Date/Time
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)		Date/Time
Received By (Please sign and print name)	Date/Time	Shipped Via UPS Fed-Ex Other ______	Shipping #	
Special Instructions:				

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original - LAB, Yellow - LAB, Pink - Client
REV 10/2009 LAB FORM 340

CH2MHILL Applied Sciences Lab
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

CVO 2300 NW Walnut Boulevard
Corvallis, OR 97330-3638
(541) 768-3120 FAX (541) 752-0276

COC #_____

Project # or Purchase Order #			Requested Analytical Method #								THIS AREA FOR LAB USE ONLY		
Project Name											Lab #	Page	of
Company Name													
Project Manager or Contact & Phone #	Report Copy to:												
Turnaround Time: ☐ 24 Hours ☐ 48 Hours ☐ 72 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days	Drinking Water? Yes ☐ No ☐	Sample Disposal: Dispose ☐ Return ☐											
Sampling: Date / Time	Type: COMP / GRAB	Matrix: WATER / SOIL / AIR	CLIENT SAMPLE ID	TOTAL # OF CONTAINERS	Preservative: UNPRES.	H_2SO_4	HNO_3	HCl	NaOH	ZnAc/NaOH			EPA Tier QC Level: 1 (Screening) 2 3 4
													Alternate Description / Lab ID

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Volatile Contaminants/Odorous ☐ Biohazard ☐ Other _____

Relinquished By	Date/Time	Received By	Date/Time
Sampled By and Title (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name)	Date/Time	Shipped Via: UPS Fed-Ex Other _____ / Shipping #	

Special Instructions:

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