# Title and Signature Page

| | |
|---|---|
| Title of Plan: | **QUALITY ASSURANCE PROJECT PLAN**<br>**ENBRIDGE MARSHALL RELEASE PROJECT** |
| Implemented By: | **ENBRIDGE ENERGY, LIMITED PARTNERSHIP(ENBRIDGE)** |
| Effective Date: | **July 2010** |

| | |
|---|---|
| Project Coordinator/Manager | Date |
| Project Chemist | Date |
| Quality Assurance Officer | Date |
| United States Environmental Protection Agency On Scene Coordinator | Date |

By signing this page, the individual agrees to the conditions of this Quality Assurance Project Plan.

# TABLE OF CONTENTS


Section 1 Project Management ..... 1-1
1.1 Introduction ..... 1-1
1.1.1 Project/Task Organization ..... 1-1
1.1.1.1 Management Responsibilities ..... 1-1
1.1.1.2 Quality Assurance Responsibilities ..... 1-2
1.1.1.3 Technical Personnel Responsibilities ..... 1-3
1.1.1.4 Laboratory Responsibilities ..... 1-3
1.1.1.5 Field Responsibilities ..... 1-3
1.1.2 QAPP Distribution List ..... 1-4
1.2 Problem Definition/Background Information ..... 1-4
1.2.1 Overall Project Objectives ..... 1-4
1.2.2 Site / Facility Description ..... 1-5
1.2.3 Site / Facility History ..... 1-5
1.3 Project/Task Description and Schedule ..... 1-5
1.3.1 Project Schedule ..... 1-5
1.4 Quality Assurance Objectives for Measurement of Data ..... 1-5
1.4.1 Precision ..... 1-5
1.4.1.1 Definition ..... 1-5
1.4.1.2 Field Precision Objectives ..... 1-5
1.4.1.3 Laboratory Precision Objectives ..... 1-6
1.4.2 Accuracy ..... 1-6
1.4.2.1 Definition ..... 1-6
1.4.2.2 Field Accuracy Objectives ..... 1-6
1.4.2.3 Laboratory Accuracy Objectives ..... 1-6
1.4.3 Completeness ..... 1-6
1.4.3.1 Definition ..... 1-6
1.4.3.2 Field Completeness Objectives ..... 1-7
1.4.3.3 Laboratory Completeness Objectives ..... 1-7
1.4.4 Representativeness ..... 1-7
1.4.4.1 Definition ..... 1-7
1.4.4.2 Measures to Ensure Representativeness of Field Data . 1-7
1.4.4.3 Measures to Ensure Representativeness of Laboratory Data 1-7
1.4.5 Comparability ..... 1-7
1.4.5.1 Definition ..... 1-7
1.4.5.2 Measures to Ensure Comparability of Field Data ..... 1-8
1.4.5.3 Measures to Ensure Comparability of Laboratory Data 1-8
1.4.6 Sensitivity ..... 1-8
1.4.6.1 Definition ..... 1-8
1.4.6.2 Sensitivity Requirements for Field Data ..... 1-8
1.4.6.3 Sensitivity Requirements for Laboratory Data ..... 1-8
1.5 Special Training Requirements and Certification ..... 1-8
1.5.1 Training ..... 1-8
1.5.2 Certification ..... 1-9

# TABLE OF CONTENTS


1.6 Documents and Records ..... 1-9
1.6.1 Data Reporting Format and Content ..... 1-9
1.6.2 Records Disposition ..... 1-9
1.6.3 Use of Historic Data ..... 1-10

Section 2 Data Generation and Acquisition ..... 2-1
2.1 Sampling Process Design ..... 2-1
2.1.1 Sampling Procedures and Methods ..... 2-1
2.1.2 Custody Procedures ..... 2-1
2.1.2.1 Field Custody and Documentation Procedures ..... 2-1
2.1.2.2 Laboratory Custody Procedures ..... 2-4
2.1.2.3 Final Evidence File ..... 2-4
2.2 Analytical Methods ..... 2-4
2.2.1 Field Analytical Procedures ..... 2-4
2.2.2 Laboratory Analytical Procedures ..... 2-5
2.2.2.1 Volatile Organic Compounds (VOCs) ..... 2-5
2.2.2.2 Semivolatile Organic Compounds (SVOCs) ..... 2-5
2.2.2.3 Polynuclear Aromatic Hydrocarbons (PAHs) ..... 2-6
2.2.3 Field Quality Control Checks ..... 2-6
2.2.4 Laboratory Quality Control Checks ..... 2-6
2.2.5 Level of Quality Control Effort ..... 2-7
2.2.6 Level of Quality Assurance Effort ..... 2-7
2.3 Calibration Procedures and Frequency ..... 2-8
2.3.1 Field Instrument Calibration ..... 2-8
2.3.2 Laboratory Instrument Calibration ..... 2-8
2.4 Preventive Maintenance ..... 2-8
2.4.1 Field Instrument Preventive Maintenance ..... 2-8
2.4.2 Laboratory Instrument Preventive Maintenance ..... 2-9
2.4.3 Inspection/Acceptance Requirements for Supplies and Consumables ..... 2-9

Section 3 Assessment and Oversight ..... 3-1
3.1 Field Performance and System Audits ..... 3-1
3.1.1 Internal Field Audits ..... 3-1
3.1.1.1 Internal Field Audit Responsibilities ..... 3-1
3.1.1.2 Internal Field Audit Frequency ..... 3-1
3.1.1.3 Internal Field Audit Procedures ..... 3-1
3.1.2 External Field Audits ..... 3-1
3.1.2.1 External Field Audit Responsibilities ..... 3-1
3.1.2.2 External Field Audit Frequency ..... 3-1
3.1.2.3 External Field Audit Procedures ..... 3-2
3.2 Performance and System Audits ..... 3-2
3.2.1 Performance Audits ..... 3-2
3.2.2 System Audits ..... 3-2
3.2.3 Audit Records ..... 3-2

# TABLE OF CONTENTS


3.3 Laboratory Performance and Systems Audits ..... 3-3
3.3.1 Internal Laboratory Audits ..... 3-3
3.3.1.1 Internal Laboratory Audit Responsibilities ..... 3-3
3.3.1.2 Internal Laboratory Audit Frequency ..... 3-3
3.3.1.3 Internal Laboratory Audit Procedures ..... 3-3
3.3.2 External Laboratory Audits ..... 3-3
3.3.2.1 External Laboratory Audit Responsibilities ..... 3-3
3.3.2.2 External Laboratory Audit Frequency ..... 3-3
3.3.2.3 Overview of the External Laboratory Audit Process ..... 3-3
3.4 Specific Routine Procedures Used to Evaluate Data Precision, Accuracy, and Completeness ..... 3-4
3.4.1 Accuracy Assessment ..... 3-5
3.4.2 Precision Assessment ..... 3-5
3.4.3 Completeness Assessment ..... 3-6
3.5 Overall Assessment of Data ..... 3-6
3.6 Corrective Actions ..... 3-7
3.6.1 Field Corrective Action ..... 3-7
3.6.2 Laboratory Corrective Action ..... 3-8
3.6.3 Corrective Action During Data Review/Validation and Assessment ..... 3-8
3.7 Quality Assurance Reports to Management ..... 3-8
3.7.1 Contents of Project QA Reports ..... 3-8

Section 4 Data Validation and Usability ..... 4-1
4.1 Data Reduction ..... 4-1
4.1.1 Field Data Reduction Procedures ..... 4-1
4.1.2 Laboratory Data Reduction Procedures ..... 4-1
4.2 Data Review and Validation ..... 4-1
4.3 Data Reporting ..... 4-2
4.3.1 Field Data Reporting ..... 4-2
4.3.2 Laboratory Data Reporting ..... 4-2
4.3.2.1 Case Narrative ..... 4-2
4.3.2.2 Chemistry Data Package ..... 4-3
4.4 Data Assessment ..... 4-3

Section 5 References ..... 5-1

# TABLE OF CONTENTS

List of Tables


Table 1-1 Quality Control Level of Effort for Analytical Testing

Table 1-2 Laboratory Control Sample Accuracy and Precision Criteria for VOC Analysis

Table 1-3 MS/MSD Accuracy and Precision Criteria for VOC Analysis

Table 1-4 Laboratory Control Sample Accuracy and Precision Criteria for SVOC Analysis

Table 1-5 MS/MSD Accuracy and Precision Criteria for SVOC Analysis

Table 1-6 Laboratory Control Sample Accuracy and Precision Criteria for PAH Analysis

Table 1-7 MS/MSD Accuracy and Precision Criteria for PAH Analysis

Table 1-8 Laboratory Control Sample Accuracy and Precision Criteria for Nitroaromatic/Nitramine Analysis

Table 1-9 MS/MSD Accuracy and Precision Criteria for Nitroaromatic/Nitramine Analysis

Table 1-10 Laboratory Control Sample Accuracy and Precision Criteria for Organochlorine Pesticide/Polychlorinated Biphenyl Analysis

Table 1-11 MS/MSD Accuracy and Precision Criteria for Organochlorine Pesticide/Polychlorinated Biphenyl Analysis

Table 1-12 Laboratory Control Sample Accuracy and Precision Criteria for Metals Analysis

Table 1-13 MS/MSD Accuracy and Precision Criteria for Metals Analysis

Table 1-14 Surrogate Compound Accuracy Criteria for Organic Parameters

Table 1-15 Laboratory Analytical Methods

Table 1-16 Method Detection Limits and Reporting Limits for Soil/Sediment Samples Analyzed for VOCs

Table 1-17 Method Detection Limits and Reporting Limits for Soil/Sediment Samples Analyzed for SVOCs

Table 1-18 Method Detection Limits and Reporting Limits for Soil/Sediment Samples Analyzed for PAHs

Table 1-19 Method Detection Limits and Reporting Limits for Soil/Sediment Samples Analyzed for Nitroaromatics/Nitramines

Table 1-20 Method Detection Limits and Reporting Limits for Aqueous Samples Analyzed for Nitroaromatics/Nitramines

Table 1-21 Method Detection Limits and Reporting Limits for Soil/Sediment Samples Analyzed for Organochlorine Pesticides/Polychlorinated Biphenyls

Table 1-22 Method Detection Limits and Reporting Limits for Aqueous Samples Analyzed for Organochlorine Pesticides/Polychlorinated Biphenyls

Table 1-23 Method Detection Limits and Reporting Limits for Soil/Sediment Samples Analyzed for Metals

# TABLE OF CONTENTS


Table 1-24 Method Detection Limits and Reporting Limits for Aqueous Samples Analyzed for Metals

Table 1-25 Method Detection Limits and Reporting Limits for Samples Analyzed by USEPA Methods 1613b and 1613 RT/TRP

Table 2-1 Sample Containers, Preservation and Holding Times

Table 4-1 Data Review/Validation Criteria for USEPA Methods SW8260B, SW8270C, and SW8270C-SIM

Table 4-2 Data Review/Validation Criteria for USEPA Methods SW8081A, SW8082, and SW8330

Table 4-3 Data Review/Validation Criteria for USEPA Methods 6010B and 7470A/7471A

Table 4-4 Validation Criteria for USEPA Method 1613b

Table 4-5 Validation Criteria for USEPA Method 1613 RT/TRP

# TABLE OF CONTENTS

## Acronyms and Abbreviations

| | |
|---|---|
| µg | Microgram(s) |
| %D | Percent Difference |
| %R | Percent Recovery |
| ADR | Automated Data Review |
| APPL | Agriculture and Priority Pollutant Laboratories, Inc. |
| °C | Degrees Celsius |
| CCC | Calibration Check Compounds |
| CCV | Continuing Calibration Verification |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| CLP | Contract Laboratory Program |
| COC | Chain-of-Custody |
| COD | Coefficient of Determination |
| COPC | Compound of Potential Concern |
| CQCP | Contractor Quality Control Plan |
| CV | Calibration Verification |
| CVAA | Cold Vapor Atomic Absorption |
| DDT | Dichloro-Diphenyl-Trichloroethane |
| DOD | Department of Defense |
| DQO | Data Quality Objective |
| ECD | Electron Capture Detector |
| EDD | Electronic Data Deliverable |
| EMAX | EMAX Laboratories, Inc. |
| GC/MS | Gas Chromatography and Mass Spectrometer |
| GO/CO | Government Owned/Contractor Operated |
| HAZWOPER | Hazardous Waste Operations and Emergency Response |
| HCl | Hydrochloric acid |
| HDPE | High Density Polyethylene |
| Hg | Mercury |
| $HNO_3$ | Nitric acid |
| ICAL | Initial Calibration |
| ICP | Inductively Coupled Plasma |
| ICS | Interference Check Sample |
| ICV | Internal Calibration Verification |
| IDL | Instrument Detection Limit |

| | |
|---|---|
| IS | Internal Standard |
| **J** | Estimated |
| kg | Kilogram(s) |
| KDHE | Kansas Department of Health and Environment |
| KSAAP | Kansas Army Ammunition Plant |
| LCG | Louisville Chemistry Guideline |
| LCS | Laboratory Control Sample |
| LCSD | Laboratory Control Sample Duplicate |
| LDC | Laboratory Data Consultants, Inc. |
| MDL | Method Detection Limit |
| MS/MD | Matrix Spike/Matrix Duplicate |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| NA | Not Applicable |
| NELAC | National Environmental Laboratory Accreditation Conference |
| NELAP | National Environmental Laboratory Accreditation Program |
| nm | Nanometer |
| OSHA | Occupational Safety and Health Administration |
| PAH | Polynuclear Aromatic Hydrocarbon |
| PCB | Polychlorinated Biphenyl |
| PDS | Post Digestion Spike |
| pH | Hydrion Ion Exponent |
| PM | Project Manager |
| ppb | Part Per Billion |
| QA | Quality Assurance |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| QSM | Quality Systems Manual |
| **R** | Rejected |
| r | Correlation Coefficient |
| RF | Response Factor |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| RRT | Relative Retention Time |
| RSD | Relative Standard Deviation |
| SCFS | Sample Collection Field Sheet |
| SIM | Selected Ion Monitoring |
| SOP | Standard Operating Procedure |

| | |
|---|---|
| SOW | Scope of Work |
| SPCC | System Performance Check Compounds |
| SSHP | Site Safety and Health Plan |
| SAP | Site Sampling and Analysis Plan |
| SVOC | Semivolatile Organic Compound |
| TAL | Target Analyte List |
| TM | Technical Manager |
| **U** | Nondetect |
| **UJ** | Estimated Nondetect |
| URS | URS Corporation |
| USEPA | United States Environmental Protection Agency |
| UV | Ultraviolet |
| VOA | Volatile Organic Analysis |
| VOC | Volatile Organic Compound |

## 1.1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with the Enbridge Marshall Pipeline Release Project to be completed performed in Marshall, Michigan. Specific protocols for sampling, sample handling and storage, chain-of-custody (COC), and laboratory and field analyses are described in this QAPP. All QA/QC procedures are structured in accordance with applicable technical standards and United States Environmental Protection Agency's (USEPA's) requirements, regulations and guidance (Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA]). This QAPP has been prepared in accordance with USEPA *Requirements for Quality Assurance Project Plans* (USEPA 2001), and *Guidance for Quality Assurance Project Plans* (USEPA 2002). The Data Quality Objectives (DQOs) are presented as Attachment 1 in the Site Sampling and Analysis Plan (SAP).

This QAPP is part of the overall Work Plans, which consists of the following documents:

- Work Plan;
- Site Safety and Health Plan (SSHP);
- Pipeline Repair Work Plan;
- Sampling and Analysis Plan (SAP);
- Oil Recovery and Containment Plan;
- Source Release Area Remediation Plan;
- Remediation Plan for Downstream Impacted Areas; and
- Waste Treatment, Transportation and Disposal Plan.

### 1.1.1 Project/Task Organization

The project management team organization is discussed below. The proper names of individuals for the positions identified below will be included in **Section 1.1.2** as an addendum for each project or specific activity.

#### *1.1.1.1 Management Responsibilities*

*Project Coordinator/Manager*

The Project Coordinator/Manager (PCM) is responsible for implementing the project, and has the authority to commit the resources necessary to meet project objectives and requirements. The PCM's primary function is to ensure that technical, financial, and scheduling objectives are achieved successfully. The PCM will:

- Oversee project objectives and develop a detailed work schedule;

- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;
- Acquire and apply technical and corporate resources as needed to ensure performance within budget and schedule constraints;
- Orient all field leaders and support staff concerning the project's special considerations;
- Monitor and direct the field leaders;
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product;
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness;
- Review and analyze overall task performance with respect to planned requirements and authorizations;
- Approve all reports (deliverables) before their submission to USEPA;
- Ultimately be responsible for the preparation and quality of interim and final reports;
- Represent the project team at meetings and public hearings; and
- Submit monthly progress reports.

#### *1.1.1.2 Quality Assurance Responsibilities*

##### *QA Officer*

The QA Officer reports directly to the PCM and will be responsible for ensuring that all procedures for this project are being followed. In addition, the QA Officer will be responsible for the data verification of all sample results from the analytical laboratory. The QA Officer is also responsible for coordination of the Data Validator and integration of all the results into the final documents. The QA officer or designee will complete any field or laboratory audits. Details of the audit procedures are presented in **Section 3**.

##### *Program Health and Safety Officer*

The Health and Safety Officer reports directly to the PCM and will be responsible for ensuring that all safety procedures for this project are being followed.

##### *Data Validator*

The Data Validator reports directly to the Project Chemist and is responsible for the validation of 10% of the investigative data. The Data Validator will submit a validation reports to the QA Officer.

### 1.1.1.3 Technical Personnel Responsibilities

#### Project Health and Safety Officer

The Project Health and Safety Officer is responsible for assisting in the development and thhe implementation of the SSHP for the project and communication of all health and safety issues with the Field Area Coordinators. The Project Health and Safety Officer will address any issues that arise during field operations.

#### Project Chemist

The Project Chemist will be responsible for development of the laboratory SOW, procurement of laboratory services, and the daily communication with the laboratory. Additionally, the Project Chemist will address any chain-of-custody discrepancies or laboratory QA/QC anomalies, complete the data management and data verification, write a quality control summary report (QCSR) summarizing the data verification findings, and determine the usability of the analytical data.

### 1.1.1.4 Laboratory Responsibilities

#### Laboratory QA Officer

The Laboratory QA Officer has the overall responsibility for data generated by that laboratory, as well as the adherence to acceptable practice. The Laboratory QA Officer will communicate data issues through the laboratory project manager. In addition, the Laboratory QA Officer will:

- Oversee laboratory QA;
- Oversee QA/QC documentation;
- Conduct a detailed data review;
- Determine whether to implement laboratory corrective actions, if required;
- Define appropriate laboratory QA procedures; and
- Prepare laboratory Standard Operating Procedures (SOPs).

### 1.1.1.5 Field Responsibilities

#### Area Coordinators

The Area Coordinators are responsible for implementing the Sampling and Analysis Plan (SAP). They are further responsible for field equipment calibration, oversight of sample collection, field documentation, submittal of samples to contract laboratories and preparation of a summary report.

The Area Coordinators are responsible for leading and coordinating the day-to-day activities of the various resource specialists under their supervision. The Area Coordinators are highly experienced environmental/construction professionals and report directly to the PCM. Specific field team leader responsibilities include:

- Day-to-day coordination with the PCM on technical issues in specific areas of expertise;
- Development and implementation of field-related work plans, assurance of schedule compliance, and adherence to management-developed study requirements;
- Coordinating and managing field staff;
- Implementing QC for technical data provided by the field staff including field measurement data;
- Adhering to work schedules provided by the PCM;
- Authoring and approving of text and graphics required for field team efforts;
- Identifying problems at the field team level, resolving difficulties in consultation with the USEPA On Scene Coordinator (OSC) and the PCM, implementing and documenting corrective action procedures, and provision of communication between team and upper management; and
- Participating in preparation of the final report.

### 1.1.2 QAPP Distribution List

The PCM and QA Officer will be responsible for ensuring that each project member has access to the most current version of the QAPP. Documents required as a result of this investigation include laboratory audit reports (if completed), field audit reports (if completed), monthly progress reports, draft-final and final report. The distribution list is as follows:

| Role | Name | Telephone |
|---|---|---|
| Project Coordinator/Manager | Mr. Bob Steele | |
| Project QA/QC Officer | | |
| Project Chemist | | |
| Area Coordinator(s) | | |
| Subcontract Laboratory (ALS) | Mr. Les Arnold | 916.673.1520 |

## 1.2 PROBLEM DEFINITION/BACKGROUND INFORMATION

### 1.2.1 Overall Project Objectives

The overall project objective is to conduct sampling to delineate the extent of impacted soil, groundwater, surface water, potable water, and post soil removal sampling.

### 1.2.2 Site / Facility Description

The impacted area encompasses approximately 8 miles of upland, creek bed, and river bed areas, located in Calhoun and Kalamazoo Counties. Additional surface water sampling is conducted outside of this impacted area.

### 1.2.3 Site / Facility History

The Enbridge pipeline in the vicinity of Marshall, Michigan experienced a crude oil release discovered on July 27, 2010. Two main areas have been impacted by this release and include the upstream release area and the downstream release area. The upstream release area mainly impacts upland areas, and the downstream areas include impacts to bank and in river areas.

## 1.3 PROJECT/TASK DESCRIPTION AND SCHEDULE

### 1.3.1 Project Schedule

Fieldwork has commenced.

## 1.4 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT OF DATA

The overall QA objective for this project is to develop and implement procedures for field and laboratory activities that will provide results that meet the project objectives and are legally defensible in a court of law. This section will provide in greater detail specific project objectives and intended data usages mentioned in **Section 1** of this QAPP. Specific procedures for sampling, COC, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP. QC parameters and the frequency of analysis are identified in **Table 1-1**.

The following subsection summarizes the precision, accuracy, completeness, representativeness, comparability and sensitivity to be used for all sample analyses.

### 1.4.1 Precision

#### *1.4.1.1 Definition*

Precision is a measure of the degree to which two or more measurements are in agreement.

#### *1.4.1.2 Field Precision Objectives*

Field precision is assessed through the collection and measurement of field duplicates and QA splits. Field duplicates samples will be collected at an approximate rate of one duplicate per 10

analytical samples collected and QA splits samples one per method/per matrix. The anticipated number of duplicates for this project is found in the SAP.

#### *1.4.1.3 Laboratory Precision Objectives*

Precision in the laboratory is assessed through the calculation of relative percent differences (RPD) between sample results. The equations to be used for precision in this project can be found in **Section 3** of this QAPP. Precision control limits for chemical data are provided in **Tables 1-2** through **1-13**.

For inorganic analyses, laboratory precision will be assessed through the analysis of a laboratory control sample/laboratory control sample duplicate (LCS/LCSD); sample/sample duplicate pair and field duplicate pairs. For organic analyses, laboratory precision will be assessed through the analysis of LCS/LCSD, matrix spike/matrix spike duplicate (MS/MSD) and field duplicate sample results.

### 1.4.2 Accuracy

#### *1.4.2.1 Definition*

Accuracy is the degree of agreement between an observed value and an accepted reference or true value.

#### *1.4.2.2 Field Accuracy Objectives*

Accuracy in the field is assessed through the use of trip blanks to assess the potential of cross contamination. Every cooler with aqueous volatile organic compound (VOC) samples will contain a trip blank sample. In addition, field accuracy is assessed by the adherence to all sample handling, preservation, and holding time criteria.

#### *1.4.2.3 Laboratory Accuracy Objectives*

Laboratory accuracy is assessed through the analysis of MS/MSD, LCS, surrogate compounds, or equivalent and the determination of percent recoveries. MS/MSD samples will be collected at a five percent frequency. The equation to be used for accuracy in this project can be found in **Section 3** of this QAPP. Accuracy control limits are given in **Tables 1-2** through **1-14**.

### 1.4.3 Completeness

#### *1.4.3.1 Definition*

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that expected under normal conditions.

#### *1.4.3.2 Field Completeness Objectives*

Field completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The equation for completeness is presented in **Section 3** of this QAPP. The field completeness goal for this project is greater than 95 percent.

#### *1.4.3.3 Laboratory Completeness Objectives*

Laboratory completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The equation for completeness is presented in **Section 3** of this QAPP. The laboratory completeness objective for this project, with respect to parameters identified in **Table 1-15** of this QAPP, is 95 percent or greater.

### 1.4.4 Representativeness

#### *1.4.4.1 Definition*

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary.

#### *1.4.4.2 Measures to Ensure Representativeness of Field Data*

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the SAP is followed and that proper sampling techniques are used. These will include the analysis of trip blank, method blank and field blank data. In designing the sampling program, media of concern have been specified.

#### *1.4.4.3 Measures to Ensure Representativeness of Laboratory Data*

Laboratory representativeness is ensured by using the proper analytical procedures, appropriate methods, meeting sample holding times and analyzing and assessing field duplicate samples. The sampling network was designed to provide data representative of facility conditions. During development of this network, consideration was given to historical activities, existing analytical data, physical setting and processes.

### 1.4.5 Comparability

#### *1.4.5.1 Definition*

Comparability is an expression of the confidence with which one data set can be compared to another.

#### *1.4.5.2 Measures to Ensure Comparability of Field Data*

Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the SAP is followed and that proper sampling techniques are used.

#### *1.4.5.3 Measures to Ensure Comparability of Laboratory Data*

Analytical data will be comparable when similar sampling and analytical methods are used as documented in the QAPP. Comparability is also dependent on similar QA objectives and will be measured through QA split samples.

### 1.4.6 Sensitivity

#### *1.4.6.1 Definition*

Sensitivity is defined as the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. Method detection limit (MDL) is defined as the minimum concentration of a substance that can be identified, measured, and reported with a 99 percent confidence that the analyte concentration is greater than zero and is determined from repeated analysis of a sample in a given matrix containing the analyte. MDLs have been determined as required in Title 40 of the Code of Federal Regulation (CFR) Part 136B. The reporting limit (RL) is greater than or equal to the lowest standard used to establish the calibration curve. The RLs for this investigation are generally at least 3 times greater than the MDL. Results greater than the MDL and less than the RL will be qualified estimated (**J**) by the laboratory.

#### *1.4.6.2 Sensitivity Requirements for Field Data*

The sensitivity goals for the field data are identified in the SAP.

#### *1.4.6.3 Sensitivity Requirements for Laboratory Data*

The laboratory MDLs, RLs and project sensitivity goals are identified in **Tables 1-16** through **1-24** of this QAPP. The laboratory will analyze MDL verification samples on a quarterly basis.

## 1.5 SPECIAL TRAINING REQUIREMENTS AND CERTIFICATION

### 1.5.1 Training

The field activities may consist of soil and surface water sampling. Personnel completing these activities have sufficient knowledge and on-the-job training to follow the procedures required for the activities listed above, including sampling for and composition samples. Field personnel have completed the Occupational Safety and Health Administration (OSHA)-approved basic 40-hour health and safety training Hazardous Waste Operations and Emergency Response (HAZWOPER) course and annual refreshers of the same. The Dredge Area and Containment

Facility Coordinators (a.k.a., Field Area Coordinators) will have OSHA approved 8-hour site supervisor training. Personnel training are included in the Site Safety and Health Plan, sample collection techniques are included in the SAP. Laboratory requirements for laboratory analysts are listed in the QSM and the laboratory has self-declared compliance with the QSM.

### 1.5.2 Certification

The contract laboratory must have current National Environmental Laboratory Accreditation Conference (NELAC) certification. No additional certifications are required for this investigation.

## 1.6 DOCUMENTS AND RECORDS

### 1.6.1 Data Reporting Format and Content

The hard copy and electronic copy of the laboratory data will be reported following the format identified below. For this project, a QC summary package and raw data package will be required. Hard copy reports will be submitted to URS. The chemical data will also be submitted electronically to the USEPA on-scene coordinator, the QA Officer for verification, and the third party validator for validation. The contents of the QC summary package include:

- Cover sheet;
- Laboratory case narrative;
- Cooler receipt forms;
- COC copy;
- Analytical results;
- Surrogate summary forms;
- Blank summary forms;
- Laboratory control sample summary forms; and
- Matrix spike/matrix spike duplicate/laboratory duplicates summary forms.

The raw data package will consist of the elements presented in the QC summary package but will additionally include the raw data. The raw data includes chromatograms, mass spectra, manual integration correction data, quantitation reports, calibration data, preparation logs, and analytical logs. The raw data package will be similar in content to the Contract Laboratory Program (CLP) Level IV data package where applicable to the referenced methods. All chemical data will also be submitted in electronic format.

### 1.6.2 Records Disposition

All project files and records will be stored on-site until the Final Report has been approved by USEPA. The project files will be moved to an off-site storage facility for 10 years. Project

information can be attained through a written request to the PCM. The requested information should be available within 7 working days.

### 1.6.3 Use of Historic Data

Only visual extent of the release was used to determine potential areas of concern. No historic data was available.

## 2.1 SAMPLING PROCESS DESIGN

### 2.1.1 Sampling Procedures and Methods

The sampling procedures to be used during the field activities will be consistent for the objectives of this project. The procedures are presented in SAP. Sample containers, preservatives, and holding time requirements for each parameter and matrix are presented in **Table 2-1**.

### 2.1.2 Custody Procedures

Custody is one of several factors that are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including originals of all laboratory reports and purge files, are maintained under document control in a secure area.

A sample or evidence file is under your custody if:

- The item is in actual possession of a person;
- The item is in the view of the person after being in actual possession of the person;
- The item was in actual physical possession but is locked up to prevent tampering; or
- The item is in a designated and identified secure area.

#### *2.1.2.1 Field Custody and Documentation Procedures*

*Field Logbook*

Field logbooks will provide the means of recording data collecting activities performed during the investigation. As such, entries will be described in as much detail as possible so that persons going to the facility could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. A project-specific document number will identify each logbook.

The title page of each logbook will contain the following:

- Person to whom the log book is assigned;
- Log book number;
- Project name;
- Project start date; and

- Estimated project end date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection equipment being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in permanent ink, signed, and dated. If an incorrect entry is made, the information will be crossed out with a single strike mark that is signed and dated by the sampler. Whenever a sample is collected or a measurement is made, a detailed description of the location, which may include compass and distance measurements or latitude and longitude information (e.g., obtained by using a global positioning system) will be recorded. The number of the photographs taken, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

### *Chain-of-Custody (COC)*

The purpose of the COC procedure is to prevent misidentification of samples, prevent tampering of the samples during shipment and storage, allow easy identification of tampering, and allow for easy tracking of possession. If the COC is broken at any time from sample collection through sample analysis, the QA Officer will be notified. The QA Officer is responsible for implementing corrective action and responsible for ensuring that all necessary documentation is completed.

If an incorrect entry is made on the COC, the incorrect information will be crossed out with a single strike mark, and the change initialed and dated by the person making the COC change. A copy will be kept by the sampling team and will be included in the field activity documentation file.

The laboratory will compare the samples entered on the COC forms with the sample containers received by the laboratory. If the laboratory finds any discrepancies, the laboratory will contact the Project Chemist for resolution. The COC forms will be the primary source of information for the laboratory to enter data into the laboratory's sample tracking system. Sample coolers packaging is an integral part of field activities. Procedures for proper sample packaging will be followed as identified SAP.

When samples leave the sampler’s immediate control (e.g., shipment to laboratory), custody seals will be placed on both the front and back of the shipping container. The custody seals will bear the collector’s name and the date signed. The sample custody seal is used to ensure that the samples in the shipping container have not been tampered with, therefore ensuring sample integrity. At the beginning of the project, an example cooler custody seal will be sent to the laboratory so the laboratory has the signatures of the samplers on file.

### *Sample Collection Field Sheets*

To supplement the information recorded in the field logbook, sample collection field sheets (SCFSs) will also be completed for each soil sampling location. The SCFS will be crosschecked for completeness and accuracy at the end of each day. The SCFS will be signed and dated by the sampler making entries on the SCFS.

### *Field Custody Procedures*

Samples will be collected following the procedures presented in the SAP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume, and number of containers in the field logbook. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive a unique sample identification number, will be noted in the field logbook and on the SCFS.

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the COC intact. The protocol for specific sample numbering and other sample designations are included in the SAP.

- The Field Area Coordinators are personally responsible for the care and custody of the samples until they are relinquished or properly dispatched. Field procedures have been designed such that as few individuals as possible will handle the samples.
- All bottles will be identified by the use of sample labels with sample numbers, sampling locations, date/time of collection, and type of analysis. The sample numbering system is presented in SAP.
- Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because the ballpoint pen would not function in freezing weather. Sample labels will be affixed to the sample containers using clear tape.
- A properly completed COC form will accompany samples. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to the permanent laboratory, or to/from a secure storage area.
- Samples will be properly packaged on ice at 4 degree Celsius (°C) ± 2$^{o}$C for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be closed and secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached to the front right and back left of the cooler and covered with clear plastic tape after being signed by the field team leader. The cooler will be secured with strapping tape in at least two locations.

#### *2.1.2.2 Laboratory Custody Procedures*

Laboratory custody procedures for sample receiving and login, sample storage and numbering, tracking during sample preparation and analysis, and storage of data are described in the laboratory Quality Programs.

#### *2.1.2.3 Final Evidence File*

The final evidence file will be the central repository for all documents, which constitute evidence relevant to sampling and analysis activities as described in this QAPP. Enbridge's Command Center Environmental Office is the custodian of the evidence file and maintains the contents of evidence files for the investigation, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, and data reviews in a secured, limited-access area and under custody of the PCM.

The final evidence file will include at a minimum:

- Field logbooks;
- Field data and data deliverables;
- Photographs;
- Drawings;
- Soil boring logs;
- Laboratory data deliverables
- Data review/validation reports;
- Data assessment reports;
- Progress reports, QA reports, interim project reports, etc.; and
- All custody documentation (tags, forms, air bills, etc.).

## 2.2 ANALYTICAL METHODS

Sediment, soil, surface water, and groundwater samples will be collected during field sampling activities as part of the investigation. All investigative samples will be sent to offsite or onsite laboratories as identified in the SAP. QA split samples will be sent to each laboratory as well. Analyses will be completed following the respective analytical methods as identified in the SAP.

### 2.2.1 Field Analytical Procedures

If called for in the SAP, field analytical measurements for aqueous samples and their respective field instrument are listed in the following table. Analytical procedures for field analyses are presented in the respective SAP.

| Field Measurement | Field Instrument |
|---|---|
| Specific Conductance (surface water) | Oakton Model 10 or equivalent |
| pH (surface water) | Oakton Model 10 or equivalent |
| Temperature (surface water) | Oakton Model 10 or equivalent |
| Headspace | MiniRae 2000 Photoionization Detector or equivalent |

### 2.2.2 Laboratory Analytical Procedures

The contract laboratories will implement the project-required SOPs. These laboratory SOPs for sample preparation, cleanup, and analysis are based on USEPA Test Method for Evaluating Solid Waste, Physical/Chemical Methods, Final Update IIIB, June 2005 and other applicable methods. The analytical procedures will follow laboratory in-house limits; as appropriate. The laboratory will report all detections above the MDL. Values above the MDL and below the RL will be qualified as estimated (**J**). MDLs were determined as outlined in 40 CFR, Part 136B. The RLs are typically 3 to 5 times the MDL (the MDL should be below half any applicable action level where achievable). Available technology may limit the achievability of this for certain analysts. The laboratory will analyze a RL check sample for each parameter and an MDL check sample for organic parameters. In house limits will be used where no QSM limits exist.

**Table 1-15** identifies the laboratory analytical methods and the proceeding sections summarize the analytical methods that will be used during this investigation. The process for determining compounds of potential concern (COPCs) is detailed in the SAP.

#### *2.2.2.1 Volatile Organic Compounds (VOCs)*

VOCs include compounds among varying classes, such as halogenated organics, nonhalogenated organics, and aromatic organics. The first two classes includes compounds associated with fuels, such as benzene, ethylbenzene, toluene, and xylenes. Samples requiring VOC analysis will be prepared using USEPA SW-846 Methods 5035 (soil/sediment) and analyzed using USEPA SW-846 Method 8260. USEPA SW-846 Method 8260 utilizes gas chromatography/mass spectrometry (GC/MS) for separation and detection, respectively. The power of GC/MS lies in the capacity for positive identification of relatively low detection limits. The target analytes, MDLs and laboratory RLs are presented in **Table 1-16** (soil/sediment).

#### *2.2.2.2 Semivolatile Organic Compounds (SVOCs)*

USEPA SW-846 Method 8270C is a GC/MS method for determining semivolatile organic compounds (SVOCs). The target analytes, MDLs and laboratory RLs are presented in **Table 1-17** (soil/sediment).

#### *2.2.2.3 Polynuclear Aromatic Hydrocarbons (PAHs)*

USEPA SW-846 Method 8270 is a GC/MS method for determining polynuclear aromatic hydrocarbons (PAHs). The target analytes, MDLs and laboratory RLs are presented in **Table 1-18** (soil/sediment).

### 2.2.3 Field Quality Control Checks

The QC criteria for each field measurement are provided in **Section 1** of this QAPP. The collection of field duplicates and quality assurance duplicates for laboratory analysis will make an assessment of field sampling precision and bias. Collection of the samples will be in accordance with the SAP as referenced in **Section 2.1** and will be collected at the frequency indicated in **Table 1-1** of this QAPP.

### 2.2.4 Laboratory Quality Control Checks

The contract laboratories have a QC program in place to ensure the reliability and validity of the analysis performed at the laboratory. All analytical procedures are documented in writing as SOPs, and each SOP includes a QC section, which addresses the minimum QC requirements for the procedure. The internal QC checks differ slightly for each individual procedure, but, in general, the QC requirements include the following:

- Method blanks;
- Reagent/preparation/calibration blanks (applicable to inorganic analysis);
- Instrument blanks;
- Initial calibration (ICAL);
- Initial calibration verification (ICV);
- Continuing calibration verification (CCV);
- Method detection limit verification;
- Method reporting limit verification;
- MS/MSDs;
- Surrogate spikes;
- Laboratory duplicates;
- Laboratory control standards;
- Internal standard areas for GC/MS analysis; and
- Mass tuning for GC/MS analysis.

All data obtained will be properly recorded. The data package will include a full deliverable package capable of allowing the recipient to reconstruct QC information and compare it to QC

criteria. The laboratory will reanalyze any samples analyzed in nonconformance with the QC criteria, if sufficient volume is available. It is expected that sufficient volumes/weights of samples will be collected to allow for reanalysis when necessary. Data packages will be available in electronic form.

### 2.2.5 Level of Quality Control Effort

Method blank, field duplicate, laboratory duplicate, laboratory control and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs.

- Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures. A method blank will be analyzed by the laboratory with each analytical batch samples for organic analyses and will be re-analyzed if common laboratory contaminants are detected above the RL or when non-laboratory contaminants are reported > ½ the RL. Samples for metals analyses will be re-analyzed if the blank concentration is > than the RL.
- Duplicate samples are analyzed to check for sampling and analytical reproducibility. Field duplicate samples will be collected at an approximate 5 percent frequency. The laboratory will analyze laboratory duplicates with each metals analytical batch.
- MS/MSDs provide information about the effect of the sample matrix on the digestion and measurement methodology. Depending on site-specific circumstances, one MS/MSD will be collected for every 20 or fewer investigative samples of a given matrix. MS/MSD samples are designated/collected for organic analyses only. A MS/MD will be collected for metals analyses and will also be collected at a frequency of 5 percent.
- LCSs provide information about the accuracy of the analytical system, independent of matrix. LCSs are laboratory-generated sample spikes with target analytes. An LCS is analyzed as part of every analytical batch. Investigative samples and the associated LCS will be re-analyzed if more than 5 percent of the LCS recoveries are less than the lower limit or any one recovery is less than ½ the lower limit.

The general level of the QC effort will be one field duplicate for every 10 investigative samples and one MS/MSD, LCS and blank for every 20 investigative samples. The number of duplicate and field blank samples to be collected is listed in the SAP.

In addition to the QC parameters identified above, the laboratory analyzes additional QC samples as part of the analytical method. **Table 1-1** summarizes all QC parameters and frequency of analysis.

### 2.2.6 Level of Quality Assurance Effort

QA samples will be collected at a frequency of 5% and will be analyzed by each respective laboratory.

## 2.3 CALIBRATION PROCEDURES AND FREQUENCY

This section describes the calibration procedures and the frequency at which these procedures will be performed for both field and laboratory instruments.

### 2.3.1 Field Instrument Calibration

The field instruments will be calibrated as described in the manufacturer's manual and procedures identified in the SAP. In general, instruments will be calibration checked at the beginning of each day and calibrated weekly. For specific instructions on the calibration frequency, the acceptance criteria, and the conditions that will require more frequent calibration, refer to the specific SOPs.

All calibration procedures performed will be documented in the field logbook and will include the date/time of calibration, name of person performing the calibration, reference standard used, temperature at which readings were taken, and the readings. Multiple readings on one sample or standard, as well as readings on replicate samples, will likewise be documented.

### 2.3.2 Laboratory Instrument Calibration

All laboratory instrumentation will be calibrated in accordance with the respective analytical method. In general, calibration procedures for a specific laboratory instrument will consist of initial calibrations (3 or 5 points), initial calibration verifications, and continuing calibration verification.

The laboratory maintains a sample logbook for each instrument which will contain the following information: instrument identification, serial number, date of calibration, analyst, calibration solutions run, and the samples associated with these calibrations.

## 2.4 PREVENTIVE MAINTENANCE

To ensure that all analytical data generated for this project are reliable, all equipment and instruments will have a prescribed routine maintenance schedule in addition to a calibration schedule. Preventive maintenance will be completed and documented by qualified project personnel.

### 2.4.1 Field Instrument Preventive Maintenance

The field equipment for this project includes a multiparameter probe for the analysis of pH, temperature and specific conductance. Specific preventative maintenance procedures to be followed for field equipment are based on those recommended by the manufacturer. Field instruments will be calibration checked daily before use and calibrated weekly. Calibration checks will be documented in the field logbook. Critical spare parts, such as tape and batteries, will be kept on site to reduce potential downtime. Backup instruments and equipment will be available within one-day shipment to avoid delays in the field schedule.

### 2.4.2 Laboratory Instrument Preventive Maintenance

As part of the QA Program Plan, the contract laboratory conducts a routine preventative maintenance program to minimize the occurrence of instrument failure and other system malfunctions. Designated laboratory employees regularly perform routine scheduled maintenance and repair of (or coordinate with the vendor for the repair of) all instruments. All maintenance that is performed is documented in the laboratory's operating record. All laboratory instruments are maintained in accordance with manufacturer's specifications. The frequency of laboratory preventive maintenance is identified in the laboratory Quality Programs.

### 2.4.3 Inspection/Acceptance Requirements for Supplies and Consumables

The Area Field Coordinators are responsible for ensuring that all consumable materials and ancillary sampling equipment is adequate for its intended use, compatible with other equipment, and free of defects. An inspection of all field supplies should be done and recorded in the logbook. The table below summarizes the supply and consumables inspection and acceptance requirements.

| Supply Name | Inspection/ Testing Requirements | Acceptance Criteria | Testing Method | Frequency of Testing | Responsible Individual | Expiration Date | Handling / Storage Requirements |
|---|---|---|---|---|---|---|---|
| En Core® or Terra Core™ samplers | Certified as pre-cleaned by supplier | Certified as pre-cleaned by supplier / laboratory | Review of documentation and visual inspection | Upon receipt | Area Field Coordinators | 3 years | Store in dry and secure location |
| Preserved sample containers | Certified as pre-cleaned by supplier and containing appropriate preservative | Certified as pre-cleaned by laboratory | Review of documentation and visual inspection | Upon receipt | Area Field Coordinators Area Field Coordinators | 3 months | Store in dry and secure location |
| Unpreserved sample containers | Certified as pre-cleaned by supplier | Certified as pre-cleaned by laboratory | Review of documentation and visual inspection | Upon receipt | Area Field Coordinators | None | Store in dry and secure location |

A field audit may be conducted to verify that sampling is performed in accordance with the procedures established in the SAP and QAPP. A performance and system audit of the laboratory may be conducted to verify analyses are completed as identified in the SOPs. The audits of field and laboratory activities include two independent parts: internal and external audits.

## 3.1 FIELD PERFORMANCE AND SYSTEM AUDITS

### 3.1.1 Internal Field Audits

#### *3.1.1.1 Internal Field Audit Responsibilities*

If performed, internal audits of field activities, including sampling and field measurements, will be conducted prior to, at the start of, or at any time during field sampling activities by the QA Officer or designee. These audits will verify that all established procedures are being followed. The audit will be completed at the beginning of the project and will include a review of all field activities completed at that time.

#### *3.1.1.2 Internal Field Audit Frequency*

Internal field audits will be conducted at least once at the beginning of the site sample collection activities. If warranted, additional field audits may be completed.

#### *3.1.1.3 Internal Field Audit Procedures*

The audits will include examination of field sampling records; field screening analytical results; field instrument operating records; sample collection, handling, and packaging in compliance with the established procedures; maintenance of QA procedures; chain-of-custody; etc. Follow-up audits may be required to correct deficiencies and to verify that QA procedures are maintained throughout the investigation. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation. The QA Officer will issue an audit report to the PCM. Nonconformances will be addressed and resolved by the PCM.

### 3.1.2 External Field Audits

#### *3.1.2.1 External Field Audit Responsibilities*

If performed, external field audits may be conducted prior to, at the start of, or at any time during field sampling activities.

#### *3.1.2.2 External Field Audit Frequency*

External field audits may be conducted any time during the field operations. These audits may or may not be announced.

#### *3.1.2.3 External Field Audit Procedures*

External field audits will be conducted according to the field activity information presented in the procedures in the SAP. The external field audit process can include (but not be limited to): sampling equipment decontamination procedures, sample bottle preparation procedures, sampling procedures, examination of field sampling and safety plans, sample vessel cleanliness and QA procedures, procedures for verification of field duplicates, sample preservation and preparation for shipment, as well as field screening practices. The QA Officer will issue an audit report to the PCM. Nonconformances will be addressed and resolved by the PCM.

## 3.2 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits may be conducted to verify documentation and implementation of the QA program, assess the effectiveness of the work plan, identify any nonconformances, and verify corrective action of identified deficiencies. Repeated failure or gross irregularities in field duplicate, QA split, and calibration or quality control samples may warrant the need for an audit.

### 3.2.1 Performance Audits

Performance audits of the laboratories participating in the project are performed in accordance with the procedures and frequencies established for SW-846 methodologies by the USEPA.

The QA Officer will evaluate the need for additional performance audits with due consideration given to the recommendations of the PCM. Performance audits are used to quantitatively assess the accuracy of measurement data through the use of performance evaluation and blind check samples. The performance audit, if needed, will be performed by the QA Officer or his/her designee in accordance with documented procedures.

### 3.2.2 System Audits

The QA Officer may conduct a system audit of the fieldwork performance. The Field Area Coordinators are responsible for supervising and checking that samples are collected and handled in accordance with the approved project plans and that documentation of work is adequate and complete. The PCM is responsible for overseeing that the project field team follows the field procedures set forth in the SAP. Reports and technical correspondence will be peer reviewed by an assigned qualified individual, otherwise external to the project, before being finalized.

### 3.2.3 Audit Records

If an audit is completed, the original records generated for all audits will be retained within the central project files. Records will include audit reports, written replies, the record of completion of corrective actions, and documents associated with the conduct of audits, which support audit findings and corrective actions as appropriate.

## 3.3 LABORATORY PERFORMANCE AND SYSTEMS AUDITS

### 3.3.1 Internal Laboratory Audits

#### *3.3.1.1 Internal Laboratory Audit Responsibilities*

If performed during this project, the QA Officer will conduct the internal laboratory audit prior to, at the start of, or at any time during field sampling activities.

#### *3.3.1.2 Internal Laboratory Audit Frequency*

The internal system audits will be done on an annual basis, while the internal performance audits will be conducted on a quarterly basis.

#### *3.3.1.3 Internal Laboratory Audit Procedures*

The internal system audits will include an examination of laboratory documentation on sample receiving, sample log-in, sample storage, COC procedures, sample preparation and analysis, instrument operating records, etc.

The performance audits, if performed will involve preparing blind QC samples and submitting them, along with project samples, to the laboratory for analysis throughout the project. The URS QA Officer will evaluate the analytical results of these blind performance samples to ensure the laboratory maintains acceptable QC performance. If the laboratory fails the QC sample analysis, they will be given another opportunity for blind QC sample analysis. A second failure will be cause for termination of the laboratory from the project.

### 3.3.2 External Laboratory Audits

#### *3.3.2.1 External Laboratory Audit Responsibilities*

An external audit may be conducted, as required, by the QA Officer or designee.

#### *3.3.2.2 External Laboratory Audit Frequency*

If performed, the external audit will be conducted prior to, during, or after sampling and analysis activities. These audits may or may not be announced. Repeated failure or gross irregularities in the field duplicate, QA split, and calibration or quality control samples may warrant the need for an audit.

#### *3.3.2.3 Overview of the External Laboratory Audit Process*

External audits may include any or all of: review of laboratory analytical procedures, laboratory on-site visits, and/or submission of performance evaluation samples to the laboratory for analysis. Nonconformances will be listed by the QA Officer or designee and a report will be

issued to the PCM and the laboratory. The laboratory will be given a week to address the nonconformances to the satisfaction of the QA Officer or designee and the PCM. Failure to resolve any or all audit procedures chosen can lead to laboratory disqualification and the requirement that another suitable laboratory be chosen.

An external on-site review can consist of: sample receipt procedures, custody, and sample security and log in procedures, sample throughput tracking procedure, review of instrument calibration records, instrument logs and statistics (number and type), review of QA procedures, logbooks, sample prep procedures, sample analytical SOP review, instrument (normal or extends quantitation report) reviews, personnel interviews, review of deadlines and glassware prep, and a close out to offer potential corrective action.

It is common practice when conducting an external laboratory audit to review one or more data packages from sample lots recently analyzed by the laboratory. This review will most likely include, but not be limited to, the following:

- Comparison of resulting data to the SOP or method, including coding for deviations;
- Verification of initial and continuing calibrations within control limits;
- Verification of surrogate recoveries and instrument timing results, where applicable;
- Review of extended quantitation reports for comparisons of library spectra to instrument spectra, where applicable;
- Recoveries on control standard runs;
- Review of run logs with run times, ensuring proper order of runs;
- Review of spike recoveries/QC sample data;
- Review of suspected manually integrated GC data and its cause (where applicable);
- Review of GC peak resolution for isolated compounds as compared to reference spectra (where applicable); and
- Assurance that samples are run within holding times.

An external audit may initiate within the laboratory to review procedures and verify the list above. Data packages may be requested either in hard copy or electronic form to be reviewed on or off the laboratory premises.

## 3.4 SPECIFIC ROUTINE PROCEDURES USED TO EVALUATE DATA PRECISION, ACCURACY, AND COMPLETENESS

The purpose for this investigation falls in line with the data quality objectives (DQOs) for the site. Factors considered in this assessment include, but are not limited to:

- Evaluation of site conditions and potential receptors;

- Evaluation of contaminants known and/or suspected to be of concern at the site, as they relate to the data quality level parameters chosen; and
- The choice of analytical and sample preparation methods for contaminants of concern whose method reportable limits will meet or exceed the data quality level concentrations for those contaminants.

Analytical data quality will be assessed based on these chosen goals and objectives to determine if the objectives have been met. In addition, the data will be reviewed for indications of interferences to results caused by sample matrices, cross contamination during sampling, cross contamination in the laboratory, and sample preservation and storage anomalies (i.e., samples holding time or analytical instrument problems).

### 3.4.1 Accuracy Assessment

In order to assure the accuracy of the analytical procedures, an environmental sample will be spiked with a known amount of the analytes included in **Tables 1-2** through **1-14**. At a minimum, one sample spike should be included in every set of 20 samples tested on each instrument, for each sample matrix to be tested (i.e., groundwater and soil). The increase in concentration of the analyte observed in the spiked sample, due to the addition of a known quantity of the analyte, compared to the reported value of the same analyte in the parent sample determines the percent recovery.

Accuracy is similarly assessed by determining percent recoveries for surrogate compounds added to each field and QC sample to be analyzed for organic analyses. Accuracy for metals analysis will also be further assessed through determination of percent recoveries for laboratory control samples (as well as MS samples).

Percent recovery for MS/MSD results is determined according to the following equation:

$$\%R = \left( \frac{\text{Amount in Spiked Sample - Amount in Parent Sample}}{Amount\ of\ Spike\ Added} \right) * 100$$

Percent recovery for LCS and surrogate compound results is determined according to the following equation:

$$\%R = \left( \frac{Amount\ Found\ in\ Spiked\ Sample}{Amount\ of\ Spike\ Added} \right) * 100$$

### 3.4.2 Precision Assessment

The RPD between the spike and matrix spike, or matrix spike and sample duplicate in the case of metals, and field duplicate pair or laboratory duplicate pair is calculated to compare to precision DQOs and plotted. The RPD is calculated according to the following formula.

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

### 3.4.3 Completeness Assessment

Completeness is the ratio of the number of valid sample results to the total number of samples analyzed with a specific matrix and/or analysis. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$Completeness = \left( \frac{Number\ of\ Valid\ Measurements}{Total\ Number\ of\ Measurements} \right) * 100$$

## 3.5 OVERALL ASSESSMENT OF DATA

The laboratory QC results will be compared to the objectives presented in **Tables 1-2** through **1-14** of this QAPP and assess the apparent human and/or ecological risks associated from any contamination found. Only data generated in association with QC results meeting these objectives will be considered usable for decision-making purposes, which is used to evaluate the nature and extent of contamination at the site.

In addition, the data obtained will be both qualitatively and quantitatively assessed on a project-wide, matrix-specific, parameter-specific, and unit-specific basis. The QA Officer will perform this assessment and the results presented and discussed in detail in the final investigation report. Factors to be considered in this assessment of field and laboratory data will include, but not necessarily be limited to, the following.

- Were all samples obtained using the methodologies proposed in the SAP?
- Were all proposed analyses performed according to the SOPs provided in the QAPP?
- Were samples obtained from all proposed sampling locations and depths?
- Do any analytical results exhibit elevated detection limits due to matrix interferences or contaminants present at high concentrations?
- Were any analytes not expected to be present at the facility, or a given unit, identified as target parameters?
- Were all field and laboratory data validated according to the validation protocols, including project-specific QC objectives, proposed in the QAPP?
- Which data sets were found to be unusable (qualified as "**R**") based on the data validation results?
- Which data sets were found to be usable for limited purposes (qualified as "**J**") based on the data validation results?

- What effects do qualifiers applied as a result of data validation have on the ability to implement the project decision rules?
- Has sufficient data of appropriate quality been generated to support a human health and/or ecological screening risk assessment?
- Were the human health and/or ecological screening risk assessments conducted properly?
- Can valid conclusions be drawn for all matrices at each unit and/or area under investigation?
- Were all issues requiring corrective action, as presented in the monthly QA Reports to management fully resolved?
- Were the project-specific decision rules used as proposed during the actual investigation?
- For any cases where the proposed procedures and/or requirements have not been met, has the effect of these issues on the project objectives been evaluated?
- Have any remaining data gaps been identified and summarized in the final investigation report?

Based on the overall findings of the investigation and this assessment, were the original project objectives appropriately defined? If not, have revised project objectives been developed?

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out-of-QC performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment. All corrective action proposed and implemented will be documented in the regular QA reports to management. Corrective action will only be implemented after approval by the PCM, or designee.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the PCM, who in turn will notify the USEPA OSC. If the problem is analytical in nature, information on these problems will be promptly communicated to the QA Officer.

Any nonconformance with the established QC procedures in the QAPP or SAP will be identified and corrected in accordance with the QAPP. The PCM or designee, will issue a nonconformance report for each nonconformance condition.

## 3.6 CORRECTIVE ACTIONS

### 3.6.1 Field Corrective Action

Corrective action in the field may be needed when the sample network is changed (i.e., more/less samples, sampling locations other than those specified in the SSA, etc.), sampling procedures and/or field analytical procedures require modification, etc., due to unexpected conditions. In

general, the Field Area Coordinators, QA Officer, or the PCM may identify the need for corrective action. The field staff in consultation with the Field Area Coordinators will recommend a corrective action. The PCM will approve the corrective measure which will be implemented by the field team. It will be the responsibility of the PCM to ensure the corrective action has been implemented. All corrective actions implemented will be documented in the field logbooks.

### 3.6.2 Laboratory Corrective Action

Corrective action in the laboratory may occur prior to, during, and after initial analyses. A number of conditions (such as broken sample containers, multiple phases, low/high pH readings, potentially high concentration samples) may be identified during sample login or just prior to analysis. Following consultation with lab analysts and section leaders, it may be necessary for the QA Officer to approve the implementation of corrective action. Depending on the condition encountered, the laboratory QA Officer may consult the QA Officer for input. Conditions during or after analysis that may automatically trigger corrective action or optional procedures include dilution of samples, additional sample extract cleanup, automatic reinjection/reanalysis when certain QC criteria are not met, etc. A summary of method-specific corrective actions is available in the laboratory QAPP (available upon request). All laboratory corrective actions will be documented and also identified in the case narrative of the data packages.

### 3.6.3 Corrective Action During Data Review/Validation and Assessment

The need for corrective action may be required during either the data review/validation or data assessment. Potential types of corrective action may include resampling by the field team or re-extraction/re-analysis of samples by the laboratory. These actions are dependent upon the ability to mobilize the field team, whether the data to be collected is necessary to meet the required QA objectives (e.g., the holding time for samples is not exceeded, etc.). If the Project Chemist identifies a corrective action situation, it is the PCM who will be responsible for approving the implementation of corrective action, including re-sampling, during data assessment. All corrective actions of this type will be documented by the PCM.

## 3.7 QUALITY ASSURANCE REPORTS TO MANAGEMENT

### 3.7.1 Contents of Project QA Reports

The Field Area Coordinators will report to the PCM on a daily basis regarding progress of the fieldwork and quality control issues associated with field activities.

The laboratory maintains detailed procedures for laboratory recordkeeping in order to support the validity of all analytical work. Each data set report submitted to the QA Officer will contain the laboratory's written certification that the requested analytical methods were run and that all QA/QC checks were within established control limits for all samples analyzed.

After receipt of all analytical data, the Project Chemist will submit a Data Review Report for each data set to the QA Officer and the PCM describing the accuracy and precision of the data. Verbal reports will be provided following the receipts of individual packages as they are received. If any QA problems are encountered, the laboratory Project Manager will call the Project Chemist immediately for corrective action and also issue a written report to the Project Chemist. The Project Chemist will immediately report the QA problem to the QA Officer and the PCM.

After the fieldwork is complete and the final analyses are completed, reviewed and validated, a final report will be prepared. The report will summarize the quality assurance and audit information (if completed), indicating any corrective actions taken and the overall results of QAPP compliance. The Project Chemist (or designee) will prepare this final summary and submit this to the QA Officer for review. The report will be utilized during the decision-making process and will be incorporated as part of the Final Report.

## 4.1 DATA REDUCTION

All data generated through field activities or by the laboratory operation, will be reduced and validated prior to reporting. The laboratory will not disseminate data until it has been subjected to these procedures, which are summarized in subsections below.

### 4.1.1 Field Data Reduction Procedures

All field data will be written into field logbooks immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed, and dated by the field member, and corrected in a space adjacent to the original (erroneous) entry. Periodically throughout the field sampling effort, the Field Area Coordinators will review the forms to determine whether the field crew has made any errors.

### 4.1.2 Laboratory Data Reduction Procedures

Laboratory data reduction procedures are located in the laboratory Quality Programs.

## 4.2 DATA REVIEW AND VALIDATION

One hundred percent of the data will undergo a data review by the Project Chemist or designee using ADR. The data review will include the review of the QC parameters listed below. The criteria used to evaluate the QC parameters are those criteria identified in **Tables 1-2** through **1-14** and **4-1** through **4-3**.

- Chain of custody;
- Laboratory case narrative/cooler receipt form;
- Holding time / sample preparation;
- Method blanks
- Reagent/preparation blanks (applicable to inorganic analysis);
- MS/MSDs;
- Surrogate spikes;
- Laboratory duplicates;
- Laboratory control standards; and
- Field duplicates.

All data obtained will be properly recorded. The data package will include a full deliverable package capable of allowing the recipient to reconstruct QC information and compare it to QC criteria. The laboratory will reanalyze any samples analyzed in nonconformance with the QC

criteria, if sufficient volume is available. It is expected that sufficient volumes/weights of samples will be collected to allow for possible reanalysis if necessary.

**Tables 4-1** through **4-3** summarize the general criteria to be used during the review and validation procedures.

## 4.3 DATA REPORTING

Data reporting procedures will be carried out for field and laboratory operations as indicated below.

### 4.3.1 Field Data Reporting

Field data reporting will be conducted principally through the transmission of report sheets containing tabulated results of all measurements made in the field and documentation of all field calibration activities.

### 4.3.2 Laboratory Data Reporting

The task of reporting laboratory data begins after the independent validation activity has been concluded. The QA Officer must perform a final review of the report summaries and case narratives to determine whether the report meets project requirements. In addition to the record of COC, the report format will consist of the following:

#### 4.3.2.1 Case Narrative

- Date of issuance;
- Laboratory analysis performed;
- Any deviations from intended analytical strategy;
- Laboratory batch number;
- Numbers of samples and respective matrices;
- QC procedures utilized and also references to the acceptance criteria;
- Laboratory report contents;
- Project name and number;
- Condition of samples ‘as-received’;
- Discussion of whether or not sample holding times were met;
- Discussion of technical problems or other observations which may have created analytical difficulties; and
- Discussion of any laboratory QC checks which failed to meet project criteria.

#### *4.3.2.2 Chemistry Data Package*

- Case narrative for each analyzed batch of samples;
- Summary page indicating dates of analyses for samples and laboratory QC checks;
- Cross referencing of laboratory sample to project sample identification numbers;
- Description of data qualifiers to be used;
- Sample preparation and analyses for samples;
- Sample results (Analytical results will be reported as estimated **J** when detected above the MDL and below the RL);
- Raw data for sample results and laboratory QC samples (including LCS, MS/MSD, surrogates, serial dilutions, blanks, etc.);
- Results of (dated) initial and continuing calibration checks; and
- GC/MS tuning results.

All chemical data will also be submitted in electronic format.

## 4.4 DATA ASSESSMENT

After all data have been reviewed and validated, a list of all data points having either a high or low bias (qualified data) will be compiled and evaluated for determination of data usability. **Tables 4-1** through **4-3** state how biased data will be qualified.

National Environmental Laboratory Accreditation Conference (NELAC). 2003. July.

United States Army Corps of Engineers (USACE). 1997. Chemical Quality Assurance for HTRW Projects. EM 200-1-6. October.

United States Army Corps of Engineers (USACE). 2001. Engineering and Design – Requirements for the Preparation of Sampling and Analysis Plans. EM 200-1-3. February.

United States Environmental Protection Agency (USEPA). 2001. EPA Requirements for Quality Assurance Project Plans. March.

United States Environmental Protection Agency (USEPA). 2002. Guidance for Quality Assurance Project Plans. December.

United States Environmental Protection Agency (USEPA). 2005. Test Methods for Evaluating Solid Waste Physical/Chemical Methods. SW-846. Third Edition. Final Update IIIB. June.

United States Environmental Protection Agency (USEPA). 2006. National Recommended Water Quality Criteria.

Will be supplied under separate cover on a CD-ROM

# TABLE 1-1
# QUALITY CONTROL LEVEL OF EFFORT FOR ANALYTICAL TESTING

| Parameter | QC Measure | Minimum Frequency |
|---|---|---|
| All Parameters | Initial Calibration | Initially |
| All Parameters | Initial Calibration Verification | After each Initial Calibration |
| All Parameters | Reporting Limit Verification | Bracket project samples |
| All Parameters | Method Detection Limit Verification | Once per quarter per instrument used |
| All Parameters | Method Blank | Every analytical batch |
| VOCs/SVOCs/PAHs | Instrument Tuning | Every 12 hours |
| Organic Parameters | Continuing Calibration | Every 12 hour period of analysis |
| Metals | Continuing Calibration | Every 10 samples |
| Metals | Continuing Calibration Blank | Every 10 samples |
| All Parameters | Laboratory Control Sample | Every preparation batch |
| All Parameters | Matrix Spike | Every preparation batch |
| Organic Parameters | Matrix Spike Duplicate | Every preparation batch |
| Metals | Matrix Duplicate | Every preparation batch |
| VOCs/SVOCs/PAHs | Internal Standard | Every sample |
| Pesticides | Endrin/DDT Breakdown | Every 12 hour period of analysis |
| Organic Parameters | Surrogate | All QC and project samples |
| ICP Metals | Interelement Check Standard | Beginning of analytical sequence |
| Metals | Serial Dilution | As needed to assess new and unusual matrices |
| Metals | Post digestion spike | As needed to confirm matrix effect |
| All Parameters | Quality Assurance | At a frequency of 5% |
| All Parameters | Field Duplicate | Every 10 investigative samples |

Note: An analytical batch consists of 20 or fewer samples extracted/analyzed together.
While the frequency of MS/MSD and duplicates is for every analytical batch, URS will submit MS/MSD at a frequency of 1/20 and field duplicates at a rate of 1/10. QA split samples will be collected at a frequency of 5%.
Samples will be submitted to the QA Lab.
DDT - Dichloro-diphenyl-trichloroethane
ICP - Inductively Coupled Plasma

PAHs - Polynuclear Aromatic Hydrocarbons
QA - Quality Assurance
QC - Quality Control
SVOCs - Semivolatile Organic Compounds
VOCs - Volatile Organic Compounds

# TABLE 1-2
# LABORATORY CONTROL SAMPLE ACCURACY AND PRECISION CRITERIA FOR VOC ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| 1,1,1-Trichloroethane | N/A | 70 - 135 | N/A | 30 |
| 1,1,2,2-Tetrachloroethane | N/A | 55 - 130 | N/A | 30 |
| 1,1,2-Trichloroethane | N/A | 60 - 125 | N/A | 30 |
| 1,1-Dichloroethane | N/A | 75 - 125 | N/A | 30 |
| 1,1-Dichloroethene | N/A | 65 - 135 | N/A | 30 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | N/A | 60 - 140 | N/A | 30 |
| 1,2-Dichloroethane | N/A | 70 - 135 | N/A | 30 |
| 1,2-Dichloropropane | N/A | 70 - 120 | N/A | 30 |
| 2-Butanone | N/A | 30 - 160 | N/A | 30 |
| 2-Hexanone | N/A | 45 - 145 | N/A | 30 |
| 4-Methyl-2-pentanone | N/A | 45 - 145 | N/A | 30 |
| Acetone | N/A | 20 - 160 | N/A | 30 |
| Benzene | N/A | 75 - 125 | N/A | 30 |
| Bromodichloromethane | N/A | 70 - 130 | N/A | 30 |
| Bromoform | N/A | 55 - 135 | N/A | 30 |
| Bromomethane | N/A | 30 - 160 | N/A | 30 |
| Carbon disulfide | N/A | 45 - 160 | N/A | 30 |
| Carbon tetrachloride | N/A | 65 - 135 | N/A | 30 |
| Chlorobenzene | N/A | 75 - 125 | N/A | 30 |
| Chloroethane | N/A | 40 - 155 | N/A | 30 |
| Chloroform | N/A | 70 - 125 | N/A | 30 |
| Chloromethane | N/A | 50 - 130 | N/A | 30 |
| cis-1,2-Dichloroethene | N/A | 65 - 125 | N/A | 30 |
| cis-1,3-Dichloropropene | N/A | 70 - 125 | N/A | 30 |
| Dibromochloromethane | N/A | 65 - 130 | N/A | 30 |
| Dichlorodifluoromethane | N/A | 35 - 135 | N/A | 30 |
| Ethylbenzene | N/A | 75 - 125 | N/A | 30 |
| m,p-Xylenes | N/A | 80 - 125 | N/A | 30 |
| Methylene chloride | N/A | 55 - 140 | N/A | 30 |
| Methyl-tert butyl ether | N/A | 60 - 150 | N/A | 30 |
| o-Xylenes | N/A | 75 - 125 | N/A | 30 |
| Styrene | N/A | 75 - 125 | N/A | 30 |
| Tetrachloroethene | N/A | 65 - 140 | N/A | 30 |
| Toluene | N/A | 70 - 125 | N/A | 30 |
| trans-1,2-Dichloroethene | N/A | 65 - 135 | N/A | 30 |
| trans-1,3-Dichloropropene | N/A | 65 - 125 | N/A | 30 |
| Trichloroethene | N/A | 75 - 125 | N/A | 30 |
| Vinyl chloride | N/A | 60 - 125 | N/A | 30 |

N/A - Not applicable
%R - Percent Recovery
RPD - Relative Percent Difference
VOC - Volatile Organic Compound
Note: Samples will be re-analyzed if more than 5% of the LCS recoveries are below the evaluation criteria or any single recovery is < 1/2 the lower limit.
Samples will be prepared using Method 5035 (soil/sediment) and analyzed by Method 8260B

# TABLE 1-3
# MS/MSD ACCURACY AND PRECISION CRITERIA FOR VOC ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| 1,1,1-Trichloroethane | N/A | 60 - 130 | N/A | 30 |
| 1,1,2,2-Tetrachloroethane | N/A | 60 - 160 | N/A | 30 |
| 1,1,2-Trichloroethane | N/A | 70 - 160 | N/A | 30 |
| 1,1-Dichloroethane | N/A | 70 - 140 | N/A | 30 |
| 1,1-Dichloroethene | N/A | 50 - 140 | N/A | 30 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | N/A | 60 - 140 | N/A | 30 |
| 1,2-Dichloroethane | N/A | 60 - 160 | N/A | 30 |
| 1,2-Dichloropropane | N/A | 70 - 150 | N/A | 30 |
| 2-Butanone | N/A | 40 - 160 | N/A | 30 |
| 2-Hexanone | N/A | 40 - 160 | N/A | 30 |
| 4-Methyl-2-pentanone | N/A | 40 - 160 | N/A | 30 |
| Acetone | N/A | 30 - 160 | N/A | 30 |
| Benzene | N/A | 60 - 150 | N/A | 30 |
| Bromodichloromethane | N/A | 60 - 150 | N/A | 30 |
| Bromoform | N/A | 50 - 160 | N/A | 30 |
| Bromomethane | N/A | 40 - 160 | N/A | 30 |
| Carbon disulfide | N/A | 40 - 140 | N/A | 30 |
| Carbon tetrachloride | N/A | 50 - 150 | N/A | 30 |
| Chlorobenzene | N/A | 70 - 130 | N/A | 30 |
| Chloroethane | N/A | 60 - 150 | N/A | 30 |
| Chloroform | N/A | 70 - 140 | N/A | 30 |
| Chloromethane | N/A | 50 - 150 | N/A | 30 |
| cis-1,2-Dichloroethene | N/A | 70 - 140 | N/A | 30 |
| cis-1,3-Dichloropropene | N/A | 60 - 140 | N/A | 30 |
| Dibromochloromethane | N/A | 70 - 150 | N/A | 30 |
| Dichlorodifluoromethane | N/A | 70 - 130 | N/A | 30 |
| Ethylbenzene | N/A | 70 - 130 | N/A | 30 |
| m,p-Xylenes | N/A | 70 - 130 | N/A | 30 |
| Methylene chloride | N/A | 60 - 150 | N/A | 30 |
| Methyl-tert butyl ether | N/A | 60 - 150 | N/A | 30 |
| o-Xylenes | N/A | 70 - 130 | N/A | 30 |
| Styrene | N/A | 30 - 150 | N/A | 30 |
| Tetrachloroethene | N/A | 70 - 130 | N/A | 30 |
| Toluene | N/A | 70 - 140 | N/A | 30 |
| trans-1,2-Dichloroethene | N/A | 70 - 130 | N/A | 30 |
| trans-1,3-Dichloropropene | N/A | 60 - 150 | N/A | 30 |
| Trichloroethene | N/A | 60 - 140 | N/A | 30 |
| Vinyl chloride | N/A | 60 - 150 | N/A | 30 |

MS/MSD - Matrix Spike/Matrix Spike Duplicate
N/A - Not Applicable
%R - Percent Recovery
RPD - Relative Percent Difference
VOC - Volatile Organic Compound
Samples will be prepared using Method 5035 (soil/sediment) and analyzed by Method 8260B

# TABLE 1-4
# LABORATORY CONTROL SAMPLE ACCURACY AND PRECISION CRITERIA FOR SVOC ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| 1,2,4-Trichlorobenzene | N/A | 45 - 110 | N/A | 30 |
| 1,2-Dichlorobenzene | N/A | 45 - 95 | N/A | 30 |
| 1,3-Dichlorobenzene | N/A | 40 - 100 | N/A | 30 |
| 1,4-Dichlorobenzene | N/A | 35 - 105 | N/A | 30 |
| 2,4,5-Trichlorophenol | N/A | 50 - 110 | N/A | 30 |
| 2,4,6-Trichlorophenol | N/A | 45 - 110 | N/A | 30 |
| 2,4-Dichlorophenol | N/A | 45 - 110 | N/A | 30 |
| 2,4-Dimethylphenol | N/A | 30 - 105 | N/A | 30 |
| 2,4-Dinitrophenol | N/A | 15 - 130 | N/A | 30 |
| 2,4-Dinitrotoluene | N/A | 50 - 115 | N/A | 30 |
| 2,6-Dinitrotoluene | N/A | 50 - 110 | N/A | 30 |
| 2-Chloronaphthalene | N/A | 45 - 105 | N/A | 30 |
| 2-Chlorophenol | N/A | 45 - 105 | N/A | 30 |
| 2-Methylnaphthalene | N/A | 45 - 105 | N/A | 30 |
| 2-Methylphenol | N/A | 40 - 105 | N/A | 30 |
| 2-Nitroaniline | N/A | 45 - 120 | N/A | 30 |
| 2-Nitrophenol | N/A | 40 - 110 | N/A | 30 |
| 3,3'-Dichlorobenzidine | N/A | 10 - 130 | N/A | 30 |
| 3/4-Methylphenol | N/A | 40 - 105 | N/A | 30 |
| 3-Nitroaniline | N/A | 25 - 110 | N/A | 30 |
| 4,6-Dinitro-2-methylphenol | N/A | 30 - 135 | N/A | 30 |
| 4-Bromophenyl phenyl ether | N/A | 45 - 115 | N/A | 30 |
| 4-Chloro-3-methylphenol | N/A | 45 - 115 | N/A | 30 |
| 4-Chloroaniline | N/A | 10 - 95 | N/A | 30 |
| 4-Chlorophenyl phenyl ether | N/A | 45 - 110 | N/A | 30 |
| 4-Nitroaniline | N/A | 35 - 115 | N/A | 30 |
| 4-Nitrophenol | N/A | 15 - 140 | N/A | 30 |
| Acenaphthylene | N/A | 45 - 105 | N/A | 30 |
| Acenaphthene | N/A | 45 - 110 | N/A | 30 |
| Anthracene | N/A | 55 - 105 | N/A | 30 |
| Benzo(a)anthracene | N/A | 50 - 110 | N/A | 30 |
| Benzo(a)pyrene | N/A | 50 - 110 | N/A | 30 |
| Benzo(b)fluoranthene | N/A | 45 - 115 | N/A | 30 |
| Benzo(g,h,i)perylene | N/A | 40 - 125 | N/A | 30 |
| Benzo(k)fluoranthene | N/A | 45 - 125 | N/A | 30 |
| Benzoic acid | N/A | 0 - 110 | N/A | 30 |
| Benzyl alcohol | N/A | 20 - 125 | N/A | 30 |
| bis(2-Chloroethoxy) methane | N/A | 45 - 110 | N/A | 30 |
| bis(2-Chloroethyl) ether | N/A | 40 - 105 | N/A | 30 |
| bis(2-Chloroisopropyl) ether | N/A | 20 - 115 | N/A | 30 |
| bis(2-Ethylhexyl) phthalate | N/A | 45 - 125 | N/A | 30 |
| Butyl benzyl phthalate | N/A | 50 - 125 | N/A | 30 |
| Carbazole | N/A | 45 - 115 | N/A | 30 |
| Chrysene | N/A | 55 - 110 | N/A | 30 |
| Dibenz(a,h)anthracene | N/A | 40 - 125 | N/A | 30 |
| Dibenzofuran | N/A | 50 - 105 | N/A | 30 |
| Diethyl phthalate | N/A | 50 - 115 | N/A | 30 |
| Dimethyl phthalate | N/A | 50 - 110 | N/A | 30 |
| Di-n-butyl phthalate | N/A | 55 - 110 | N/A | 30 |
| Di-n-octyl phthalate | N/A | 40 - 130 | N/A | 30 |
| Fluoranthene | N/A | 55 - 115 | N/A | 30 |

# TABLE 1-4
# LABORATORY CONTROL SAMPLE ACCURACY AND PRECISION CRITERIA FOR SVOC ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| Fluorene | N/A | 50 - 110 | N/A | 30 |
| Hexachlorobenzene | N/A | 45 - 120 | N/A | 30 |
| Hexachlorobutadiene | N/A | 40 - 115 | N/A | 30 |
| Hexachlorocyclopentadiene | N/A | 10 - 130 | N/A | 30 |
| Hexachloroethane | N/A | 35 - 110 | N/A | 30 |
| Indeno(1,2,3-cd)pyrene | N/A | 40 - 120 | N/A | 30 |
| Isophorone | N/A | 45 - 110 | N/A | 30 |
| Naphthalene | N/A | 40 - 105 | N/A | 30 |
| Nitrobenzene | N/A | 40 - 115 | N/A | 30 |
| N-Nitroso-di-n-propylamine | N/A | 40 - 115 | N/A | 30 |
| N-Nitrosodiphenylamine | N/A | 50 - 115 | N/A | 30 |
| Pentachlorophenol | N/A | 25 - 120 | N/A | 30 |
| Phenanthrene | N/A | 50 - 110 | N/A | 30 |
| Phenol | N/A | 40 - 100 | N/A | 30 |
| Pyrene | N/A | 45 - 125 | N/A | 30 |

N/A - Not applicable
%R - Percent Recovery
RPD - Relative Percent Difference
SVOCs - Semivolatile Organic Compound
Note: Samples will be re-analyzed if more than 5% of the LCS recoveries are below the evaluation criteria or any single recovery is < 1/2 the lower limit.
Samples will be prepared using Method 3540C (soil/sediment) and analyzed by Method 8270C

# TABLE 1-5
# MS/MSD ACCURACY AND PRECISION CRITERIA FOR SVOC ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| 1,2,4-Trichlorobenzene | N/A | 10 - 130 | N/A | 50 |
| 1,2-Dichlorobenzene | N/A | 30 - 130 | N/A | 50 |
| 1,3-Dichlorobenzene | N/A | 30 - 130 | N/A | 50 |
| 1,4-Dichlorobenzene | N/A | 10 - 130 | N/A | 50 |
| 2,4,5-Trichlorophenol | N/A | 40 - 130 | N/A | 50 |
| 2,4,6-Trichlorophenol | N/A | 40 - 130 | N/A | 50 |
| 2,4-Dichlorophenol | N/A | 30 - 130 | N/A | 50 |
| 2,4-Dimethylphenol | N/A | 30 - 130 | N/A | 50 |
| 2,4-Dinitrophenol | N/A | 20 - 130 | N/A | 50 |
| 2,4-Dinitrotoluene | N/A | 20 - 130 | N/A | 50 |
| 2,6-Dinitrotoluene | N/A | 50 - 130 | N/A | 50 |
| 2-Chloronaphthalene | N/A | 40 - 130 | N/A | 50 |
| 2-Chlorophenol | N/A | 20 - 130 | N/A | 50 |
| 2-Methylnaphthalene | N/A | 30 - 130 | N/A | 50 |
| 2-Methylphenol | N/A | 30 - 130 | N/A | 50 |
| 2-Nitroaniline | N/A | 40 - 130 | N/A | 50 |
| 2-Nitrophenol | N/A | 30 - 130 | N/A | 50 |
| 3,3'-Dichlorobenzidine | N/A | 40 - 130 | N/A | 50 |
| 3/4-Methylphenol | N/A | 30 - 130 | N/A | 50 |
| 3-Nitroaniline | N/A | 50 - 130 | N/A | 50 |
| 4,6-Dinitro-2-methylphenol | N/A | 40 - 130 | N/A | 50 |
| 4-Bromophenyl phenyl ether | N/A | 50 - 130 | N/A | 50 |
| 4-Chloro-3-methylphenol | N/A | 30 - 130 | N/A | 50 |
| 4-Chloroaniline | N/A | 30 - 130 | N/A | 50 |
| 4-Chlorophenyl phenyl ether | N/A | 50 - 130 | N/A | 50 |
| 4-Nitroaniline | N/A | 50 - 130 | N/A | 50 |
| 4-Nitrophenol | N/A | 20 - 130 | N/A | 50 |
| Acenaphthylene | N/A | 30 - 130 | N/A | 50 |
| Acenaphthene | N/A | 20 - 130 | N/A | 50 |
| Anthracene | N/A | 30 - 130 | N/A | 50 |
| Benzo(a)anthracene | N/A | 40 - 130 | N/A | 50 |
| Benzo(a)pyrene | N/A | 40 - 130 | N/A | 50 |
| Benzo(b)fluoranthene | N/A | 50 - 130 | N/A | 50 |
| Benzo(g,h,i)perylene | N/A | 40 - 130 | N/A | 50 |
| Benzo(k)fluoranthene | N/A | 40 - 130 | N/A | 50 |
| Benzoic acid | N/A | 10 - 130 | N/A | 50 |
| Benzyl alcohol | N/A | 30 - 130 | N/A | 50 |
| bis(2-Chloroethoxy) methane | N/A | 30 - 130 | N/A | 50 |
| bis(2-Chloroethyl) ether | N/A | 20 - 130 | N/A | 50 |
| bis(2-Chloroisopropyl) ether | N/A | 20 - 130 | N/A | 50 |
| bis(2-Ethylhexyl) phthalate | N/A | 50 - 130 | N/A | 50 |
| Butyl benzyl phthalate | N/A | 50 - 130 | N/A | 50 |
| Carbazole | N/A | 50 - 130 | N/A | 50 |
| Chrysene | N/A | 40 - 130 | N/A | 50 |
| Dibenz(a,h)anthracene | N/A | 40 - 130 | N/A | 50 |
| Dibenzofuran | N/A | 40 - 130 | N/A | 50 |
| Diethyl phthalate | N/A | 50 - 130 | N/A | 50 |
| Dimethyl phthalate | N/A | 50 - 130 | N/A | 50 |
| Di-n-butyl phthalate | N/A | 50 - 130 | N/A | 50 |
| Di-n-octyl phthalate | N/A | 50 - 130 | N/A | 50 |

# TABLE 1-5
# MS/MSD ACCURACY AND PRECISION CRITERIA FOR SVOC ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| Fluoranthene | N/A | 40 - 130 | N/A | 50 |
| Fluorene | N/A | 30 - 130 | N/A | 50 |
| Hexachlorobenzene | N/A | 10 - 160 | N/A | 50 |
| Hexachlorobutadiene | N/A | 30 - 130 | N/A | 50 |
| Hexachlorocyclopentadiene | N/A | 10 - 130 | N/A | 50 |
| Hexachloroethane | N/A | 30 - 130 | N/A | 50 |
| Indeno(1,2,3-cd)pyrene | N/A | 40 - 130 | N/A | 50 |
| Isophorone | N/A | 40 - 130 | N/A | 50 |
| Naphthalene | N/A | 20 - 130 | N/A | 50 |
| Nitrobenzene | N/A | 30 - 130 | N/A | 50 |
| N-Nitroso-di-n-propylamine | N/A | 20 - 130 | N/A | 50 |
| N-Nitrosodiphenylamine | N/A | 20 - 140 | N/A | 50 |
| Pentachlorophenol | N/A | 20 - 130 | N/A | 50 |
| Phenanthrene | N/A | 30 - 130 | N/A | 50 |
| Phenol | N/A | 20 - 130 | N/A | 50 |
| Pyrene | N/A | 10 - 160 | N/A | 50 |

MS/MSD - Matrix Spike/Matrix Spike Duplicate
N/A - Not applicable
%R - Percent Recovery
RPD - Relative Percent Difference
SVOC - Semivolatile Organic Compound
Samples will be prepared using Method 3540C (soil/sediment) and analyzed by Method 8270C

# TABLE 1-6
# LABORATORY CONTROL SAMPLE ACCURACY AND PRECISION CRITERIA FOR PAH ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| Acenaphthylene | N/A | 45 - 105 | N/A | 30 |
| Acenaphthene | N/A | 45 - 110 | N/A | 30 |
| Anthracene | N/A | 55 - 105 | N/A | 30 |
| Benzo(a)anthracene | N/A | 50 - 110 | N/A | 30 |
| Benzo(a)pyrene | N/A | 50 - 110 | N/A | 30 |
| Benzo(b)fluoranthene | N/A | 45 - 115 | N/A | 30 |
| Benzo(g,h,i)perylene | N/A | 40 - 125 | N/A | 30 |
| Benzo(k)fluoranthene | N/A | 45 - 125 | N/A | 30 |
| Chrysene | N/A | 55 - 110 | N/A | 30 |
| Dibenz(a,h)anthracene | N/A | 40 - 125 | N/A | 30 |
| Fluoranthene | N/A | 55 - 115 | N/A | 30 |
| Fluorene | N/A | 50 - 110 | N/A | 30 |
| Indeno(1,2,3-cd)pyrene | N/A | 40 - 120 | N/A | 30 |
| Naphthalene | N/A | 40 - 105 | N/A | 30 |
| Phenanthrene | N/A | 50 - 110 | N/A | 30 |
| Pyrene | N/A | 45 - 125 | N/A | 30 |

N/A - Not applicable
PAH - Polynuclear Aromatic Hydrocarbon
%R - Percent Recovery
RPD - Relative Percent Difference
Note: Samples will be re-analyzed if more than 5% of the LCS recoveries are below the evaluation criteria or any single recovery is < 1/2 the lower limit.
Samples will be prepared using Method 3540C (soil/sediment) and analyzed by Method 8270C-SIM

# TABLE 1-7
# MS/MSD ACCURACY AND PRECISION CRITERIA FOR PAH ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| Acenaphthylene | N/A | 30 - 130 | N/A | 50 |
| Acenaphthene | N/A | 20 - 130 | N/A | 50 |
| Anthracene | N/A | 30 - 130 | N/A | 50 |
| Benzo(a)anthracene | N/A | 40 - 130 | N/A | 50 |
| Benzo(a)pyrene | N/A | 40 - 130 | N/A | 50 |
| Benzo(b)fluoranthene | N/A | 50 - 130 | N/A | 50 |
| Benzo(g,h,i)perylene | N/A | 40 - 130 | N/A | 50 |
| Benzo(k)fluoranthene | N/A | 40 - 130 | N/A | 50 |
| Chrysene | N/A | 40 - 130 | N/A | 50 |
| Dibenz(a,h)anthracene | N/A | 40 - 130 | N/A | 50 |
| Fluoranthene | N/A | 40 - 130 | N/A | 50 |
| Fluorene | N/A | 30 - 130 | N/A | 50 |
| Indeno(1,2,3-cd)pyrene | N/A | 40 - 130 | N/A | 50 |
| Naphthalene | N/A | 20 - 130 | N/A | 50 |
| Phenanthrene | N/A | 30 - 130 | N/A | 50 |
| Pyrene | N/A | 10 - 160 | N/A | 50 |

MS/MSD - Matrix Spike/Matrix Spike Duplicate
N/A - Not applicable
PAH - Polynuclear Aromatic Hydrocarbon
%R - Percent Recovery
RPD - Relative Percent Difference
Samples will be prepared using Method 3540C (soil/sediment) and analyzed by Method 8270C-SIM

# TABLE 1-8
# LABORATORY CONTROL SAMPLE ACCURACY AND PRECISION CRITERIA FOR NITROAROMATIC/NITRAMINE ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| 1,3,5-Trinitrobenzene | 65 - 140 | 75 - 125 | 30 | 30 |
| 1,3-Dinitrobenzene | 45 - 160 | 80 - 125 | 30 | 30 |
| 2,4,6-Trinitrotoluene | 50 - 145 | 55 - 140 | 30 | 30 |
| 2,4-Dinitrotoluene | 60 - 135 | 80 - 125 | 30 | 30 |
| 2,6-Dinitrotoluene | 60 - 135 | 80 - 120 | 30 | 30 |
| 2-Amino-4,6-Dinitrotoluene | 50 - 155 | 80 - 125 | 30 | 30 |
| 2-Nitrotoluene | 45 - 135 | 80 - 125 | 30 | 30 |
| 3-Nitrotoluene | 50 - 130 | 75 - 120 | 30 | 30 |
| 4-Amino-2,6-Dinitrotoluene | 55 - 155 | 80 - 125 | 30 | 30 |
| 4-Nitrotoluene | 50 - 130 | 75 - 125 | 30 | 30 |
| HMX | 80 - 115 | 75 - 125 | 30 | 30 |
| Nitrobenzene | 50 - 140 | 75 - 125 | 30 | 30 |
| RDX | 50 - 160 | 70 - 135 | 30 | 30 |
| Tetryl | 70 - 130 | 10 - 150 | 30 | 30 |

HMX - Cyclotetramethylenetetranitramine

%R - Percent Recovery
RDX - Cyclotrimethylenetrinitramine
RPD - Relative Percent Difference
Note: Samples will be re-analyzed if more than one of the LCS recoveries are below the evaluation criteria or any single recovery is < 1/2 the lower limit.
Samples will be prepared and analyzed using Method 8330

# TABLE 1-9
# MS/MSD ACCURACY AND PRECISION CRITERIA FOR NITROAROMATIC/NITRAMINE ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| 1,3,5-Trinitrobenzene | 70 - 130 | 70 - 130 | 30 | 50 |
| 1,3-Dinitrobenzene | 60 - 130 | 70 - 130 | 30 | 50 |
| 2,4,6-Trinitrotoluene | 70 - 130 | 70 - 130 | 30 | 50 |
| 2,4-Dinitrotoluene | 70 - 130 | 70 - 130 | 30 | 50 |
| 2,6-Dinitrotoluene | 70 - 130 | 70 - 130 | 30 | 50 |
| 2-Amino-4,6-Dinitrotoluene | 70 - 130 | 70 - 130 | 30 | 50 |
| 2-Nitrotoluene | 60 - 130 | 70 - 130 | 30 | 50 |
| 3-Nitrotoluene | 60 - 130 | 70 - 130 | 30 | 50 |
| 4-Amino-2,6-Dinitrotoluene | 70 - 130 | 70 - 130 | 30 | 50 |
| 4-Nitrotoluene | 60 - 130 | 70 - 130 | 30 | 50 |
| HMX | 70 - 130 | 70 - 130 | 30 | 50 |
| Nitrobenzene | 60 - 130 | 70 - 130 | 30 | 50 |
| RDX | 60 - 130 | 70 - 130 | 30 | 50 |
| Tetryl | 60 - 130 | 60 - 130 | 30 | 50 |

HMX - Cyclotetramethylenetetranitramine

MS/MSD - Matrix Spike/Matrix Spike Duplicate
%R - Percent Recovery
RDX - Cyclotrimethylenetrinitramine
RPD - Relative Percent Difference
Samples will be prepared and analyzed using Method 8330

# TABLE 1-10
# LABORATORY CONTROL SAMPLE ACCURACY AND PRECISION CRITERIA FOR ORGANOCHLORINE PESTICIDE/POLYCHLORINATED BIPHENYL ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| ***Organochlorine pesticides*** | | | | |
| Aldrin | 25 - 140 | 45 - 140 | 30 | 50 |
| alpha-BHC | 60 - 130 | 60 - 125 | 30 | 50 |
| beta-BHC | 65 - 125 | 60 - 125 | 30 | 50 |
| delta-BHC | 45 - 135 | 55 - 130 | 30 | 50 |
| gamma-BHC | 25 - 135 | 60 - 125 | 30 | 50 |
| alpha-Chlordane | 65 - 125 | 65 - 120 | 30 | 50 |
| gamma-Chlordane | 60 - 125 | 65 - 125 | 30 | 50 |
| 4,4'-DDD | 25 - 150 | 30 - 135 | 30 | 50 |
| 4,4'-DDE | 35 - 140 | 70 - 125 | 30 | 50 |
| 4,4'-DDT | 45 - 140 | 45 - 140 | 30 | 50 |
| Dieldrin | 60 - 130 | 65 - 125 | 30 | 50 |
| Endosulfan I | 50 - 110 | 15 - 135 | 30 | 50 |
| Endosulfan II | 30 - 130 | 35 - 140 | 30 | 50 |
| Endosulfan sulfate | 55 - 135 | 60 - 135 | 30 | 50 |
| Endrin | 55 - 135 | 60 - 135 | 30 | 50 |
| Endrin aldehyde | 55 - 135 | 35 - 145 | 30 | 50 |
| Endrin ketone | 75 - 125 | 65 - 135 | 30 | 50 |
| Heptachlor | 40 - 130 | 50 - 140 | 30 | 50 |
| Heptachlor epoxide | 60 - 130 | 65 - 130 | 30 | 50 |
| Methoxychlor | 55 - 150 | 55 - 145 | 30 | 50 |
| ***Polychlorinated Biphenyls*** | | | | |
| Aroclor 1016 | 25 - 145 | 40 - 140 | 30 | 50 |
| Aroclor 1260 | 30 - 145 | 60 - 130 | 30 | 50 |

N/A - Not applicable
%R - Percent Recovery
RPD - Relative Percent Difference
Note: Samples will be re-analyzed if more than 5% of the LCS recoveries are below the evaluation criteria or any single recovery is < 1/2 the lower limit.
Samples will be prepared using Methods 3540C (soil/sediment) and 3520C (aqueous) and analyzed by Methods 8081A and 8082.

# TABLE 1-11
# MS/MSD ACCURACY AND PRECISION CRITERIA FOR ORGANOCHLORINE PESTICIDE/POLYCHLORINATED BIPHENYL ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| ***Organochlorine pesticides*** | | | | |
| Aldrin | 40 - 140 | 20 - 160 | 30 | 50 |
| alpha-BHC | 30 - 150 | 30 - 150 | 30 | 50 |
| beta-BHC | 30 - 150 | 50 - 140 | 30 | 50 |
| delta-BHC | 30 - 150 | 30 - 150 | 30 | 50 |
| gamma-BHC | 50 - 130 | 20 - 150 | 30 | 50 |
| alpha-Chlordane | 30 - 150 | 50 - 140 | 30 | 50 |
| gamma-Chlordane | 30 - 150 | 60 - 160 | 30 | 50 |
| 4,4'-DDD | 30 - 150 | 50 - 160 | 30 | 50 |
| 4,4'-DDE | 30 - 150 | 50 - 150 | 30 | 50 |
| 4,4'-DDT | 60 - 140 | 30 - 160 | 30 | 50 |
| Dieldrin | 50 - 160 | 10 - 160 | 30 | 50 |
| Endosulfan I | 30 - 150 | 50 - 160 | 30 | 50 |
| Endosulfan II | 30 - 150 | 40 - 160 | 30 | 50 |
| Endosulfan sulfate | 30 - 150 | 40 - 160 | 30 | 50 |
| Endrin | 50 - 140 | 20 - 160 | 30 | 50 |
| Endrin aldehyde | 30 - 150 | 50 - 140 | 30 | 50 |
| Endrin ketone | 30 - 150 | 50 - 160 | 30 | 50 |
| Heptachlor | 40 - 130 | 20 - 140 | 30 | 50 |
| Heptachlor epoxide | 30 - 150 | 40 - 140 | 30 | 50 |
| Methoxychlor | 30 - 150 | 60 - 160 | 30 | 50 |
| ***Polychlorinated Biphenyls*** | | | | |
| Aroclor 1016 | 50 - 130 | 20 - 160 | 30 | 50 |
| Aroclor 1260 | 70 - 160 | 20 - 160 | 30 | 50 |

MS/MSD - Matrix Spike/Matrix Spike Duplicate
%R - Percent Recovery
RPD - Relative Percent Difference
Samples will be prepared using Method 3540C (soil/sediment) and analyzed by Methods 8081A and 8082

# TABLE 1-12
# LABORATORY CONTROL SAMPLE ACCURACY AND PRECISION CRITERIA FOR METALS ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| Aluminum | 80 - 120 | 80 - 120 | 20 | 20 |
| Antimony | 80 - 120 | 80 - 120 | 20 | 20 |
| Arsenic | 80 - 120 | 80 - 120 | 20 | 20 |
| Barium | 80 - 120 | 80 - 120 | 20 | 20 |
| Beryllium | 80 - 120 | 80 - 120 | 20 | 20 |
| Cadmium | 80 - 120 | 80 - 120 | 20 | 20 |
| Calcium | 80 - 120 | 80 - 120 | 20 | 20 |
| Chromium | 80 - 120 | 80 - 120 | 20 | 20 |
| Cobalt | 80 - 120 | 80 - 120 | 20 | 20 |
| Copper | 80 - 120 | 80 - 120 | 20 | 20 |
| Iron | 80 - 120 | 80 - 120 | 20 | 20 |
| Lead | 80 - 120 | 80 - 120 | 20 | 20 |
| Magnesium | 80 - 120 | 80 - 120 | 20 | 20 |
| Manganese | 80 - 120 | 80 - 120 | 20 | 20 |
| Mercury* | 80 - 120 | 80 - 120 | 20 | 20 |
| Nickel | 80 - 120 | 80 - 120 | 20 | 20 |
| Potassium | 80 - 120 | 80 - 120 | 20 | 20 |
| Selenium | 80 - 120 | 80 - 120 | 20 | 20 |
| Silver | 80 - 120 | 75 - 120 | 20 | 20 |
| Sodium | 80 - 120 | 80 - 120 | 20 | 20 |
| Thallium | 80 - 120 | 80 - 120 | 20 | 20 |
| Vanadium | 80 - 120 | 80 - 120 | 20 | 20 |
| Zinc | 80 - 120 | 80 - 120 | 20 | 20 |

N/A - Not Applicable
%R - Percent Recovery
RPD - Relative Percent Difference
Note: Samples will be re-analyzed if more than 5% of the LCS recoveries are below the evaluation criteria or any single recovery is < 1/2 the lower limit.
All metals will be prepared by Methods 3050B (soil/sediment) and 3010A (aqueous) and analyzed by Method 6010B unless noted otherwise
*Prepared and analyzed by Methods 7470A (aqueous) / 7471A (soil/sediment)

# TABLE 1-13
# MS/MD ACCURACY AND PRECISION CRITERIA FOR METALS ANALYSIS

| Spiking Compound | Accuracy (%R) | | Precision (RPD) | |
|---|---|---|---|---|
| | Aqueous | Soil/Sediment | Aqueous | Soil/Sediment |
| Aluminum | 75 - 125 | 75 - 125 | 20 | 20 |
| Antimony | 75 - 125 | 75 - 125 | 20 | 20 |
| Arsenic | 75 - 125 | 75 - 125 | 20 | 20 |
| Barium | 75 - 125 | 75 - 125 | 20 | 20 |
| Beryllium | 75 - 125 | 75 - 125 | 20 | 20 |
| Cadmium | 75 - 125 | 75 - 125 | 20 | 20 |
| Calcium | 75 - 125 | 75 - 125 | 20 | 20 |
| Chromium | 75 - 125 | 75 - 125 | 20 | 20 |
| Cobalt | 75 - 125 | 75 - 125 | 20 | 20 |
| Copper | 75 - 125 | 75 - 125 | 20 | 20 |
| Iron | 75 - 125 | 75 - 125 | 20 | 20 |
| Lead | 75 - 125 | 75 - 125 | 20 | 20 |
| Magnesium | 75 - 125 | 75 - 125 | 20 | 20 |
| Manganese | 75 - 125 | 75 - 125 | 20 | 20 |
| Mercury* | 75 - 125 | 75 - 125 | 20 | 20 |
| Nickel | 75 - 125 | 75 - 125 | 20 | 20 |
| Potassium | 75 - 125 | 75 - 125 | 20 | 20 |
| Selenium | 75 - 125 | 75 - 125 | 20 | 20 |
| Silver | 75 - 125 | 75 - 125 | 20 | 20 |
| Sodium | 75 - 125 | 75 - 125 | 20 | 20 |
| Thallium | 75 - 125 | 75 - 125 | 20 | 20 |
| Vanadium | 75 - 125 | 75 - 125 | 20 | 20 |
| Zinc | 75 - 125 | 75 - 125 | 20 | 20 |

MS/MD - Matrix Spike/Matrix Duplicate
N/A - Not Applicable
%R - Percent Recovery
RPD - Relative Percent Difference

All metals will be prepared by Methods 3050B (soil/sediment) and 3010A (aqueous) and analyzed by Method 6010B unless noted otherwise

*Prepared and analyzed by Methods 7470A (aqueous) / 7471A (soil/sediment)

# TABLE 1-14
# SURROGATE COMPOUND ACCURACY CRITERIA FOR ORGANIC PARAMETERS

| Analysis | Spiking Compound | Accuracy | |
|---|---|---|---|
| | | Aqueous | Soil/Sediment |
| **VOCs** | 1,2-Dichloroethane-$d_4$ | N/A | 70 - 140 |
| | 4-Bromofluorobenzene | N/A | 85 - 120 |
| | Toluene-$d_8$ | N/A | 85 - 115 |
| **SVOCs/PAHs** | 2,4,6-Tribromophenol | N/A | 35 - 125 |
| | 2-Fluorobiphenyl | N/A | 45 - 105 |
| | 2-Fluorophenol | N/A | 35 - 105 |
| | Nitrobenzene-$d_5$ | N/A | 35 - 100 |
| | Phenol-$d_5$ | N/A | 40 - 100 |
| | Terphenyl-$d_{14}$ | N/A | 30 - 125 |
| | Tetrachloro-m-xylene | 30 - 130 | 70 - 125 |

N/A -Not applicable
PAHs - Polynuclear Aromatic Hydrocarbons
SVOCs - Semivolatile Organic Compounds
VOCs - Volatile Organic Compounds

# TABLE 1-15
# LABORATORY ANALYTICAL METHODS

| Parameter | Analyte List | Preparation Method | | Method Reference |
|---|---|---|---|---|
| | | Aqueous | Soil/Sediment | |
| Volatile Organic Compounds | See QAPP Table 1-16 | N/A | 5035 | USEPA SW-846 8260B |
| Semivolatile Organic Compounds | See QAPP Table 1-17 | N/A | 3540C | USEPA SW-846 8270C |
| Metals | See QAPP Table 1-23 | 3010A/7470A | 3050B/7471A | USEPA SW-846 6010B/7470A/7471A |

Note: All metals will be analyzed by Method 6010B with the exception of mercury (7470A/7471A).
USEPA SW-846 - USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Properties, Final Update IIIB, June 2005

N/A -Not applicable
[1] Preparation method is provided in the analytical method.

# TABLE 1-16
# METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR VOCs

| Volatile Organic Compounds (µg/kg) | MDL | RL |
|---|---|---|
| 1,1,1-Trichloroethane | 2 | 5 |
| 1,1,2,2-Tetrachloroethane | 2 | 5 |
| 1,1,2-Trichloroethane | 2 | 5 |
| 1,1-Dichloroethane | 2 | 5 |
| 1,1-Dichloroethene | 2 | 5 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 2 | 5 |
| 1,2-Dichloroethane | 2 | 5 |
| 1,2-Dichloropropane | 2 | 5 |
| 2-Butanone | 5 | 10 |
| 2-Hexanone | 5 | 10 |
| 4-Methyl-2-Pentanone (MIBK) | 5 | 10 |
| Acetone | 5 | 10 |
| Benzene | 2 | 5 |
| Bromodichloromethane | 2 | 5 |
| Bromoform | 2 | 5 |
| Bromomethane | 2 | 5 |
| Carbon disulfide | 2 | 5 |
| Carbon tetrachloride | 2 | 5 |
| Chlorobenzene | 2 | 5 |
| Chloroethane | 2 | 10 |
| Chloroform | 2 | 5 |
| Chloromethane | 2 | 5 |
| cis-1,2-Dichlorethene | 2 | 5 |
| cis-1,3-Dichloropropene** | 2 | 5 |
| Dibromochloromethane | 2 | 5 |
| Dichlorodifluoromethane | 3 | 10 |
| Ethylbenzene | 2 | 5 |
| m,p-Xylene* | 2 | 10 |
| Methylene chloride | 2 | 10 |
| Methyl-tert butyl ether | 2 | 5 |
| o-Xylene* | 2 | 5 |
| Styrene | 2 | 5 |
| Tetrachloroethene | 2 | 5 |
| Toluene | 2 | 5 |
| trans-1,2-Dichloroethene | 2 | 5 |
| trans-1,3-Dichloropropene** | 2 | 5 |
| Trichloroethene | 2 | 5 |
| Vinyl chloride | 2 | 5 |

Notes: 1. Values detected above the MDL and below the RL will b

2. The actual RLs may be higher than those listed above. T
adjusted for moisture content and sample volume variatio

MDL - Method Detection Limit
N/A - Not Applicable
RL - Reporting Limit
µg/kg - microgram per kilogram
VOCs - Volatile Organic Compounds
Samples will be prepared using Methods 5035 (soil and sediment)
* KDHE pathway for Xylene (mixed)
** KDHE pathway for 1,3-Dichloropropene

# TABLE 1-17
# METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR SVOCs

| Semivolatile Organic Hydrocarbons (µg/kg) | MDL | RL |
|---|---|---|
| 1,2,4-Trichlorobenzene | 167 | 330 |
| 1,2-Dichlorobenzene | 167 | 330 |
| 1,3-Dichlorobenzene | 167 | 330 |
| 1,4-Dichlorobenzene | 167 | 330 |
| 2,4,5-Trichlorophenol | 167 | 330 |
| 2,4,6-Trichlorophenol | 184 | 330 |
| 2,4-Dichlorophenol | 167 | 330 |
| 2,4-Dimethylphenol | 167 | 330 |
| 2,4-Dinitrophenol | 167 | 660 |
| 2,4-Dinitrotoluene | 167 | 330 |
| 2,6-Dinitrotoluene | 167 | 330 |
| 2-Chloronaphthalene | 167 | 330 |
| 2-Chlorophenol | 167 | 330 |
| 2-Methylnaphthalene | 167 | 330 |
| 2-Methylphenol | 167 | 330 |
| 2-Nitroaniline | 167 | 330 |
| 2-Nitrophenol | 167 | 330 |
| 3,3'-Dichlorobenzidine | 167 | 330 |
| 3-Nitroaniline | 167 | 330 |
| 4,6-Dinitro-2-methylphenol | 167 | 660 |
| 4-Bromophenyl phenyl ether | 167 | 330 |
| 4-Chloro-3-methylphenol | 167 | 330 |
| 4-Chloroaniline | 167 | 330 |
| 4-Chlorophenyl phenyl ether | 167 | 330 |
| 4-Methylphenol | 167 | 330 |
| 4-Nitroaniline | 167 | 330 |
| 4-Nitrophenol | 167 | 660 |
| Acenaphthylene | 167 | 330 |
| Acenaphthene | 167 | 330 |
| Anthracene | 167 | 330 |
| Benzo(a)anthracene | 167 | 330 |
| Benzo(a)pyrene | 167 | 330 |
| Benzo(b)fluoranthene | 167 | 330 |
| Benzo(g,h,i)perylene | 167 | 330 |
| Benzo(k)fluoranthene | 167 | 330 |
| Benzoic acid | 420 | 830 |
| Benzyl alcohol | 167 | 330 |
| bis(2-Chloroethoxy) methane | 167 | 330 |
| bis(2-Chloroethyl) ether | 167 | 330 |
| bis(2-Chloroisopropyl) ether | 167 | 330 |
| bis(2-Ethylhexyl) phthalate | 167 | 330 |
| Butyl benzyl phthalate | 167 | 330 |
| Carbazole | 167 | 330 |
| Chrysene | 167 | 330 |
| Dibenz(a,h)anthracene | 167 | 330 |
| Dibenzofuran | 167 | 330 |
| Diethyl phthalate | 167 | 330 |

# TABLE 1-17
# METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR SVOCs

| Semivolatile Organic Hydrocarbons (µg/kg) | MDL | RL |
|---|---|---|
| Dimethyl phthalate | 167 | 330 |
| Di-n-butyl phthalate | 167 | 330 |
| Di-n-octyl phthalate | 167 | 330 |
| Fluoranthene | 167 | 330 |
| Fluorene | 167 | 330 |
| Hexachlorobenzene | 167 | 330 |
| Hexachlorobutadiene | 190 | 330 |
| Hexachlorocyclopentadiene | 167 | 330 |
| Hexachloroethane | 167 | 330 |
| Indeno(1,2,3-cd)pyrene | 167 | 330 |
| Isophorone | 167 | 330 |
| Naphthalene | 167 | 330 |
| Nitrobenzene | 167 | 330 |
| N-Nitroso-di-n-propylamine | 167 | 330 |
| N-Nitrosodiphenylamine | 167 | 330 |
| Pentachlorophenol | 175 | 660 |
| Phenanthrene | 167 | 330 |
| Phenol | 167 | 330 |
| Pyrene | 167 | 330 |

Notes: 1. Values detected above the MDL and below the I
2. The actual RLs will be higher than those listed a
for moisture content.

MDL - Method Detection Limit
N/A - Not Applicable
RL - Reporting Limit
µg/kg - micrograms per kilogram
Samples will be prepared using Method 3540C and analyz

# TABLE 1-18
# METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR PAHs

| Polynuclear Aromatic Hydrocarbons (µg/kg) | MDL | RL |
|---|---|---|
| Acenaphthylene | 10 | 20 |
| Acenaphthene | 10 | 20 |
| Anthracene | 10 | 20 |
| Benzo(a)anthracene | 10 | 20 |
| Benzo(a)pyrene | 10 | 20 |
| Benzo(b)fluoranthene | 10 | 20 |
| Benzo(g,h,i)perylene | 10 | 20 |
| Benzo(k)fluoranthene | 10 | 20 |
| Chrysene | 10 | 20 |
| Dibenz(a,h)anthracene | 10 | 20 |
| Fluoranthene | 10 | 20 |
| Fluorene | 10 | 20 |
| Indeno(1,2,3-cd)pyrene | 10 | 20 |
| Naphthalene | 10 | 20 |
| Phenanthrene | 10 | 20 |
| Pyrene | 10 | 20 |

Notes: 1. Values detected above the MDL and below the
2. The actual RLs will be higher than those listed a
for moisture content.

MDL - Method Detection Limit
N/A - Not applicable
RL - Reporting Limit
µg/kg - microgram per kilogram
Samples will be prepared using Method 3540C and analy

# TABLE 1-19
# METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR NITROAROMATICS/NITRAMINES

| Nitroaromatics/Nitramines (µg/kg) | MDL | RL |
|---|---|---|
| 1,3,5-Trinitrobenzene | 200 | 400 |
| 1,3-Dinitrobenzene | 200 | 400 |
| 2,4,6-Trinitrotoluene | 200 | 400 |
| 2,4-Dinitrotoluene | 200 | 400 |
| 2,6-Dinitrotoluene | 200 | 400 |
| 2-Amino-4,6-Dinitrotoluene | 200 | 400 |
| 2-Nitrotoluene | 200 | 400 |
| 3-Nitrotoluene | 200 | 400 |
| 4-Amino-2,6-Dinitrotoluene | 200 | 400 |
| 4-Nitrotoluene | 200 | 400 |
| HMX | 200 | 400 |
| Nitrobenzene | 200 | 400 |
| RDX | 200 | 400 |
| Tetryl | 200 | 400 |

Notes: 1. Values detected above the MDL and below the
2. The actual RLs will be higher than those listed for moisture content.

MDL - Method Detection Limit
N/A - Not Applicable
RL - Reporting Limit
µg/kg- microgram per kilogram
Samples will be prepared and analyzed using Method 83

# TABLE 1-20
# METHOD DETECTION LIMITS AND REPORTING LIMITS FOR AQUEOUS SAMPLES ANALYZED FOR NITROAROMATICS/NITRAMINES

| Nitroaromatics/Nitramines (µg/L) | MDL | RL |
|---|---|---|
| 1,3,5-Trinitrobenzene | 0.2 | 1 |
| 1,3-Dinitrobenzene | 0.2 | 1 |
| 2,4,6-Trinitrotoluene | 0.2 | 1 |
| 2,4-Dinitrotoluene | 0.2 | 1 |
| 2,6-Dinitrotoluene | 0.2 | 1 |
| 2-Amino-4,6-Dinitrotoluene | 0.2 | 1 |
| 2-Nitrotoluene | 0.2 | 1 |
| 3-Nitrotoluene | 0.3 | 1 |
| 4-Amino-2,6-Dinitrotoluene | 0.2 | 1 |
| 4-Nitrotoluene | 0.2 | 1 |
| HMX | 0.2 | 1 |
| Nitrobenzene | 0.2 | 1 |
| RDX | 0.2 | 1 |
| Tetryl | 0.2 | 1 |

Note: Values detected above the MDL and below the RL will be

MDL - Method Detection Limit
N/A - Not Applicable
RL - Reporting Limit
µg/L - microgram per liter
USEPA - United States Environmental Protection Agency
Samples will be prepared and analyzed using Method 8330

# TABLE 1-21
# METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR ORGANOCHLORINE PESTICIDES/POLYCHLORINATED BIPHENYLS

| Organochlorine Pesticides (µg/kg) | MDL | RL |
|---|---|---|
| Aldrin | 0.6 | 2 |
| alpha-BHC* | 0.6 | 2 |
| beta-BHC* | 0.6 | 2 |
| delta-BHC* | 0.6 | 2 |
| gamma-BHC (lindane) | 0.6 | 2 |
| alpha-Chlordane** | 0.6 | 2 |
| gamma-Chlordane** | 0.6 | 2 |
| 4,4'-DDD | 1.2 | 4 |
| 4,4'-DDE | 1.2 | 4 |
| 4,4'-DDT | 1.2 | 4 |
| Dieldrin | 1.2 | 4 |
| Endosulfan I*** | 0.6 | 2 |
| Endosulfan II*** | 1.2 | 4 |
| Endosulfan sulfate*** | 1.5 | 4 |
| Endrin | 1.2 | 4 |
| Endrin aldehyde**** | 1.2 | 4 |
| Endrin ketone**** | 1.2 | 4 |
| Heptachlor | 0.6 | 2 |
| Heptachlor epoxide | 0.6 | 2 |
| Methoxychlor | 4 | 20 |
| **Polychlorinated Biphenyls (µg/kg)** | | |
| Aroclor 1016# | 20 | 50 |
| Aroclor 1221# | 20 | 50 |
| Aroclor 1232# | 20 | 50 |
| Aroclor 1242# | 20 | 50 |
| Aroclor 1248# | 20 | 50 |
| Aroclor 1254# | 20 | 50 |
| Aroclor 1260# | 20 | 50 |

Notes: 1. Values detected above the MDL and below the RL wi
2. The actual RLs will be higher than those listed above.
for moisture content.

KDHE - Kansas Department of Health and Environment
KSAAP - Kansas Army Ammunition Plant
MDL - Method Detection Limit
RL - Reporting Limit
µg/kg- microgram per kilogram
Samples will be prepared using Method 3540C and analyzed by
* KDHE for Lindane
** KDHE for Chlordane
*** KDHE pathway for Endosulfan
**** KDHE pathway for Endrin
# KDHE pathway for PCBs

# TABLE 1-22
# METHOD DETECTION LIMITS AND REPORTING LIMITS FOR AQUEOUS SAMPLES ANALYZED FOR ORGANOCHLORINE PESTICIDES/POLYCHLORINATED BIPHENYLS KSAAP SI

| Organochlorine Pesticides (µg/L) | MDL | RL | Sensitivity Goal | KDHE Residential Groundwater Pathway | KDHE Non-Residential Groundwater Pathway |
|---|---|---|---|---|---|
| Aldrin | 0.02 | 0.1 | | 0.05 | 0.2 |
| alpha-BHC* | 0.02 | 0.1 | | 0.2 | 0.2 |
| beta-BHC* | 0.02 | 0.1 | | 0.2 | 0.2 |
| delta-BHC* | 0.02 | 0.1 | | 0.2 | 0.2 |
| gamma-BHC (lindane) | 0.02 | 0.1 | | 0.2 | 0.2 |
| alpha-Chlordane** | 0.02 | 0.1 | | 2 | 2 |
| gamma-Chlordane** | 0.02 | 0.1 | | 2 | 2 |
| 4,4'-DDD | 0.02 | 0.2 | | 0.9 | 3 |
| 4,4'-DDE | 0.02 | 0.2 | | 0.7 | 2 |
| 4,4'-DDT | 0.02 | 0.2 | | 0.5 | 2 |
| Dieldrin | 0.02 | 0.2 | | 0.05 | 0.2 |
| Endosulfan I*** | 0.02 | 0.1 | | 90 | 590 |
| Endosulfan II*** | 0.02 | 0.2 | | 90 | 590 |
| Endosulfan sulfate*** | 0.02 | 0.2 | | 90 | 590 |
| Endrin | 0.02 | 0.2 | | 2 | 2 |
| Endrin aldehyde**** | 0.02 | 0.2 | | 2 | 2 |
| Endrin ketone**** | 0.02 | 0.2 | | 2 | 2 |
| Heptachlor | 0.02 | 0.1 | | 0.4 | 0.4 |
| Heptachlor epoxide | 0.02 | 0.1 | | 0.2 | 0.2 |
| Methoxychlor | 0.2 | 1 | | 40 | 40 |
| **Polychlorinated Biphenyls (µg/L)** | | | | | |
| Aroclor 1016# | 0.5 | 1 | | 0.5 | 0.5 |
| Aroclor 1221# | 0.5 | 1 | | 0.5 | 0.5 |
| Aroclor 1232# | 0.5 | 1 | | 0.5 | 0.5 |
| Aroclor 1242# | 0.5 | 1 | | 0.5 | 0.5 |
| Aroclor 1248# | 0.5 | 1 | | 0.5 | 0.5 |
| Aroclor 1254# | 0.5 | 1 | | 0.5 | 0.5 |
| Aroclor 1260# | 0.5 | 1 | | 0.5 | 0.5 |

Notes: 1. Values detected above the MDL and below the RL will be reported as estimated J.

2. The actual RLs will be higher than those listed above. The listed reporting limits will be adjusted for moisture content.

KDHE - Kansas Department of Health and Environment

MDL - Method Detection Limit
RL - Reporting Limit
µg/L- microgram per liter
Samples will be prepared using Method 3520C and analyzed by Methods 8081A and 8082
* KDHE for Lindane
** KDHE for Chlordane
*** KDHE pathway for Endosulfan
**** KDHE pathway for Endrin
# KDHE pathway for PCBs

# TABLE 1-23
# METHOD DETECTION LIMITS AND REPORTING LIMITS FOR SOIL/SEDIMENT SAMPLES ANALYZED FOR METALS

| Metals (mg/kg) | MDL | RL |
|---|---|---|
| Aluminum | 5 | 20 |
| Antimony | 2 | 10 |
| Arsenic | 0.4 | 1 |
| Barium | 0.2 | 1 |
| Beryllium | 0.2 | 1 |
| Cadmium | 0.1 | 1 |
| Calcium | 10 | 100 |
| Chromium | 0.2 | 1 |
| Cobalt | 0.2 | 1 |
| Copper | 0.2 | 1 |
| Iron | 3 | 20 |
| Lead | 0.2 | 1 |
| Magnesium | 10 | 100 |
| Manganese | 0.1 | 1 |
| Mercury* | 0.033 | 0.1 |
| Nickel | 0.2 | 1 |
| Potassium | 25 | 100 |
| Selenium | 0.5 | 1 |
| Silver | 0.25 | 1 |
| Sodium | 10 | 100 |
| Thallium | 0.5 | 1 |
| Vanadium | 0.5 | 1 |
| Zinc | 0.5 | 1 |

Notes: 1. Values detected above the MDL and below
2. The actual RLs will be higher than those li
<DL - Calculate tolerance limit is less than the detec
KDHE - Kansas Department of Health and Environr
MDL - Method Detection Limit
mg/kg - milligram per kilogram
N/A - Not applicable
RL - Reporting Limit
analyzed by Method 6010B unless noted otherwise
*Prepared and analyzed by Method 7471A

# TABLE 1-24
# METHOD DETECTION LIMITS AND REPORTING LIMITS FOR AQUEOUS SAMPLES ANALYZED FOR METALS

| Metals (µg/L) | MDL | RL |
|---|---|---|
| Aluminum | 60 | 200 |
| Antimony* | 0.2 | 1 |
| Arsenic* | 0.2 | 1 |
| Barium | 2 | 10 |
| Beryllium* | 0.12 | 1 |
| Cadmium* | 0.27 | 0 |
| Calcium | 100 | 1000 |
| Chromium | 2.5 | 10 |
| Cobalt | 2.5 | 10 |
| Copper | 2 | 10 |
| Iron | 40 | 200 |
| Lead* | 0.1 | 1 |
| Magnesium | 100 | 1000 |
| Manganese | 3 | 10 |
| Mercury** | 0.1 | 0.5 |
| Nickel | 2.5 | 10 |
| Potassium | 2.5 | 10 |
| Selenium | 5 | 10 |
| Silver | 3 | 10 |
| Sodium | 100 | 1000 |
| Thallium | 5 | 10 |
| Vanadium | 5 | 10 |
| Zinc | 5 | 10 |

Note: Values detected above the MDL and below the RL will be r
KDHE - Kansas Department of Health and Environment

MDL - Method Detection Limit
N/A - Not applicable
RL - Reporting Limit
µg/L - microgram per liter
USEPA - United States Environmental Protection Agency
All metals will be prepared by Method 3010A and analyzed by
* - Indicates that these metals will be prepared by Method 3010A
** - Mercury will be prepared and analyzed by Method 7470A

# TABLE 2-1
# SAMPLE CONTAINERS, PRESERVATION AND HOLDING TIMES

| | Parameter | Method Number | Container | Preservative | Holding Time |
|---|---|---|---|---|---|
| **Aqueous Samples** | Semivolatile Organic Compounds | 8270C | (2) 500 mL amber bottles | 4°C | 7 days to extract, 40 days to analysis |
| | DRO - Wisconsin Modified | 8015 | (3) 40 mL VOA glass bottl | 4°C, HCL | 7 days to extract, 40 days to analysis |
| | Polynuclear Aromatic Hydrocarbons- ext Petro Hydro | 8270 | (2) 500 mL amber bottles | 4°C | 7 days to extract, 40 days to analysis |
| **Soil / Sediment Samples** | Volatile Organic Compounds | 8260B | (3) 40 mL VOA vials | 4°C, two vials reagent water, one vial methanol | 48 hours until frozen by laboratory (< -7°C) 14 days to analysis |
| | Semivolatile Organic Compounds | 8270C | 8 oz jar | 4°C | 14 days to extract, 40 days to analysis |
| | Polynuclear Aromatic Hydrocarbons- ext Petro Hydro | 8270C-SIM | 8 oz jar | 4°C | 14 days to extract, 40 days to analysis |

Sample containers will arrive on site already prepared with the appropriate preservative.
HDPE - High-Density Polyethylene
$HNO_3$ - Nitric acid

SIM - Selected Ion Monitoring
VOA - Volatile Organic Anlaysis

# TABLE 4-1
# DATA REVIEW/VALIDATION CRITERIA FOR USEPA METHODS SW8260B, SW8270C AND SW8270C-SIM

| QC Check | Minimum Frequency | Acceptance Criteria | Laboratory Corrective Action | Comments | URS Flagging Criteria |
|---|---|---|---|---|---|
| MDL study | At initial set-up and subsequently once per 12-month period; otherwise quarterly MDL verification checks shall be performed. | See 40 CFR 136B. MDL verification checks must produce a signal at least 3 times the instrument's noise level. | Run MDL verification check at higher level and set MDL higher or reconduct MDL study. | Samples cannot be analyzed without a valid MDL. | Apply **R**-flag to data without a valid MDL study |
| Holding time | Every sample | Soil VOCs: 48 hours until frozen by laboratory (< -7°C), 14 days to analysis. Soil SVOCs: 14 days to extract, 40 days to analysis | Contact URS as to additional measures to be taken. | | Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria. |
| Sample temperature | Every cooler | 4+2 °C | Contact URS as to additional measures to be taken. | None | Samples arriving at temperature 6-10°C, apply **J**-flag to detects and **UJ**-flag to nondetects.<br><br>Samples arriving at temperature > 10°C, apply **J**-flag to detects and **R**-flag to nondetects (SVOCs only). VOC samples received at temperature > 10°C, **R**-flag all results. |
| Tuning | Prior to calibration and every 12 hours during sample analysis | Refer to method for specific ion criteria. | Retune instrument and verify. Rerun affected samples. | Problem must be corrected. No samples may be accepted without a valid tune. | Apply **R**-flag to data without a valid tune |
| Breakdown check (DDT Method 8270C only) | Daily prior to analysis of samples | Degradation ≤ 20% for DDT | Correct problem then repeat breakdown check | No samples shall be run until degradation ≤ 20%. Benzidine and pentachlorophenol should be present at their normal responses and no peak tailing should be observed. | Apply **R**-flag to data without a valid breakdown check |
| Minimum five point initial calibration for all analytes (ICAL) | Initial calibration prior to sample analysis | 1. Average response factor (RF) for SPCCs: VOCs - ≥ 0.30 for Chlorobenzene and 1,1,2,2- tetrachloroethane, ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. SVOCs - ≥ 0.050. | Correct problem then repeat initial calibration | Problem must be corrected. No samples may be run until ICAL has passed | Apply **R**-flag to data without a valid ICAL |

# TABLE 4-1
# DATA REVIEW/VALIDATION CRITERIA FOR USEPA METHODS SW8260B, SW8270C AND SW8270C-SIM

| QC Check | Minimum Frequency | Acceptance Criteria | Laboratory Corrective Action | Comments | URS Flagging Criteria |
|---|---|---|---|---|---|
| | | Average response factor (RF) for non-SPCCs: VOCs and SVOCs ≥ 0.050.<br><br>2. RSD for RFs for CCCs: VOCs and SVOCs - ≤ 30% and one option below;<br>Option 1: RSD for each analyte ≤ 15%<br>Option 2: linear least squares regression r ≥ 0.995<br>Option 3: non-linear regression - coefficient of determination (COD) $r^2$ ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order) | | | Apply **R**-flag to data without a valid ICAL |
| | | 3. RSD for RFs for non-CCCs: VOCs and SVOCs - ≤ 15% and one option below;<br><br>Option 1: RSD for each analyte ≤ 15%<br>Option 2: linear least squares regression r ≥ 0.995<br>Option 3: non-linear regression - coefficient of determination (COD) $r^2$ ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order) | | | Apply **J**-flag to detects and **R**-flag to nondetects. |
| Second source calibration verification | Once after each initial calibration | Value of second source for all analytes within ± 20% for VOCs and ± 30% for SVOCs of expected value (initial source) | Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration. | None | **VOCs** High bias: Apply **J**-flag to detects Low bias : Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<60%): Apply **J**-flag to detects and **R**-flag to nondetects.<br><br>**SVOCs** High bias: Apply **J**-flag to detects Low bias : Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<50%): Apply **J**-flag to detects and **R**-flag to nondetects. |

# TABLE 4-1
# DATA REVIEW/VALIDATION CRITERIA FOR USEPA METHODS SW8260B, SW8270C AND SW8270C-SIM

| QC Check | Minimum Frequency | Acceptance Criteria | Laboratory Corrective Action | Comments | URS Flagging Criteria |
|---|---|---|---|---|---|
| Evaluation of relative retention times | Each sample | RRT of each target analyte in each calibration standard within ± 0.06 RRT units. | Correct problem, then rerun ICAL | None | Apply **R**-flag to data outside retention time window |
| Manual Integration | All | Acceptance by URS Chemist or 3rd Party validator | Provide justification for each instance of manual integration | Laboratory will provide chromatograms before and after each manual integration | Apply **R**-flag to all compounds with improper integration |
| Calibration verification (CV) | Daily, before sample analysis, and every 12 hours of analysis time. | Average RF for SPCCs: VOCs ≥ 0.30 for Chlorobenzene and 1,1,2,2-tetrachlorolethane, ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. SVOCs ≥ 0.050. | | | Apply **J**-flag to detects and **UJ**-flag to nondetects if average RF not met |
| | | Average RF for non-SPCCs: VOCs and SVOCs ≥ 0.050. | | | Apply **J**-flag to detects and **UJ**-flag to nondetects if average RF not met |
| | | % Difference/Drift for CCCs: VOCs and SVOCs ≤ 20%D (Note: D ≤ difference when using RFs or drift when using least squares regression or non-linear calibration.) | Correct problem, then rerun CV. If that fails, repeat initial calibration. | None | High bias: Apply **J**-flag to detects<br>Low bias: Apply **J**-flag to detects and **R**-flag to nondetects |
| | | % Difference/Drift for non-CCCs: VOCs and SVOCs ≤ 20%D (Note: D ≤ difference when using RFs or drift when using least squares regression or non-linear calibration.) | Correct problem, then rerun CV. | None | High bias: Apply **J**-flag to detects<br>Low bias: Apply **J**-flag to detects and **R**-flag to nondetects |
| Internal standards verification | In all field samples and standards | Retention time ± 30 seconds from retention time of the midpoint standard in the CV | Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory. | Sample results are not acceptable without a valid IS verification. | If corrective action fails in field samples, apply **J**-flag to detects and **UJ**-flag to nondetects to analytes with IS recoveries between 30%-50% or > 150%. Apply **R**-flag to samples with IS recoveries < 30%. |
| | | EICP area within - 50% to + 100% of ICAL midpoint standard | | | |

# TABLE 4-1
# DATA REVIEW/VALIDATION CRITERIA FOR USEPA METHODS SW8260B, SW8270C AND SW8270C-SIM

| QC Check | Minimum Frequency | Acceptance Criteria | Laboratory Corrective Action | Comments | URS Flagging Criteria |
|---|---|---|---|---|---|
| Method blank | One per preparatory batch | No analytes detected > 1/2 RL. For common laboratory contaminants, no anlaytes detected > RL. | Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. | None | Apply **U**-flag to analytes detected in field samples < 5X blank contamination (<10X for common laboratory contaminants). |
| Laboratory control sample (LCS) | One per preparatory batch | QC acceptance criteria specified in QAPP Tables 1-2, 1-4 and 1-6. | Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. | LCS should contain all analytes to be reported, including surrogates | High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<30%): Apply **J**-flag to detects and **R**-flag to nondetects. |
| Matrix spike/Matrix spike duplicate (MS/MSD) | One per preparatory batch per matrix | QC acceptance criteria specified in QAPP Tables 1-3, 1-5 and 1-7. | Examine the project-specific DQOs. Contact URS as to additional measures to be taken. | For matrix evaluation only. If MS results are outside QC limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. | For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met. MS/MSD data should not be used alone to qualify data. |
| Laboratory sample duplicate | One per preparatory batch per matrix (if MS/MSD is not performed) | RPD $\leq$ 30% (sample and sample duplicate) | Examine the project-specific DQOs. Contact URS as to additional measures to be taken. | For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met. | Data shall be evaluated to determine the source of difference. Apply **J**-flag to detects if acceptance criteria are not met. |

# TABLE 4-1
# DATA REVIEW/VALIDATION CRITERIA FOR USEPA METHODS SW8260B, SW8270C AND SW8270C-SIM

| QC Check | Minimum Frequency | Acceptance Criteria | Laboratory Corrective Action | Comments | URS Flagging Criteria |
|---|---|---|---|---|---|
| Surrogate spike | All field and QC samples | QC acceptance criteria specified in QAPP Table 1-14. | For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. | Analytes identified in QAPP Table 1-14. | SW8260B: High bias: Apply **J**-flag to detects Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<10%): Apply **J**-flag to detects and **R**-flag to nondetects.<br><br>SW8270C: Must be two or more surrogate recoveries from the same fraction outside criteria. Each fraction will be qualified separately. High bias: Apply **J**-flag to detects Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<10%): Apply **J**-flag to detects and **R**-flag to nondetects. |
| Field Duplicate | One per 10 field samples | See Table 4-1 of the LCG, Ver 5 | N/A | N/A | None |

# TABLE 4-2
# DATA REVIEW/VALIDATION CRITERIA FOR USEPA METHODS SW8081A, SW8082 AND SW8330

| QC Check | Minimum Frequency | Acceptance Criteria | Laboratory Corrective Action | Comments | Flagging Criteria |
|---|---|---|---|---|---|
| MDL study | At initial set-up and subsequently once per 12-month period; otherwise quarterly MDL verification checks shall be performed. | See 40 CFR 136B. MDL verification checks must produce a signal at least 3 times the instrument's noise level. | Run MDL verification check at higher level and set MDL higher or reconduct MDL study. | Samples cannot be analyzed without a valid MDL. | Apply **R**-flag to data without a valid MDL study |
| Holding time | Every sample | Soil samples: 14 days to extract, 40 days to analysis<br>Aqueous samples: 7 days to extract, 40 days to analysis | Contact URS as to additional measures to be taken. | | Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria. |
| Sample temperature | Every cooler | 4+2 °C | Contact URS as to additional measures to be taken. | None | Samples arriving at temperature 6-10°C, apply **J**-flag to detects and **UJ**-flag to nondetects.<br>Samples arriving at temperature > 10°C, apply **J**-flag to detects and **R**-flag to nondetects. |
| Breakdown check (Endrin/DDT Method 8081A only) | Daily prior to analysis of samples | Degradation ≤ 15% for both endrin and DDT | Correct problem then repeat breakdown check | No samples shale be analyzed until degradation ≤ 15% | Apply **R**-flag to data without valid breakdown check |
| Minimum five point initial calibration for all analytes (ICAL) | Initial calibration prior to sample analysis | One of the options below:<br>Option 1: RSD for each analyte ≤ 20%<br>Option 2: linear least squares regression r ≥ 0.995<br>Option 3: non-linear regression: coefficient of determination (COD) $r^2$ ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order) | Correct problem then repeat initial calibration | | Apply **R**-flag to data without a valid ICAL |

# TABLE 4-2
# DATA REVIEW/VALIDATION CRITERIA FOR USEPA METHODS SW8081A, SW8082 AND SW8330

| QC Check | Minimum Frequency | Acceptance Criteria | Laboratory Corrective Action | Comments | Flagging Criteria |
|---|---|---|---|---|---|
| Second source calibration verification | Once after each initial calibration | Value of second source for all analytes within ± 15% of expected value (initial source) | Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration. | Problem must be corrected. No samples may be run until calibration has been verified. | High bias: Apply **J**-flag to detects. Slight Low bias : Apply **J**-flag to detects and **UJ**-flag to nondetects. Low bias (%R<80%): Apply **J**-flag to detects and **R**-flag to nondetects. |
| Retention time window verification | Each calibration verification standard | Analyte within established window | Correct problem, then reanalyze all samples analyzed since the last acceptable retention time check. If they fail, redo ICAL and reset retention time window | No samples shall be run without a verified retention time window at the initial calibration | Apply **R**-flag to data outside retention time window |
| Manual Integration | All | Acceptance by URS Chemist or 3rd Party validator | Provide justification for each instance of manual integration | Laboratory will provide chromatograms before and after each manual integration | Apply **R**-flag to all compounds with improper integration |
| Calibration verification (CCV) | After every 12 hours and at the end of the analysis sequence. | All analytes within ± 15% of expected value form ICAL | Correct problem then repeat CCV and reanalyze all samples since last successful calibration verification | If %D for an individual analyte is > 15%, no samples may be analyzed until the problem has been corrected | High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects. |
| Method blank | One per preparatory batch | No analytes detected > 1/2 RL. For common laboratory contaminants, no anlaytes detected > RL. | Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. | None | Apply **U**-flag to analytes detected in field samples < 5X blank contamination. |
| Laboratory control sample (LCS) | One per preparatory batch | QC acceptance criteria specified in QAPP Tables 1-8 and 1-10. | Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. | LCS should contain all analytes to be reported, including surrogates | High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<30%): Apply **J**-flag to detects and **R**-flag to nondetects. |

# TABLE 4-2
# DATA REVIEW/VALIDATION CRITERIA FOR USEPA METHODS SW8081A, SW8082 AND SW8330

| QC Check | Minimum Frequency | Acceptance Criteria | Laboratory Corrective Action | Comments | Flagging Criteria |
|---|---|---|---|---|---|
| Matrix spike/Matrix spike duplicate (MS/MSD) | One per preparatory batch per matrix | QC acceptance criteria specified in QAPP Tables 1-9 and 1-11. | Examine the project-specific DQOs. Contact URS as to additional measures to be taken. | For matrix evaluation only. If MS results are outside QC limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. | For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met. MS/MSD data should not be used alone to qualify data. |
| Laboratory sample duplicate | One per preparatory batch per matrix (if MS/MSD is not performed) | RPD $\leq$ 30% (sample and sample duplicate) | Examine the project-specific DQOs. Contact URS as to additional measures to be taken. | For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met. | Data shall be evaluated to determine the source of difference. Apply **J**-flag to detects if acceptance criteria are not met. |
| Surrogate spike | All field and QC samples | QC acceptance criteria specified in QAPP Table 1-14 | For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. | Analytes identified in QAPP Table 1-14 | High bias: Apply **J**-flag to detects<br>Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<10%): Apply **J**-flag to detects and **R**-flag to nondetects. |
| Confirmation of positive results (second column or detector) | All positive results must be confirmed | Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD $\leq$ 40% | N/A | Report the higher of two confirmed results unless overlapping peaks are causing erroneously high results, then report the non-affected result and document in the case narrative. | Apply **J**-flag if RPD >40%. Apply **U**-flag if primary result not confirmed. |
| Field Duplicate | One per 10 field samples | See Table 4-1 of the LCG, Ver 5 | N/A | N/A | None |

# TABLE 4-3
# DATA REVIEW/VALIDATION CRITERIA FOR USEPA METHODS 6010B, 6020, AND 7470A/7471A

| QC Check | Minimum Frequency | Acceptance Criteria | Laboratory Corrective Action | Comments | Flagging Criteria |
|---|---|---|---|---|---|
| MDL study | At initial set-up and subsequently once per 12-month period; otherwise quarterly MDL verification checks shall be performed. | See 40 CFR 136B. MDL verification checks must produce a signal at least 3 times the instrument's noise level. | Run MDL verification check at higher level and set MDL higher or reconduct MDL study. | Samples cannot be analyzed without a valid MDL. | Apply **R**-flag to data without a valid MDL study |
| IDL study (ICP only) | At initial set-up and after significant change | Detection limits established shall be $\leq$ MDL | N/A | Samples cannot be analyzed without a IDL. | Apply **R**-flag to data without a valid IDL study |
| Holding time | Every sample | Soil samples: 6 months (Hg 28 days) Aqueous samples (preserved with $HNO_3$, pH<2): 6 months (Hg 28 days) | Contact URS as to additional measures to be taken. | | Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria. |
| Tuning (6020 only) | Prior to initial calibration | Mass calibration $\leq$ 0.1 amu from the true value; resolution < 0.9 amu full width at 10% peak height; for stability, RSD $\leq$ 5% for at least four replicate analytes. | Retune instrument then reanalyze tuning solutions | No analysis shall be performed without a valid MS tune | Apply **R**-flag to data without a valid MS tune |
| Initial calibration for all analytes (ICAL)<br><br>ICP: minimum of two standards and a blank<br><br>CVAA: minimum 5 standards and a calibration blank | Initial calibration prior to sample analysis | $r \geq 0.995$ | Correct problem then repeat initial calibration | | Apply **R**-flag to data without a valid ICAL |
| Second source calibration verification (ICV) | Once after each initial calibration, prior to sample analysis | Value of second source for all analytes within ± 10% of expected value (initial source) | Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat initial calibration. | Problem must be corrected. No samples may be run until calibration has been verified. | Apply **R**-flag to data without second source verification |

# TABLE 4-3
# DATA REVIEW/VALIDATION CRITERIA FOR USEPA METHODS 6010B, 6020, AND 7470A/7471A

| QC Check | Minimum Frequency | Acceptance Criteria | Laboratory Corrective Action | Comments | Flagging Criteria |
|---|---|---|---|---|---|
| Calibration verification (CCV) | After every 10 samples and at the end of the analysis sequence. | ICP: All analytes within ± 10% of expected value from ICAL. CVAA: Mercury within ± 20% of expected value | Correct problem, rerun calibration verification. If that fails, then repeat initial calibration. Reanalyze all samples since the last successful calibration verification. | Problem must be corrected. Results may not be reported without a valid CCV. | Apply **R**-flag to data with CCV outside criteria. |
| Method blank | One per preparatory batch | No analytes detected > 1/2 RL. For common laboratory contaminants, no anlaytes detected > RL. | Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank. | None | Apply **U**-flag to analytes detected in field samples < 5X blank contamination. |
| Interference check solutions (ICS) (ICP only) | At the beginning of an analytical run | ICS-A: Absolute value of concentration for all nonspiked analytes < 2X MDL (unless they are a verified trace impurity from one of the spiked analytes). ICS-AB: Within ± 20% of expected value. | Terminate analysis; locate and correct problem; reanalyze ICS. | No samples may be analyzed without a valid ICS | Apply **R**-flag to data with ICS outside criteria. |
| Laboratory control sample (LCS) | One per preparatory batch | QC acceptance criteria specified in QAPP Table 1-12. | Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. | LCS should contain all analytes to be reported. | High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (ICP Metals %R<60%, Hg %R < 50%): Apply **J**-flag to detects and **R**-flag to nondetects. |
| Dilution test | Each preparatory batch or when a new or unusual matrix is encountered | Five fold dilution must agree within ± 10% of the original determination. | ICP: Perform post-digestion spike (PDS) addition. CVAA: Perform matrix spike | Only applicable for samples with concentrations > 50X MDL (6010B), >100X (6020) or > 25X MDL (CVAA) | Apply **J**-flag to data from parent sample outside criteria |

# TABLE 4-3
# DATA REVIEW/VALIDATION CRITERIA FOR USEPA METHODS 6010B, 6020, AND 7470A/7471A

| QC Check | Minimum Frequency | Acceptance Criteria | Laboratory Corrective Action | Comments | Flagging Criteria |
|---|---|---|---|---|---|
| Post-digestion spike (ICP only) | When dilution test fails or analyte concentration in all samples < 50X MDL (6010B) or < 100X MDL (6020) | 75-125% | Run samples by method of standard additions | The spike addition should produce a level between 10-100X MDL | Apply **J**-flag to data from parent sample outside criteria |
| Matrix spike/Matrix spike duplicate (MS/MSD) | One per preparatory batch per matrix | QC acceptance criteria specified in QAPP Table 1-13. | Examine the project-specific DQOs. Contact URS as to additional measures to be taken. | For matrix evaluation only. If MS results are outside QC limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. No data flagging if native concentrations are > 4X spiking amount | For the specific analyte(s) in the batch. High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<30%): Apply **J**-flag to detects and **R**-flag to nondetects. |
| Laboratory sample duplicate | One per preparatory batch per matrix (if MS/MSD is not performed) | RPD ≤ 20% (sample and sample duplicate) | Examine the project-specific DQOs. Contact URS as to additional measures to be taken. | For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met. | Data shall be evaluated to determine the source of difference. Apply **J**-flag to detects if acceptance criteria are not met. |
| Field Duplicate | One per 10 field samples | See Table 4-1 of the LCG, Ver 5 | N/A | N/A | None |