# QUALITY ASSURANCE PROJECT PLAN FOR [104(k)Program Brownfields Assessments] [Grantee Name]

*Prepared for:*

**U.S. ENVIRONMENTAL PROTECTION AGENCY REGION 3**

1600 JFK Boulevard

Philadelphia, PA 19103



*Prepared by:*

**[Organization Name]**

|  |  |
| --- | --- |
| Date Submitted: | [MM/DD/YYYY] |
| Brownfields Grant No.: | [0123456789] |

EPA Region 3 Brownfields QAPP Template version 1.0

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## LIST OF ACRONYMS

***Include and define all acronyms and abbreviations used throughout the plan. The following list can be used as a starting point. Add or delete acronyms and abbreviations as appropriate.***

|  |  |
| --- | --- |
| %R | Percent Recovery |
| µg/kg | micrograms per kilogram |
| µg/L | micrograms per liter |
| µg/m3 | micrograms per cubic meter |
| ACM | Asbestos-Containing Material |
| AHA | Activity Hazard Analysis |
| AHERA | American Hazard Emergency Response Act |
| AIHA | American Industrial Hygiene Association |
| ANSI/ASQ | American National Standards Institute/American Society of Quality |
| ARF | Analytical Request Form |
| ASTM | American Society for Testing and Materials |
| BFB | bromofluorobenzene |
| BS | Blank Spike |
| C° | Degree Celsius |
| CA | Corrective Action |
| CAA | Clean Air Act |
| CAR | Corrective Action Report |
| CARB | California Air Resources Board |
| CAS | Chemical Abstracts Service |
| CBC | chlorinated biphenyl congener |
| CCV | Continuing Calibration Verification |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CES | Central Equipment Store |
| CF | Calibration Factor |
| CFR | *Code of Federal Regulations* |
| CGI/O2 | Combustible Gas Indicator/ Oxygen |
| CLP | Contract Laboratory Program |
| CN- | Cyanide |
| CNS | Covenant Not to Sue |
| CO | Contracting Officer |
| COC | chain of custody |
| COI | Conflict of Interest |
| CQM-C | Construction Quality Management for Contractors |
| COR | Contracting Officer Representative |
| CPR | cardiopulmonary resuscitation |
| CRQL | contract-required quantitation limit |
| CSM | Conceptual Site Model |
| CVAA | Cold-Vapor Atomic Absorption |
| CWA | Clean Water Act |
| DAO | Designated Approving Official |
| DAS | Delivery of Analytical Services |
| DDT | dichlorodiphenyltrichloroethane |
| DE | Delaware |
| DFTPP | decafluorotriphenyl/phosphine |
| DI | distilled and deionized |
| DLHS | dust-lead hazard standards |
| DMC | deuterated monitoring compounds |
| DO | dissolved oxygen |
| DOT | Department of Transportation |
| DQA | data quality assessment |
| DQI | data quality indicator |
| DQO | data quality objective |
| DRO | diesel-range organic |
| DTN | document tracking number |
| DUA | data usability assessment |
| EDD | electronic data deliverable |
| EM | electromagnetic |
| EPA | U.S. Environmental Protection Agency |
| ESA | Environmental Site Assessment |
| FID | Flame Ionization Detector |
| FSP | Field Sampling Plan |
| GC/ECD | Gas Chromatograph/Electron Capture Detector |
| GC/FID | Gas Chromatograph/Flame Ionization Detector |
| GC/MS | Gas chromatography/mass spectrometry |
| GIS | Geographical Information System |
| GPC | gel permeation chromatography |
| GPR | Ground penetrating radar |
| GPS | Global Positioning System |
| GRO | Gasoline-range organics |
| HASP | Health and Safety Plan |
| HAZWOPER | Hazardous Waste Operations/Emergency Response |
| HCl | hydrochloric acid |
| HDPE | high-density polyethylene |
| HNO3 | nitric acid |
| HPLC | high performance liquid chromatography |
| HRGC | High Resolution Gas Chromatography |
| HRMS | High Resolution Mass Spectrometry |
| HRS | Hazard Ranking System |
| H2S | hydrogen sulfide |
| HSO | Health and Safety Officer |
| HUD | U.S. Department of Housing and Urban Development |
| IATA | International Air Transport Association |
| ICAL | Initial Calibration |
| ICP-AES | Inductively coupled plasma-atomic emission spectroscopy |
| ICP-MS | Inductively coupled plasma-mass spectrometry |
| ICS | Incident Command System |
| ICSA | Interference Check Solution A |
| ICSAB | Interference Check Solution AB |
| IDQTF | Intergovernmental Data Quality Task Force |
| IDW | investigation-derived waste |
| IS | internal standards |
| L | liter |
| LBP | lead-based paint |
| LCS | laboratory control sample |
| LCSD | laboratory control sample duplicate |
| LEB | leachate extraction blank |
| LEL | lower explosive limit |
| LF | linear feet |
| LFB | laboratory fortified blank |
| LFSM | laboratory fortified sample matrix |
| LFSMD | laboratory fortified sample matrix duplicate |
| LIMS | Laboratory Information Management System |
| LRB | laboratory reagent blank |
| LTSB | Laboratory and Technical Services Branch |
| MB | method blank |
| MCL | Maximum Contaminant Level |
| MDL | method detection limit |
| mg | milligram |
| mg/cm2 | milligrams per square centimeter |
| mg/kg | milligrams per kilogram |
| mg/L | milligram per liter |
| mL | milliliter |
| MPC | Measurement Performance Criteria |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| NA | not applicable |
| NaHSO4 | sodium bisulfate |
| NaOH | sodium hydroxide |
| NELAC | National Environmental Laboratory Accreditation Conference |
| NELAP | National Environmental Laboratory Accreditation Program |
| NESHAP | National Emission Standards for Hazardous Air Pollutants |
| NFA | no further action |
| NFG | National Functional Guidelines |
| ng/kg | nanograms/kilogram |
| ng/m3 | nanogram per cubic meter |
| NIOSH | National Institute for Occupational Safety and Health |
| NOI | Notice of Incident |
| NTU | Nephelometric Turbidity Units |
| NVLAP | National Voluntary Laboratory Accreditation Program |
| O2 | oxygen |
| OC | organochlorine |
| OCDD | octachlorodibenzo-p-dioxin |
| OCDF | octachlorodibenzofuran |
| OLEM | Office of Land and Emergency Management |
| ORO | oil-range organics |
| ORP | oxidation-reduction potential |
| OSHA | Occupational Safety and Health Administration |
| oz. | ounce |
| PAH | polycyclic aromatic hydrocarbons |
| PAL | project action limit |
| PARCCS | precision, accuracy, representativeness, completeness, comparability, and sensitivity |
| PCB | polychlorinated biphenyl |
| PDF | Portable Document Format |
| PE | Performance Evaluation |
| PID | Photoionization Detector |
| pg/L | picograms/liter |
| PLM | polarized light microscopy |
| PM | Program Manager |
| PO | Project Officer |
| POC | Point of Contact |
| ppbv | parts per billion by volume |
| ppm | parts per million |
| PPE | personal protective equipment |
| PTFE | Polytetrafluoroethylene |
| PWS | Project Work Scope |
| QA | quality assurance |
| QAM | Quality Assurance Manual |
| QAM | Quality Assurance Manager |
| QAPrP | Quality Assurance Program Plan |
| QC | quality control |
| QMP | Quality Management Plan |
| RCRA | Resource Conservation and Recovery Act |
| REC | recognized environmental condition |
| RL | reporting limit |
| RPD | relative percent difference |
| RQAM | Regional Quality Assurance Manager |
| RRF | Relative Response Factor |
| RSCC | Regional Sample Control Coordinator |
| RSD | relative standard deviation |
| RSL | regional screening level |
| SC | Sample Coordinator |
| SD | standard deviation |
| S/D | matrix spike and duplicate |
| SF | square feet |
| SHSO | Site Health and Safety Officer |
| SIM | selected ion monitoring |
| SM | Standard Method |
| SMO | Sample Management Office |
| SOP | Standard Operating Procedure |
| SOW | Statement of Work |
| SPLP | Synthetic Precipitation Leaching Procedure |
| SR | sample result |
| Std | Standard |
| SVOC | semivolatile organic compound |
| SWP | Safe Work Practice |
| TAL | Target Analyte List |
| TAT | turnaround time |
| TBD | to be determined |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TOC | total organic carbon |
| TPH | total petroleum hydrocarbons |
| TSA | Technical System Audit |
| UFP | Uniform Federal Policy |
| U.S. EPA | United States Environmental Protection Agency |
| USGS | United States Geological Survey |
| VOA | volatile organic analysis |
| VOC | volatile organic compound |
| WHO | World Health Organization |
| XRF | x-ray fluorescence |
| ZHE | Zero Headspace Extractor |

## INTRODUCTION

This Quality Assurance Project Plan (QAPP) template and guidance is intended to assist organizations in documenting the programmatic, procedural, and analytical requirements for brownfields assessment projects eligible for funding under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) § 104(k).

This template combines the elements of a Quality Assurance Program Plan (QAPrP) and site-specific Field Sampling Plans (FSPs) in Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) format, which allows for the inclusion of multiple sites with the addition of site-specific details and sampling plans for each site on several worksheets. Programmatic information common to all the sites is captured on the remaining worksheets.

The site-specific information typically contained in standalone FSPs is required for each site that is assessed. This site-specific information will provide the historical perspective and rationale for each site’s sampling design. The site-specific information will identify the problems to be solved and/or decisions to be made; define the project’s data quality objectives (DQOs); describe the measurements that will be made during the course of the project; describe samples to be collected; identify field methodologies to be used; identify contaminants of concern, reporting limits, and analytical methods; state specific quality standards criteria and objectives; state any special personnel and equipment requirements; describe assessment tools needed; provide a schedule of the work to be performed; and state project and quality control records required, including the type of reports needed.

The format can cover both hazardous substance- and petroleum-contaminated sites of limited scope and presumes that the work will be going to a laboratory whose analytical services are not funded directly by EPA. This might include, but not be limited to, a private or commercial laboratory, a state laboratory, an in-house laboratory or any other laboratory under contract to the organization authoring the QAPP. It is intended to be used for projects generating a limited number of samples to be collected over a relatively short time. This template is not intended to be used for on-going monitoring events, or for remediation or removal activities.

Following the procedures outlined in this QAPP will ensure that the data collected meet the project objectives. The QAPP must be approved by the EPA Region 3 Regional Quality Assurance Manager (RQAM) or a designated approving official (DAO) prior to implementation.

### Instructions

This template provides instructions for each worksheet of the QAPP. Some worksheets include information and example language that may be used with or without modification. In all instances, organizations must modify the text to accurately describe their organization-specific policies, procedures, and practices.

Worksheet #10 – Conceptual Site Model, Worksheet #11 – Data Quality Objectives, and Worksheet #17/18 – Sampling Design, Rationale, Locations, and Methods must be prepared with site-specific information for each site assessed as part of the overall project. When including multiple sites, clearly identify and differentiate all sites that will be assessed as part of the project. Use an alphanumeric naming convention for each site on the abovementioned worksheets (i.e., Worksheet #10a, 10b, 10c, etc.).

Worksheet #12 – Measurement Performance Criteria and Worksheet #15 – Project Action Limits, Laboratory-Specific Detection/Quantitation Limits contain tables for analytical methods that are commonly used in brownfields assessments. The tables for analytical methods not utilized for the project should be deleted.

Organizations must provide copies of their standard operation procedures (SOPs) as attachments to the QAPP. This could include, but is not limited to, SOPs for field sampling, equipment decontamination, sample custody, and data validation activities.

The format of the template is as follows:

* ***Instructions and tutorial information to aid in populating the worksheets are included as text that is highlighted, bold, and italicized***. This text should be deleted from the final QAPP.
* [Organization-specific information needed] - A bracketed word or phrase that is shaded light gray indicates that organization-specific information is needed. Examples are provided in many cases. Replace the bracketed text with the appropriate information. The gray shading should be removed.
* Suggested text, definitions, and background information common to most projects is presented in normal type. This text can be used, modified, or deleted as necessary to align with the policies, procedures, and practices of each organization.

## 

## WORKSHEET #1 & 2: TITLE AND APPROVAL PAGE

|  |  |
| --- | --- |
| **Document Title:** | Quality Assurance Project Plan for [Description of Project] |
| **Prepared for:** | [Investigative Organization/Grant Recipient] |
| **EPA Grant No.:** | [Grant Number] |
| **Preparer’s Name:** | [Preparer’s Name] |
| **Preparer’s Organizational Affiliation:** | [Preparer’s Organization Name] |
| **Preparer’s Address:** | [Preparer’s Address] |
| **Preparer’s Telephone No.:** | [Preparer’s Telephone Number], |
| **Preparer’s E-mail:** | [Preparer’s E-mail] |
| **Preparation Date:** | [Date] |
| **Status:** | [Draft or Final] |
| **Revision:** | Revision [Revision Number] |

**Approvals**

|  |  |
| --- | --- |
| **[Grantee Name] Project Manager** | [Individual’s Name], [Grantee Name] Project Manager, Date |
| **[Contractor Name] Project Manager** | [Individual’s Name], [Contractor Name] Project Manager, Date |
| **[Contractor Name] Quality Assurance Manager** | [Individual’s Name], [Contractor Name] Quality Assurance Manager, Date |
| **EPA Region 3 Brownfields Project Officer** | [Individual’s Name], USEPA Region 3 Project Officer, Date |
| **EPA Region 3 Applied Science and Quality Assurance Branch Delegated Approving Official** | [Individual’s Name], USEPA Delegated Approving Official (DAO), Date |

Note: This approval action represents EPA’s determination that the document(s) under review comply with applicable requirements of the EPA Region 3 Quality Management Plan [https://www.epa.gov/sites/production/files/2020-06/documents/r3qmo-final-r3-signatures-2020.pdf] and other applicable requirements in EPA quality regulations and policies [https://www.epa/gov/quality]. This approval action does not represent EPA’s verification of the accuracy or completeness of document(s) under review and is not intended to constitute EPA direction of work by contractors, grantees or subgrantees, or other non-EPA parties.

## WORKSHEET #3 & 5: PROGRAM ORGANIZATION AND QAPP DISTRIBUTION

|  |  |  |  |
| --- | --- | --- | --- |
| **QAPP Recipient Name** | **Title** | **Organization** | **E-Mail Address** |
| [Name] | [Grantee/City/Community Coalition] Project Manager | [Organization] |  |
| [Name] | [Consultant/Contractor] Project Manager | [Organization] |  |
| [Name] | Quality Assurance Manager | [Organization] |  |
| [Name] | Project Chemist | [Organization] |  |
| [Name] | Field Team Leader | [Organization] |  |
| [Name] | Laboratory Project Manager | [Organization] |  |
| [Name] | Data Validator | [Organization] |  |
|  |  |  |  |
|  | Brownfields Project Manager | EPA Region 3 |  |
| Kia Long | Regional Quality Assurance Manager | EPA Region 3 | Long.Kia@epa.gov |
| Notes: NA – Not applicable  QAPP – Quality Assurance Project Plan  TBD – To be determined | | | |

This QAPP is good for the life of the project or five years, whichever is longer. The QAPP will be reviewed annually and updated as necessary. The annual reviews will be documented (letter format is acceptable) and sent to all recipients of the QAPP with any updated materials to insert into the QAPP.

***The QAPP distribution list will vary for each project and organization, but the personnel listed on the table are common to all brownfields assessments. Please edit the list to include all individuals and their organizations who need copies of the approved QAPP and any subsequent revisions, including all persons responsible for implementation (e.g., project managers), the QA managers, and representatives of all groups involved. Other key project personnel could include, but are not limited to, field samplers, data reviewers, statisticians, and risk assessors. Please delete or add extra lines as necessary.***

### Project Quality Assurance Manager Independence

***EPA Region 3 uses a graded approach for the evaluation of brownfields QAPPs and understands that some personnel may have more than one role due to the smaller size of some organizations. In all cases, the project quality assurance manager must not participate in the generation of environmental information. The QAPP shall describe the project QA Manager’s independence including an affirmative statement that the QA Manager will be independent of environmental field activities.***

## WORKSHEET #4, 7, & 8: PROJECT ORGANIZATION

### Key Project Personnel Sign-off Sheet

| **Project Personnel Name** | **Title** | **Organization** | **E-mail address** | **E-mail Receipt Confirmation** |
| --- | --- | --- | --- | --- |
| [Name] | [Grantee/City/Community Coalition] Project Manager | [Organization] |  |  |
| [Name] | [Consultant/Contractor] Project Manager | [Organization] |  |  |
| [Name] | Quality Assurance Manager | [Organization] |  |  |
| [Name] | Field Team Leader | [Organization] |  |  |
| [Name] | Project Chemist | [Organization] |  |  |
| [Name] | Laboratory Project Manager | [Organization] |  |  |
| [Name] | Data Validator | [Organization] |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

***The Project Personnel Sign-off Sheet documents that all key personnel identified in the Distribution List performing work must read the applicable sections of the QAPP and will perform the tasks as described in the Distribution List. A copy of the Key Project Personnel Sign-off Sheet shall be maintained and on file by the lead organization conducting the environmental information operations and made available to approval authorities upon request.***

### Special Personnel Training Requirements Table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Project Function** | **Specialized Training by Title or Description of Course** | **Training Provider** | **Training Date[[1]](#footnote-2)** | **Personn****el/ Groups Receiving Training** | **Personnel Titles/ Organizational Affiliation** | **Location of Training Records/Certificates[[2]](#footnote-3)** |
| Field Operations | 40-Hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Site Worker Training; 8-Hour OSHA Refresher Training; | Registered Training Organization – Various1 | Varies | All | Various | [Location of records] |
| All Staff | First Aid Cardiopulmonary Resuscitation (CPR) | Registered Training Organization – Various1 | Varies | All | Various | [Location of records] |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

Notes:

***Identify and describe any training or certifications needed by personnel to successfully complete the project. Training shall include on-the-job training as well as training on internal procedures. Describe how such training will be provided and how the necessary skills will be assured and documented, including the location of training records.***

***Note: The information populated in the table is for example purposes only. Any project-specific or organization-specific training requirements must be included. If no training requirements exist, it should be noted.***

### Project Organization Chart

***Provide a concise organization chart showing both the lines of authority/reporting relationships and the lines of communication both within the lead organization and between the lead organization and all organizations involved in the project.***

***The Project Organization Chart should include the following:***

* ***The Approval Authority for the QAPP***
* ***The Name of the Lead Organization***
* ***The Name of the Lead Organization’s Project Manager***
* ***The Name of the Lead Organization Project QA Manager***
* ***Names, titles, and roles of all individuals within the organization conducting or supporting environmental information operations and their reporting relationships,***
* ***Identification of all Contractors, Subcontractors and their project Role***
* ***reporting relationships between the contractors and sub-contractors and the lead organization***
* ***Identification and reporting relationships between organizations or sub-organizations conducting work to support environmental information operations such as field samplers, on-site and off-site laboratory analyses and data review services or contractors.***

## WORKSHEET #6: COMMUNICATION PATHWAYS

| **Communication Drivers[[3]](#footnote-4)** | **Responsible Person** | **Name** | **Phone Number** | **Procedure (timing, pathways, etc.)** |
| --- | --- | --- | --- | --- |
| Project Status | [Responsible Person] *ex. Project Manager* | [Name] | [Phone Number] | Reporting of project information to EPA through work plans, monthly progress reports, e-mail updates, teleconference calls, and meetings. |
| Manage All Project Phases | [Responsible Person] *ex. Project Manager* | [Name] | [Phone Number] | Primary modes of communication are telephone, E- mail, letter, document submittal; timing dependent on nature of communication and pre-defined schedules, as applicable and as requested by agencies. |
| Stop Work due to safety issues | [Responsible Person] *ex. Field Team Leader* | [Name] | [Phone Number] | [Field Team Leader] or field staff notify project management regarding safety issues as they occur. Documentation may include Notice of Incident (NOI) and emails. |
| Corrective Actions | [Responsible Person] *ex. Project Quality Assurance Manager (QAM*) | [Name] | [Phone Number] | As they occur, the [QAM] will investigate programmatic, procedural, field, data validation, and analytical issues which require corrective actions. The appropriate project personnel will be involved with developing and implementing the corrective action. The issues and subsequent resolution will be documented in memorandum format. |
| Standard operating procedure (SOP) or quality assurance project plan (QAPP) changes in the field and field corrective action | [Responsible Person] *ex. Project Quality Assurance Manager (QAM*) | [Name] | [Phone Number] | Notify [Project Manager](s) of any changes to the procedures proposed in the approved QAPP (including SOP changes) prior to or during sampling events along with rationale for changes. Document changes in field logbook. Maintain files for progress reports and memoranda to project personnel EPA. Need for field corrective action will be determined by the EPA Brownfields Project Manager and will be documented in the daily field progress reports and memoranda to EPA. |
| Reporting Laboratory Data Quality Issues | [Responsible Person] *ex. Laboratory Project Manager* | *Provide name or reference laboratory quality assurance manual.* | *Provide name or reference laboratory quality assurance manual.* | All laboratory quality assurance (QA)/quality control (QC) issues with project field samples will be reported by the [Laboratory Project Manager] to the [Program Chemist]. |
| Laboratory Analytical Corrective Actions | [Responsible Person] *ex. Laboratory Project Manager* | *Provide name or reference laboratory quality assurance manual.* | *Provide name or reference laboratory quality assurance manual.* | Need for laboratory corrective actions will be determined by the [Project Chemist] and/or [Quality Assurance Manager or the [Laboratory Project Manager] and/or [Laboratory QA Manager]. Corrective actions will be documented in project records, and if necessary, in memoranda to the EPA Brownfields Project Manager. |
| Data Tracking and Management, Release of Analytical Data | [Responsible Person(s)] *ex. Project Chemist and/or 3rd Party Data Validator* | [Name] | [Phone Number] | The [Project Chemist and/or Data Validator] will track data from sample collection, analysis, and validation using a database program. The laboratory will release preliminary data packages to project personnel or for data validation after a cursory completeness check. Any missing deliverables will be requested from the laboratory by the [Project Chemist and/or Data Validator]. |
| Analytical/Data Validation issues and corrective actions | [Responsible Person(s)] *ex. Project Chemist and/or 3rd Party Data Validator* | [Name] | [Phone Number] | Laboratory data packages and validation reports will be reviewed by the [Project Chemist and/or Data Validator]. Any issues or deficiencies will be communicated to the [Project Manager and Quality Assurance Manager] for resolution and/or corrective action. |
| Distribution of QAPP and QAPP Updates | [Responsible Person] *ex. Project Quality Assurance Manager (QAM*) | [Name] | [Phone Number] | The QAPP will be reviewed annually, and changes to the QAPP that impact data quality will be approved EPA. The QAPP is good for the life of the project, and it will be updated and resubmitted to EPA for approval every 5 years, at a minimum. |

***The communication pathways and procedures included as examples in this table present clear, logical processes for notifying project personnel and initiating the resolution process for commonly encountered situations. However, this table is neither prescriptive nor comprehensive. Please add or delete information as necessary to accurately describe the policies and procedures of the organizations involved in the project.***

## WORKSHEET #9: PROJECT PLANNING SESSION SUMMARY AND SCOPING MEETINGS

### Project Scoping/Planning Session Participants Sheet

|  |  |
| --- | --- |
| Project Name |  |
| Site Name |  |
| Site Location |  |
| Project Manager |  |
| Date of Session |  |
| Scoping/Planning Session Purpose | Kick-off meeting to discuss site work. |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Name** | **Title** | **Affiliation** | **Phone #** | **E-Mail Address** | **Project Role** |
| [Name] | [Title] | [Affiliation] | [Phone #] | [E-Mail Address] | [Project Role] |
| [Name] | [Title] | [Affiliation] | [Phone #] | [E-Mail Address] | [Project Role] |
| [Name] | Project Manager | EPA Region 3 | [Phone #] | [E-Mail Address] | [Project Role] |

|  |  |
| --- | --- |
| **Comments/Decisions:** | *Insert a description of the scoping session and associated decisions* |
| **Action Items:** | *Insert a list of action times, responsible personnel, and timeframe for completion* |

Notes:

EPA is the U.S. Environmental Protection Agency.

***This worksheet is provided as a convenient way to document project planning activities, and it is optional using EPA Region 3’s graded approach for the evaluation of brownfields QAPPs due to the non-critical nature of many of these assessments. Project-specific and site-specific information from the planning phase of the project must be included in subsequent worksheets of this QAPP. If Worksheet #9 is not utilized, please delete the tables, and include a statement indicating that details of and decisions resulting from the planning phase are integrated on subsequent worksheets of the QAPP.***

## WORKSHEET #10: CONCEPTUAL SITE MODEL

***Because brownfield assessment projects often include assessments of multiple sites by the same organization, site-specific conceptual site models (CSMs) and other site-specific information must be provided for each site. This QAPP template allows multiple sites to be included in the same plan on separate worksheets or added later as addenda. When including multiple sites and CSMs, clearly identify and differentiate all sites that will be assessed as part of the project. Use an alphanumeric naming convention for each site (i.e., Worksheet #10a, 10b, 10c, etc.).***

***The CSM should include the following information where available and as applicable:***

* ***Background information (i.e., location and site operational history).***
* ***Sources of known chemicals used on site or suspected hazardous waste.***
* ***Known or suspected contaminants or classes of contaminants.***
* ***Primary release mechanism, volume or mass of release, and form of release (e.g., solid or liquid).***
* ***Secondary contaminant migration.***
* ***Fate and transport considerations.***
* ***Potential human or ecological receptors and exposure pathways.***
* ***Land use considerations (existing site conditions and use of the property).***
* ***Maps (historical and current)***
* ***Key physical aspects of the site (e.g., site geology, hydrology, topography, and climate).***
* ***Current interpretation of nature and extent of contamination to the extent that it will influence project- specific decision making.***

***Data gaps and uncertainties related to the CSM need to be identified because those elements of the CSM generally represent additional data needs.***

***The CSM should provide the rationale and a historical perspective for the sampling event. The CSM and proposed sampling effort will be described succinctly, including a brief statement addressing the phase(s) of the work and intended objectives of the sampling investigation. Background information such as maps, plans, tables, and figures will be provided to place the problem in historical perspective, giving the reviewer a sense of the project’s purpose.***

***Further, the CSM will state the problem to be solved and/or decision to be made; describe the measurements that will be made during the course of the project; state specific quality standards criteria and objectives; state any special personnel and equipment requirements; describe assessment tools needed; provide a schedule of the work to be performed; and state project and quality control records required, including the type of reports needed. All applicable SOPs needed for site activities, and sources of historical information should be referenced. The site-specific information should be available to field team members.***

## WORKSHEET #11: DATA QUALITY OBJECTIVES

***Because brownfield assessment projects often include assessments of multiple sites by the same organization, site-specific data quality objectives (DQOs) and other site-specific information must be provided for each site. This QAPP template allows multiple sites to be included in the same plan or added later as addenda. When including multiple sites and DQOs, clearly identify and differentiate all sites that will be assessed as part of the project. Use an alphanumeric naming convention consistent with the scheme adopted in Worksheet #10 (i.e., Worksheet #11a, 11b, 11c, etc.) such that sites a, b, and c stay the same throughout the rest of the QAPP.***

DQOs are qualitative and quantitative statements and goals developed to ensure that sufficient data of known and appropriate quality are obtained to support specific decisions or regulatory actions. EPA’s seven-step DQO process outlined in EPA QA/G-4, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA/240/B-06/001 (EPA 2006) should be followed. Background information/data, pre-planning site visits, and scoping meetings/conference calls may be used to support the DQO process and the development of site-specific DQOs. Because different data uses may require different quantities of data and levels of quality, DQOs must be established for each site.

Site-specific DQOs describe site activities, including project management and functional organization, sample collection and field methodologies, identify contaminants of concern and reporting limits, specify laboratory and field analytical methods, and details QA/QC activities to meet the site DQOs.

When the data do not meet the project DQOs, the root cause of the deficiency should be investigated. Reasons may include laboratory operation, such as the failure of laboratory reporting limits to meet site criteria. In these situations, project management should determine corrective actions commensurate with the project’s needs. Corrective actions may include:

* Re-sampling for all or some of the parameters.
* Preparing a technical memorandum to the site file, detailing limitations to the data.
* Validating the data at a higher tier level to better qualify the results.
* Preparing a technical memorandum describing the bias of field results.

### EPA 7-Step DQO Process

***Site-specific DQOs shall be developed using the EPA’s 7-step DQO process; the DQOs will be presented in this QAPP on separate worksheets. The seven-step process, described verbatim in the guidance for Worksheet #11 in the Optimized UFP-QAPP Worksheets (Intergovernmental Data Quality Task Force [IDQTF] 2012), includes the following:***

1. **State the Problem.** [The problem statement should be consistent with information contained in the site-specific CSM (Worksheet #10).]
2. **Identify the Goals of the Study.** [Identify specific study questions and define alternative outcomes. The goals for either decision or estimation problems should explain how the data will be used to answer questions and choose among the stated alternatives. Characterizing the “nature and extent of contamination” is a commonly stated but inappropriate study goal because it is vague and not focused on potential outcomes.]
3. **Identify Information Inputs.** [Specify the types of data that are required to fill gaps in the CSM. Explain in specific terms how all data will be used. In addition to analytical data, this could include published information on geology, climate, population distributions, endangered species, etc. Information inputs should be consistent with decisions made during project planning.]
4. **Define the Boundaries of the Study.** [Specify the target population and characteristics of interest, define spatial/temporal limits and the scale of inference (i.e., which populations will be represented by which data). Developing the list of target analytes presents one of the greatest opportunities for streamlining a project, as it can help avoid unnecessary costs associated with not only sampling, but also analysis, data review, reporting and management. Target analytes should be focused on specific constituents reasonably known or suspected to be present. The list of target analytes should be based on data gaps in the CSM. Focusing the list of analytes also provides better opportunities for optimizing method performance to best suit those analytes.]
5. **Develop the Analytic Approach.** [Define the parameter(s) of interest, specify the type of inference (e.g., “samples from groundwater monitoring wells x, y, and z will represent potable water at the site) and develop the logic for drawing conclusions from findings (i.e., which sample results will be used to support which decisions). For decision problems, these are expressed as “if---then” statements, or decision rules, that link the potential results with conclusions or future actions. For estimation problems, specify the estimator and the estimation procedure.]
6. **Specify Performance or Acceptance Criteria.** [For projects that involve hypothesis testing (e.g., presence or absence of contamination exceeding some threshold value) for decision-making, this will involve specifying probability limits for decision errors. For estimations and other analytic approaches (e.g., estimating the volume of groundwater or soil potentially requiring remediation), this will involve the development of performance criteria (for new data being collected) or acceptance criteria (for existing data being considered for use).]
7. **Develop the Detailed Plan for Obtaining Data.** [Worksheet #11 will briefly explain the basis for the sampling design, and then refer to Worksheet #17 – Sample Design and Rationale. Worksheets #19/30, 20, and 24 to 28 will specify analytical design requirements.]

### Analytical Performance Criteria

***Once DQOs are defined, analytical performance criteria must be established to achieve those objectives. An efficient way to summarize analytical performance criteria for is tables that contain, at a minimum, the contaminants of concern, the concentration levels, and the associated matrices; the analytical method; the project action levels, method detection limits, and quantitation limits for each contaminant of concern; and the source of the action level (regulation, health-based criteria, water quality standards, etc.). If a contaminant does not have an action level, or will not be used in decision making, text should be included discussing how the data for that contaminant will be used.***

***When populating Worksheets #15.1 – 15.15 with project-specific and laboratory-specific information, delete all unnecessary tables for contaminants of concern and analytical methods that are not applicable to the project. If additional contaminants of concern and/or analytical methods other than those included in this template are needed, the applicable information must be incorporated into in Worksheet #15.***

Once DQOs are defined, analytical performance criteria must be established to ensure that analytical methods will accurately and adequately identify the contaminants of concern, and to ensure that the analyses selected will be able to achieve the quantitation limits less than or equal to the target cleanup levels. Worksheet #15 summarizes the contaminants of concern, the concentration levels, and the associated matrices; the project action levels, method detection limits, and quantitation limits for each contaminant of concern; and the source of the action level (regulation, health-based criteria, water quality standards, etc.)

### Laboratory Accreditation

Include the laboratory certification or accreditation information as an attachment to the QAPP.

The laboratories used must be either state certified or possess accreditation from an accrediting authority such as National Environmental Laboratory Accreditation Program (NELAP), National Voluntary Laboratory Accreditation Program (NVLAP), or American Industrial Hygiene Association (AIHA) for the specific analytical methods used for the project. Certified laboratories have undergone performance evaluation performed by an applicable state program, accrediting authority, or through the NELAP, NVLAP, or AIHA programs, for method accuracy and precision, and meet the requirements set forth by the state or U.S. EPA. All potential analyses (VOCs, semivolatile organic compounds [SVOCs], metals, total petroleum hydrocarbon [TPH] compounds – gasoline-range organics, diesel-range organics, oil-range organics [GRO/DRO/ORO], PCBs, cyanide [CN-], pesticides, herbicides, waste characterization, and natural attenuation parameters) should be performed by a state-certified laboratory, or NELAP-, NVLAP-, or AIHA-certified laboratory.

Note that asbestos testing laboratories should have NVLAP certification and lead-based paint (LBP) testing laboratories should be AIHA-certified.

### Field Screening

***Worksheet #22 provides field screening instrument calibration, maintenance, testing, and inspection activities with the required frequency; details acceptance criteria, corrective actions, and responsible personnel; and it provides SOP references. The information on this worksheet covers common field instrumentation with procedures and criteria that are commonly used for many brownfields projects. It must be updated to reflect organization-specific instrumentation and procedures.***

Field-screening instruments provide a lower quality of analytical data compared with laboratory equipment in a controlled environment. However, field methods provide rapid “real-time” results for field personnel to help guide field decision-making processes. These techniques are often used for health and safety monitoring, initial site characterization to locate areas for detailed assessment, and preliminary comparison or remedial objective. This type of field-screening data can include measurements of pH, temperature, conductivity, turbidity, oxidation reduction potential (ORP), dissolved oxygen (DO), or similar monitoring data. Field measurements of pH, temperature, conductivity, turbidity, ORP, and DO will be collected during groundwater and surface water sampling activities. During sampling and other property assessment activities, the breathing space of site personnel may be monitored for the presence of volatile organic compounds (VOC) using a photoionization detector (PID) or flame ionization detector (FID) based on the suspected or known contamination at the site. The PID or FID may also be used to perform field screening of soil and sediment sample to assist in the selection of samples to be submitted for laboratory analysis. Field screening may also include the use of x-ray fluorescence (XRF) to estimate metals concentration in soil.

For field screening data used to make site decisions, at least 10% must be confirmed by a fixed laboratory.

All field instruments shall be calibrated in accordance with the manufacturer’s instructions at least once per day during field use. Calibration should also be performed whenever accuracy and reproducibility of results become inconsistent. Worksheet #22 lists field screening instrument calibration, maintenance, testing, and inspection activities with the required frequency; details acceptance criteria, corrective actions, and responsible personnel; and it provides SOP references. Records for each field instrument used shall be maintained to ensure its capability of providing accurate and precise measurements. Records will be maintained on instrument maintenance and calibration during the field effort.

## WORKSHEET #12: MEASUREMENT PERFORMANCE CRITERIA

***The analytical methods presented in the Worksheet #12 measurement performance criteria (MPC) tables are expected to include the most common analytical methods that will be utilized in brownfields site assessments.***

***If methods other than those included in this template are needed, the applicable information must be incorporated into in Worksheet #12. Delete the worksheets for analytes and analytical methods that will not be utilized for the project.***

### Analytical Method Categories and Method Selection

Analytical methods were developed by EPA and other related organizations for specific programs or analytical needs; analyses from any of these method categories should be used for brownfields assessments. General categories of analyses include:

* EPA SW-846 Methods developed for organic and inorganic analyses of water, soil, oil, and waste matrices for compliance with the Resource Conservation and Recovery Act (RCRA).
* Clean Air Act (CAA) methods developed for air samples.
* Miscellaneous analyses (such as asbestos and National Institute for Occupational Safety and Health [NIOSH] methods.

Most samples will be analyzed using methods included in the EPA’s methods compendium *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846). However, there may be instances where the sample matrix, parameters to be analyzed, DQOs, or intended use of the data require the use of methods other than SW-846 methods. For example, discharges to surface waters may require analysis using methods approved under the CWA regulations, which include EPA methods and non-EPA methods (e.g., *Standard Methods for the Examination of Water and Wastewater* [Standard Methods or SM])) and methods published by the ASTM International (ASTM). Methods approved under the CWA include EPA, SMs, and ASTM methods. Ambient air and soil gas samples may require volatile organic compound analysis using EPA Toxic Organics (TO) method 15.

During the project planning phase, the Project Manager will work with the Project Chemist to select the appropriate analytical methods and detection limits, based on the DQOs established for the site. The selected laboratory needs to hold state certifications appropriate for the analytical method, if applicable.

In addition to the EPA TO-15 method for the analysis of air volatile organic compounds, a summary of methods included by parameter in Worksheet #12 that are most likely to be utilized in brownfields assessments includes the following:

| **Parameter** | **Method[[4]](#footnote-5)** |
| --- | --- |
| Volatile organic compounds | SW-846 8260C/D |
| Semivolatile organic compounds | SW846- 8270D/E |
| Organochlorine pesticides | SW-846 8081B |
| Polychlorinated biphenyls (PCB) (Aroclors) | SW-846 8082A |
| Herbicides | SW-846 8151A |
| Gasoline-, diesel-, and oil-range organics | SW-846 8015C |
| Metals (by Inductively Coupled Plasma - Atomic Emission Spectroscopy) | SW-846 6010C/D |
| Metals (by Inductively Coupled Plasma - Mass Spectroscopy) | SW-846 6020A/B |
| Mercury | SW-846 7470A/7471B |
| Cyanide (Total) | SW-846 9012A/B |
| Dioxins/Furans | SW-846 8290A or EPA 1613B |
| PCB Congeners | EPA1668C |

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Analytical needs (including analytes, detection limit requirements, and analytical methods) will be identified during the project planning process. The number and types of QC samples and analytical methods will depend on the site DQO and data use, and specific QC samples required for the project will be included in site-specific worksheets.

Field QC samples are QC samples collected in the field and shipped in coolers with investigative samples for the purpose of evaluating data quality. Types of field QC samples collected may include field duplicates, field blanks, and temperature indicator bottles.

### Field Blanks

Field blanks consist of blank matrix samples collected in the field and are normally an aqueous matrix. Field blanks include ambient field blanks, equipment blanks, trip blanks, and lot blanks. Each field blank type is described below.

#### Ambient Field Blank

An ambient field blank is primarily used to provide information about contaminants that may be introduced into samples from the atmosphere during sample collection. In addition, the ambient field blank may also be exposed to contamination during storage, transport, sample preparation, and analysis.

The ambient field blank is an aqueous sample exposed to field conditions to evaluate the potential for contamination by ambient site contaminants. Ambient field blank samples will only be collected for the collection of water samples for volatile constituents such as VOCs, GRO, and wherever specifically required by the analytical method. Ambient field blanks will not be collected for soil samples.

Analyte-free water, typically distilled or deionized (DI) water, is carried to the sampling site in sealed containers, exposed to sampling conditions upon transfer into sample containers, preserved, transported to the laboratory, and treated as an environmental sample. Since field blanks are transported, stored, prepared, and analyzed in the laboratory, they may be exposed to contamination from both field and laboratory sources. Method blank results, which aid in identifying laboratory cross-contamination, are used to evaluate potential sources of contamination in field blanks during data validation. Certain drinking water methods refer to the field blank as a field reagent blank. *For the purpose of streamlining QAPP worksheets, field reagent blanks and ambient field blanks will be referred to as “ambient field blanks.”*

Ambient field blanks will be collected at a minimum frequency of one per day or 1 per 20 water samples, whichever is more frequent. Ambient field blanks will be shipped to the same laboratory as the associated samples and analyzed for the same analytical parameters. The need for collection of ambient field blanks will be evaluated during the project planning process.

#### Equipment Blanks (Rinsate Blank)

An equipment blank (i.e., “rinsate blank” or “equipment rinsate blank”) consists of a sample of analyte-free DI water poured over or through decontaminated field sampling equipment prior to collection of environmental samples. Equipment blanks will be collected from non-dedicated sampling equipment only and will primarily be used to assess the adequacy of the equipment decontamination process. Since equipment blanks are transported, stored, prepared, and analyzed in the laboratory, they may be exposed to contamination from both field and laboratory sources. The method blank results, which would aid in identifying laboratory cross-contamination, are used to evaluate potential sources of contamination in equipment blanks during data validation.

Equipment blanks will be collected at a minimum frequency of one per day per matrix or 1 per 20 samples per matrix, whichever is more frequent. Equipment blanks will be shipped to the same laboratory as the associated samples and analyzed for the same analytical parameters. The need for collection of equipment blanks will be evaluated during the project planning process. When disposable or dedicated sampling equipment is used, equipment blank samples are not required.

#### Trip Blank

A trip blank is primarily used to provide information about volatile contaminants that may be introduced into field samples during transport and sample storage. A trip blank is a sample prepared in the field or in the laboratory, accompanies the sample bottles to the laboratory, and is analyzed for the same target analytes. For trip blanks prepared in the field, DI water is placed into pre-preserved sample containers. Since trip blanks are transported, stored, prepared, and analyzed in the laboratory, they may be exposed to contamination from both field and laboratory sources. The method blank results, which would aid in identifying laboratory contaminants, are used to evaluate potential sources of contamination in trip blanks during data validation.

Trip blanks will be collected at a minimum frequency of one per cooler of VOC samples. Trip blanks will be shipped to the same laboratory as the associated VOC samples and analyzed for the same list of target analytes. The need for collection of trip blanks will be evaluated during the project planning process.

#### Lot Blank

A lot blank is primarily used to identify contamination from the sampling media used to collect field samples (e.g., filters from cartridges used to collect air samples, gauze, and Ghost wipes media for wipe samples). The lot blank sample consists of an unopened unit of sampling media that can be tracked by lot number, and is assigned a sample identifier, accompanies the field samples to the laboratory, and is analyzed for the same target analytes. Lot blank results are used in conjunction with method blank results to aid in identifying the source of contaminants which may impact field sample results. The need for collection of lot blanks will be evaluated during the project planning process.

#### Field Duplicate

A field duplicate is a generic term for a field sample collected at the same time and in the same location as its associated parent sample. The pair of field duplicate samples is collected using the same equipment, placed in separate but identical types of sample containers, and preserved in the same manner. The field duplicates are shipped to the laboratory and are treated as separate samples by the laboratory and taken through identical sample preparation and analysis processes. Field duplicates provide information on the precision of the sample collection and the overall analytical process. There are two categories of field duplicate samples which are defined by the sample collection method: co-located field duplicates and subsample field duplicates.

Co-located field duplicates are independent samples collected from side-by-side locations at the same point in time and space to be considered identical. Co-located field duplicate samples are homogenized individually (except for VOC/GRO samples) prior to placement in the sample container. An example of co-located field duplicates is soil samples collected for VOC analysis which are collected side-by-side using EnCore or similar sampling devices. It is not acceptable to homogenize soil for VOC analysis due to loss of VOCs during the homogenization process; therefore, collecting co-located field duplicates for VOCs is the only acceptable sampling method.

Subsample field duplicate samples are obtained from one sample collection at one sample location. Soil field duplicate samples will be homogenized and subsampled in the field into separate sample containers with separate sample identifiers to generate an original (parent) sample and a field duplicate sample.

For most field investigative sampling events, field duplicate samples will be collected at a frequency of 5% (1 field duplicate for every 20 samples collected per matrix). Depending on the site DQOs, field duplicates may not be collected for some sample types; for example, a sample collected solely for the purpose of waste characterization would not require field duplicate analysis.

#### Temperature Indicator

A temperature indicator is a container of water that is packed and shipped to the laboratory with the field samples requiring preservation by cooling to ≤ 6 degrees Celsius (°C). Upon opening the sample cooler, the laboratory measures the temperature of the temperature indicator. The temperature reading is used to document whether field samples were received within the acceptable temperature range. This information is used by both the laboratory and by the data validator. If the temperature indicator is outside the acceptance criteria, the laboratory is expected to notify the Project Chemist immediately for guidance on whether to proceed with analysis. The Project Chemist, in conjunction with project management, will direct the laboratory on whether to analyze the samples or if re-sampling may be required. It should be noted that samples received by the laboratory on the same day as collection may not have adequate time to achieve ideal preservation temperatures. Generally, by providing the laboratory documentation as evidence that the preservation process is underway during sample receipt (e.g., solid ice remaining in the cooler), data quality will not likely be impacted.

### Laboratory QC Samples

Laboratory QC sample types typically include method blank, instrument blanks, storage blanks, laboratory control samples (LCS), laboratory duplicates, and MS/MSDs. While surrogates are not separate QC samples but are compounds added to field and QC samples, they are typically included in Worksheet #12.

#### Method Blank

The laboratory method blank consists of analyte-free reagent water or solid matrix to which solvents, surrogates, internal standards, etc. are added in the same volumes or proportions as in field samples of the same matrix. The method blank is then carried through the complete sample preparation and analytical process. The purpose of the method blank is to assess contamination introduced during the sample preparation process. A method blank shall be included in every volatile analytical or extraction/digestion/distillation batch. Most but not all analytical methods define a batch as including up to 20 samples analyzed or prepared within a 7-day period. Certain analytical methods refer to the laboratory method blank as a laboratory reagent blank (LRB*). For the purpose of streamlining QAPP worksheets, LRBs will be referred to as “method blanks.”*

#### Instrument Blanks

Instrument blanks consist of analyte-free water samples which are introduced as sample injections into analytical instruments to verify that the analytical system of measurement is clean. Instrument blanks are either incorporated as a requirement into the analytical method (e.g., metals, pesticides, and PCBs) or often injected after a highly contaminated sample.

#### Laboratory Control Sample

The LCS consists of analyte-free water (for analysis of aqueous samples) or analyte-free solid matrix (for analysis of solid samples) spiked with the target analytes of interest. LCS samples are not required for all analytical methods. The LCS is analyzed to assess accuracy by measuring analyte recovery from a clean matrix. LCS samples are prepared at the same frequency as method blanks: one per analytical or extraction/digestion/distillation batch. Certain analytical methods refer to the LCS as a laboratory fortified blank (LFB). *For the purpose of streamlining QAPP worksheets, LFBs will be referred to as laboratory control samples or “LCS.”*

#### Laboratory Duplicate Samples

Laboratory duplicate samples are performed by splitting a field sample into two separate aliquots and performing separate analyses on each aliquot. The analysis of laboratory duplicate samples monitors laboratory precision; however, it may be affected by sample non-homogeneity, particularly in the case of non-aqueous samples. Laboratory duplicates are typically performed for inorganic analyses (e.g., metals, mercury, and cyanide) and certain drinking water methods.

*For the purposes of streamlining QAPP worksheets and maintaining sampling program consistency, laboratory duplicates will be collected only for inorganic test parameters.* Organic MS/MSD samples will be collected in lieu of laboratory duplicates for drinking water methods because many target analytes organics are frequently not detected in drinking water samples and often do not provide sufficient evaluation of laboratory precision; the MSD allows for evaluating laboratory precision.

A laboratory duplicate will be run for every preparation batch of up to 20 inorganic field samples. In the case of VOCs, double the amount will be collected. Typically, laboratories require two to three sample containers for each sample location, therefore four to six sample containers will be collected for laboratory MS/MSD analyses (nine TerraCores or six EnCore sample tubes will be collected for soil/sediment matrix). The need for collection of additional sample volume for the field sample designated for laboratory duplicate analysis will be evaluated during the project planning process in conjunction with the Project Chemist.

#### Matrix Spikes/Matrix Spike Duplicates (MS/MSD)

A MS is prepared from an aliquot of a field sample that is spiked by the laboratory with known concentrations of method-specific target analytes, then carried through the entire sample preparation and analytical process. Accuracy is calculated from the spike recoveries in the matrix spike sample and results are used to assess the nature of the sample matrix and direction of analytical bias. Certain organic methods often refer to the MS as a laboratory fortified sample matrix (LFSM).

An MSD is prepared from a second aliquot of a field sample that is spiked by the laboratory with known concentrations of method-specific target analytes, then carried through the entire sample preparation and analytical process. Accuracy is calculated from the spike recoveries in the matrix spike duplicate sample and direction of analytical bias. The precision between the MS and MSD can also be calculated mathematically as the relative percent difference (RPD) and results are used to assess the nature of the sample matrix. Certain organic methods often refer to the MSD as a laboratory fortified sample matrix duplicate (LFSMD).

Laboratory QC for inorganic samples typically includes a single MS analysis (e.g., metals, mercury, and cyanide) collected at a frequency of 1 per 20 field samples.

MS and MSD are typically performed for organic analyses. MS/MSD samples will be included for GC/MS methods.

Examples of these GC/MS methods include:

* VOCs by SW-846 8260C or 8260D
* SVOCs by SW-846 8270D or 8270E

For high performance liquid chromatography (HPLC) analyses and GC analyses using detectors other than mass spectrometers, a minimum of one MS/MSD pair will be collected per 20 field samples for each matrix collected. Sampling locations selected for the purpose of assigning an MS/MSD should be an area anticipated to be free from contamination or with low concentrations of targeted analytes. During collection of soil MS/MSD samples, field personnel will avoid areas that are stained or known or suspected to have high levels of contamination. The need for collection of MS and MSDs will be evaluated during the site scoping process in conjunction with the Project Chemist.

*MSD samples will be collected in lieu of laboratory duplicates for organic GC and HPLC methods.* Frequently, many organic target analytes are not detected in drinking water samples and often do not provide sufficient evaluation of laboratory precision; the MSD allows for evaluating laboratory precision. MS/MSD analyses are not conducted for air samples analyzed by Method TO-15.

#### Surrogate Spikes

Surrogates are organic compounds similar to the target analyte(s) in structure and chemical behavior but are not normally detected in environmental samples. Surrogate results are used to evaluate accuracy, method performance, and extraction efficiency. Surrogate compounds are spiked by the laboratory into environmental samples, QC samples, and blank samples according to method requirements. Several organic methods refer to surrogates as deuterated monitoring compounds (DMC). *For the purpose of streamlining QAPP worksheets, surrogates and DMCs will be referred to as “surrogates.”*

## WORKSHEET #12.1: MEASUREMENT PERFORMANCE CRITERIA FOR VOLATILE ORGANIC COMPOUNDS (VOCS) BY GC/MS

**Matrix:** Water, Drinking Water, Soil/Sediment, Solid, Waste, TCLP Leachate, SPLP Leachate, Air (ambient, indoor, and soil gas)  
**Analytical Group/Method:** VOCs/ SW-846 8260C/D, EPA 624.1, EPA 524.2, TO-15  
**Concentration Level:** Trace/Low/Medium

| **Data Quality Indicators (DQIs)** | **QC Sample or Measurement Performance Activity** | **Measurement Performance Criteria** |
| --- | --- | --- |
| Precision - Overall | Field Duplicates: 1 per 20 field samples or fewer per matrix  (Water, drinking water, and soil/sediment matrices; not required for Waste or TCLP/SPLP leachates) | Water RPD: ≤30%; Soil RPD: ≤50%; Air RPD: ≤30% |
| Accuracy/Bias - Laboratory | LCS: 1 per analysis batch of up to 20 samples  (Full list LCS is required for SW-846 8260C/D, EPA 624.1, and EPA 524.2) | %R within statistically derived laboratory acceptance limits |
| Precision and Accuracy/Bias – Laboratory (matrix interference) | MS/MSD: 1 MS/MSD per 20 or fewer samples per matrix | Air (TO-15) – If laboratory has capability, if not lab should do LCS/LCSD.  %R within statistically derived laboratory acceptance limits  RPD within statistically derived control limits developed by the laboratory |
| Accuracy/Bias – Laboratory | Surrogates added to each field and QC sample as specified by the method and/or laboratory SOP | %R within statistically derived control limits developed by the laboratory if not specifically stated in the NFGs |
| Accuracy/Bias  (Laboratory Contamination) | Laboratory Blanks include:   * SW-846 8260C/D: 1 per 12-hour shift * Method blank (EPA 624.1): 1 per day (minimum) * Method blank (EPA 524.2): 1 per 8-hour shift * Method blank for TO-15: 1 per 24-hour shift * Instrument blank (all methods): after samples with analytes exceeding the instrument calibration range or detector saturation * TCLP/SPLP LEB (SW-846 8260C/D): 1 per   extraction batch of up to 20 samples | SW-846 8260C/D Blanks:   * Method: analyte concentrations < MDL * Instrument: analyte concentrations < MDL * Storage: not required; trip blank results may be used to monitor for contamination during storage * TCLP/SPLP LEB: required but no acceptance criteria   EPA 624.1 and EPA 524.2 Blanks:   * Method: analyte concentrations < MDL * Instrument: analyte concentrations < MDL * Storage: none, refer to field reagent blank |
| Overall Accuracy/Bias (Contamination) | Field Blanks include:   * Trip Blank – 1 trip blank per cooler containing samples for VOC analysis * Equipment Blank – 1 per 20 samples, minimum 1 per day for non-dedicated equipment * Ambient Field Blank[[5]](#footnote-6) | All analyte concentrations < RL |
| Sensitivity (method) | Review Laboratory RLs and MDLs[[6]](#footnote-7) | Action Level at least 3 to 10x > RL, if feasible |
| Completeness | Review data package for required elements | Refer to Worksheet #34 |

Notes:

QC Samples for VOCs by GC/MS are listed along with their method-specified frequency and MPCs.

Soil samples for VOCs will be collected using EnCore or equivalent sampling devices or using Terra-Core devices and placed in tared VOA vials in the field. Soil samples for VOCs only will also require collection of a separate jar for percent solids determination. Refer to optimized QAPP Worksheet #19&30 for details.

|  |  |
| --- | --- |
| %R | percent recovery |
| GC/MS | Gas Chromatography/Mass Spectrometry |
| LCS | Laboratory Control Sample |
| LEB | Leachate Extraction Blank |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| QC | Quality Control |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| SDG | Sample Delivery Group |
| SPLP | Synthetic Precipitation Leaching Procedure |
| TCLP | Toxicity Characteristic Leaching Procedure |
| VOC | Volatile Organic Compound |

## WORKSHEET #12.2: MEASUREMENT PERFORMANCE CRITERIA FOR SEMIVOLATILE ORGANIC COMPOUNDS (SVOCS) INCLUDING POLYNUCLEAR AROMATIC HYDROCARBONS (PAHS) BY GC/MS WITH/WITHOUT SELECTED ION MONITORING (SIM)

**Matrix:** Water, Drinking Water, Soil/Sediment, Solid, Wipe, Waste, TCLP Leachate, SPLP Leachate   
**Analytical Group/Method:** SVOCs/SW-846 8270D/E, EPA 625.1, EPA 525.2   
**Concentration Level:** Trace/Low/Medium

| **Data Quality Indicators (DQIs)** | **QC Sample or Measurement Performance Activity** | **Measurement Performance Criteria** |
| --- | --- | --- |
| Precision - Overall | Field Duplicates: 1 per 20 field samples or fewer per matrix  (Water, drinking water, and soil/sediment matrices; not required for Wipe, Waste or TCLP/SPLP leachates) | Water RPD: ≤30% Soil RPD: ≤50% |
| Accuracy/Bias - Laboratory | LCS: 1 per analysis batch of up to 20 samples of each matrix (Full list LCS is required for SW-846 8270D/E, EPA 625.1, and EPA 525.2) | %R within statistically derived laboratory acceptance limits |
| Precision and Accuracy/Bias – Laboratory (matrix interference) | MS/MSD: 1 MS/MSD per 20 or fewer samples per matrix | %R within statistically derived laboratory acceptance limits  RPD within statistically derived control limits developed by the laboratory |
| Accuracy/Bias – Laboratory | Surrogates added to each field and QC sample as specified by the method and laboratory SOP | %R within statistically derived control limits developed by the laboratory if not specifically stated in the NFGs |
| Accuracy/Bias (Laboratory Contamination) | Laboratory Blanks include:   * Method blank (all methods): 1 per extraction batch of 20 samples * Instrument blank (all methods): run after high concentration samples or detector saturation * TCLP/SPLP LEB (SW-846 8270D/E): 1 per TCLP/SPLP extraction batch of 20 samples | SW-846 8270C/D Blanks:   * Method: analyte concentrations < MDL * Instrument: analyte concentrations < MDL * TCLP/SPLP LEB: required but no acceptance criteria   EPA 625.1 and EPA 525.2 Blanks:   * LRB (method blank): analyte concentrations < MDL * Instrument: analyte concentrations < MDL |
| Overall Accuracy/Bias (Contamination) | Field Blanks include: Equipment Blank – 1 field blank per 20 samples, minimum 1 field blank per day for non-dedicated equipment Lot Blank (wipes only) – 1 per lot of media[[7]](#footnote-8) | All analyte concentrations < RL |
| Sensitivity (method) | Review Laboratory RLs and MDLs against action limits[[8]](#footnote-9) | Action Level at least 3 to 10x > RL, if feasible |
| Completeness | Review data package for required elements | Refer to Worksheet #34 |

Notes:

QC Samples for SVOCs by GC/MS are listed along with their method-specified frequency and MPCs.

|  |  |
| --- | --- |
| %R | percent recovery |
| GC/MS | Gas Chromatography/Mass Spectrometry |
| LCS | Laboratory Control Sample |
| LEB | Leachate Extraction Blank |
| LRB | Laboratory Reagent Blank |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| SPLP | Synthetic Precipitation Leaching Procedure |
| TCLP | Toxicity Characteristic Leaching Procedure |

## WORKSHEET #12.3: MEASUREMENT PERFORMANCE CRITERIA FOR ORGANOCHLORINE (OC) PESTICIDES BY GC/ECD

**Matrix:** Water, Drinking Water, Soil/Sediment, Solid, Wipe, Waste, TCLP Leachate, SPLP Leachate   
**Analytical Group/Method:** Pesticides/ SW-846 8081B, EPA 608.3, EPA 508.1   
**Concentration Level:** Low

| **Data Quality Indicators (DQIs)** | **QC Sample or Measurement Performance Activity** | **Measurement Performance Criteria** |
| --- | --- | --- |
| Precision - Overall | Field Duplicates: 1 per 20 field samples or fewer per matrix  (Water, drinking water, and soil/sediment matrices; not required for Wipe, Waste or TCLP/SPLP leachates) | Water RPD: ≤30% Soil RPD: ≤50% |
| Accuracy/Bias - Laboratory | LCS: 1 per analysis batch of up to 20 samples of each matrix (Full list spike is required for SW-846 8081B, EPA 608.3, and EPA 508.1) | %R within statistically derived laboratory acceptance limits |
| Precision and Accuracy/Bias – Laboratory (matrix interference) | MS/MSD: 1 MS/MSD per 20 or fewer samples per matrix | SW-846 8081B, EPA 608.3: %R within statistically derived laboratory acceptance limits if not specifically stated in the NFGs  EPA 508.1: %R within 70-130%  RPDs within statistically derived laboratory acceptance limits |
| Accuracy/Bias – Laboratory | Surrogates added to each field and QC sample as specified by the method and laboratory SOP | %R within statistically derived laboratory acceptance limits |
| Accuracy/Bias (Laboratory Contamination) | Laboratory Blanks include:   * Method blank (all methods): 1 per extraction batch * Instrument blank: After high concentration samples * TCLP/SPLP LEB (SW-846 8081B): 1 per extraction batch of 20 samples | * Method: analyte concentrations < MDL * Instrument: analyte concentrations < MDL * TCLP/SPLP LEB: required but no acceptance criteria |
| Overall Accuracy/Bias (Contamination) | Field Blanks include:   * Equipment Blank – 1 field blank per 20 samples, minimum 1 field blank per day for non-dedicated equipment * Lot Blank (wipes only) – 1 per lot of media[[9]](#footnote-10) | All analyte concentrations < RL |
| Sensitivity (method) | Review Laboratory RLs and MDLs against action limits[[10]](#footnote-11) | Action Level at least 3 to 10x > RL, if feasible |
| Completeness | Review data package for required elements | Refer to Worksheet #34 |

|  |  |
| --- | --- |
| %R | percent recovery |
| GC/ECD | Gas Chromatography/Electron Capture Detector |
| LCS | Laboratory Control Sample |
| LEB | Leachate Extraction Blank |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| QC | Quality Control |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| SPLP | Synthetic Precipitation Leaching Procedure |
| TCLP | Toxicity Characteristic Leaching Procedure |

## 

## WORKSHEET #12.4: MEASUREMENT PERFORMANCE CRITERIA FOR POLYCHLORINATED BIPHENYLS (PCBs) AS AROCLORS BY GC/ECD

**Matrix:** Water, Soil/Sediment, Solid, Wipe, Waste  
**Analytical Group/Method:** PCBs (Aroclors)/ SW-846 8082A, EPA 608.3  
**Concentration Level:** Low

| **Data Quality Indicators (DQIs)** | **QC Sample or Measurement Performance Activity** | **Measurement Performance Criteria** |
| --- | --- | --- |
| Precision - Overall | Field Duplicates: 1 per 20 field samples or fewer per matrix  (Water and soil/sediment matrices; not required for Wipe and Waste) | Water RPD: ≤30% Soil RPD: ≤50% |
| Accuracy/Bias - Laboratory | LCS: 1 per analysis batch of up to 20 samples of each matrix | %R within statistically derived laboratory acceptance limits |
| Precision and Accuracy/Bias – Laboratory (matrix interference) | MS/MSD: 1 per 20 samples or fewer of each matrix | %R within statistically derived laboratory acceptance limits  RPDs within statistically derived laboratory acceptance limits |
| Accuracy/Bias – Laboratory | Surrogates added to each field and QC sample as specified by the method and laboratory SOP | %R within statistically derived laboratory acceptance limits if not specifically stated in the NFGs |
| Accuracy/Bias  (Laboratory Contamination) | Laboratory Blanks include:   * Method blank for SW-846 8082A: 1 per extraction batch of 20 samples * Instrument blank: At the beginning and the end every 12-hour period in which samples were analyzed and/or after high concentration samples | * Method: analyte concentrations < MDL * Instrument: analyte concentrations < MDL |
| Overall Accuracy/Bias (Contamination) | Field Blanks include:   * Equipment Blank – 1 field blank per 20 samples, minimum 1 field blank per day for non-dedicated equipment * Lot Blank (wipes only) – 1 per lot of media[[11]](#footnote-12) | All analyte concentrations < RL |
| Sensitivity (method) | Review Laboratory RLs and MDLs against action limits[[12]](#footnote-13) | Action Level at least 3 to 10x > RL, if feasible |
| Completeness | Review data package for required elements | Refer to Worksheet #34 |

Notes

|  |  |
| --- | --- |
| %R | percent recovery |
| GC/ECD | Gas Chromatography/Electron Capture Detector |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| QC | Quality Control |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| SOP | Standard Operating Procedure |

## WORKSHEET #12.5: MEASUREMENT PERFORMANCE CRITERIA FOR CHLORINATED HERBICIDES BY GC/ECD

**Matrix:** Water, Soil/Sediment, Solid, Waste/TCLP or SPLP Leachate   
**Analytical Group/Method:** Herbicides/ SW-846 8151A, EPA 615  
**Concentration Level:** Low

|  |  |  |
| --- | --- | --- |
| **Data Quality Indicators (DQIs)** | **QC Sample or Measurement Performance Activity** | **Measurement Performance Criteria** |
| Precision - Overall | Field Duplicates: 1 per 20 field samples or fewer per matrix  (Water/soil/sediment matrices; not required for Waste or TCLP/SPLP leachate) | Water RPD: ≤30% Soil RPD: ≤50% |
| Accuracy/Bias - Laboratory | LCS: 1 per extraction batch of up to 20 samples of each matrix *(Full list spike is required)* | %R within statistically derived laboratory acceptance limits |
| Precision and Accuracy/Bias – Laboratory (matrix interference) | MS/MSD: 1 per 20 samples or fewer of each matrix | %R within statistically derived laboratory acceptance limits  RPDs within statistically derived laboratory acceptance limits |
| Accuracy/Bias – Laboratory | Surrogates added to each field and QC sample as specified by the method and laboratory SOP | %R within statistically derived laboratory acceptance limits |
| Accuracy/Bias  (Laboratory Contamination) | Laboratory Blanks include:   * Method blank: 1 per extraction batch * Instrument blank: After high concentration samples * TCLP/SPLP LEB: 1 per extraction batch of 20 samples | SW-846 8151A Blanks:   * Method: analyte concentrations < Reporting Limits * Instrument: analyte concentrations < MDL * TCLP/SPLP LEB: required but no acceptance criteria |
| Overall Accuracy/Bias (Contamination) | Field Blanks include:  Equipment Blank – 1 field blank per 20 samples, minimum 1 field blank per day for non-dedicated equipment | All analyte concentrations < RL |
| Sensitivity (method) | Review Laboratory RLs and MDLs against action limits[[13]](#footnote-14) | Action Level at least 3 to 10x > RL, if feasible |
| Completeness | Review data package for required elements | Refer to Worksheet #34 |

Notes

|  |  |
| --- | --- |
| %R | percent recovery |
| GC/ECD | Gas Chromatography/Electron Capture Detector |
| LCS | Laboratory Control Sample |
| LEB | Leachate Extraction Blank |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| QC | Quality Control |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| SOP | Standard Operating Procedure |
| SPLP | Synthetic Precipitation Leaching Procedure |
| TCLP | Toxicity Characteristic Leaching Procedure |

## WORKSHEET #12.6: MEASUREMENT PERFORMANCE CRITERIA FOR NONHALOGENATED ORGANIC COMPOUNDS (GASOLINE RANGE ORGANICS [GRO], DIESEL RANGE ORGANICS [DRO], OIL RANGE ORGANICS [ORO]) BY GC/FID

**Matrix:** Water, Soil/Sediment, Waste  
**Analytical Group/Method:** Nonhalogenated Organic Compounds/ SW-846 8015C/D modified  
**Concentration Level:** Low

|  |  |  |
| --- | --- | --- |
| **Data Quality Indicators (DQIs)** | **QC Sample or Measurement Performance Activity** | **Measurement Performance Criteria** |
| Precision - Overall | Field Duplicates: 1 per 20 field samples or fewer per matrix | Water RPD: ≤30% Soil RPD: ≤50% |
| Accuracy/Bias - Laboratory | LCS: 1 per analysis batch of up to 20 samples | %R within statistically derived control limits developed by the laboratory |
| Precision and Accuracy/Bias – Laboratory (matrix interference) | MS/MSD: 1 per 20 samples or fewer of each matrix | %R within statistically derived control limits developed by the laboratory  RPD within statistically derived control limits developed by the laboratory |
| Accuracy/Bias – Laboratory | Surrogates added to each field and QC sample as specified by the method and laboratory SOP | %R within statistically derived laboratory acceptance limits |
| Accuracy/Bias (Laboratory Contamination) | Laboratory Blanks include:   * Method blank: 1 per extraction batch * Instrument blank: after high concentration samples or when interference is suspected | * Method: analyte concentrations < MDL * Instrument: analyte concentrations < MDL |
| Overall Accuracy/Bias (Contamination) | Field Blanks include:   * Trip Blank (GRO only) * Equipment Blank * Ambient field blank (GRO only) [[14]](#footnote-15) | All analyte concentrations < RL |
| Sensitivity (method) | Review Laboratory RLs and MDLs against action limits [[15]](#footnote-16) | Action Level at least 3 to 10x > RL, if feasible |
| Completeness | Review data package for required elements | Refer to Worksheet #34 |

Notes

|  |  |
| --- | --- |
| %R | percent recovery |
| GC/FID | Gas Chromatography/Flame Ionization Detector |
| GRO | Gasoline Range Organic |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| QC | Quality Control |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| SOP | Standard Operating Procedure |

## WORKSHEET #12.7: MEASUREMENT PERFORMANCE CRITERIA FOR METALS AND MERCURY

**Matrix:** Water, Drinking water, Soil/Sediment, Solid, Waste, Wipe, TCLP and SPLP Leachates  
**Analytical Group/Method:** Metals and Mercury / SW-846 6010C/D, EPA 200.7, SW-846 6020B, EPA 200.8, SW-846 7470A/7471B, EPA 245.1, EPA 245.2  
**Concentration Level:** Low

| **Data Quality Indicators (DQIs)** | **QC Sample or Measurement Performance Activity** | **Measurement Performance Criteria** |
| --- | --- | --- |
| Precision - Overall | Field Duplicates: 1 per 20 field samples or fewer per matrix  (Required for water, drinking water, and soil/sediment; not required for Solid, Waste, Wipe, or TCLP/SPLP leachates) | Water RPD: ≤30% Soil RPD: ≤50% |
| Precision - Laboratory | Lab Duplicate: (Required for water, drinking water, and soil/sediment; not required for Solid, Wipe, and TCLP/SPLP leachates) | RPD within statistically derived control limits developed by the laboratory if not specifically stated in the NFGs |
| Accuracy/Bias - Laboratory | LCS: 1 per analysis batch of up to 20 samples | %R within statistically derived control limits developed by the laboratory |
| Precision and Accuracy/Bias – Laboratory (matrix interference) | MS: 1 per 20 samples or fewer of each matrix | %R within statistically derived control limits developed by the laboratory if not specifically stated in the NFGs |
| Accuracy/Bias (Laboratory Contamination) | Laboratory Blanks include:   * Method blank: 1 per extraction batch * Instrument blank: at beginning of analytical run (ICB), and after every 10 analytical samples (CCB) * TCLP/SPLP LEB: 1 per extraction batch of 20 samples | * Method: analyte concentrations < RL * Instrument: analyte concentrations < RL * TCLP/SPLP LEB: required but no acceptance criteria |
| Overall Accuracy/Bias (Contamination) | Field Blanks include:   * Equipment Blank – 1 field blank per 20 samples, minimum field blank per day for non-dedicated equipment | All analyte concentrations < RL |
| Sensitivity (method) | Review Laboratory RLs and MDLs against action limits[[16]](#footnote-17) | Action Level at least 3 to 10x > RL, if feasible |
| Completeness | Review data package for required elements | Refer to Worksheet #34 |

Notes:

|  |  |
| --- | --- |
| %R | percent recovery |
| CCB | continuing calibration blank |
| CCB | continuing calibration blank |
| ICB | initial calibration blank |
| LCS | Laboratory Control Sample |
| LEB | Leachate Extraction Blank |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| NFG | National Functional Guidelines |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| SPLP | Synthetic Precipitation Leaching Procedure |
| TCLP | Toxicity Characteristic Leaching Procedure |

## WORKSHEET #12.8: MEASUREMENT PERFORMANCE CRITERIA FOR TOTAL CYANIDE

**Matrix:** Water, Drinking Water, Soil/Sediment, Solid, Waste   
**Analytical Group/Method:** Total Cyanide / SW-846 9012A/B, EPA 335.4   
**Concentration Level:** Low

| **Data Quality Indicators (DQIs)** | **QC Sample or Measurement Performance Activity** | **Measurement Performance Criteria** |
| --- | --- | --- |
| Precision - Overall | Field Duplicates: 1 per 20 field samples or fewer per matrix  (Required for water, drinking water, and soil/sediment matrices; not required for Solid or Waste) | Water RPD: ≤30% Soil RPD: ≤50% |
| Accuracy/Bias - Laboratory | LCS: 1 per analysis batch of up to 20 samples | %R within statistically derived control limits developed by the laboratory |
| Precision and Accuracy/Bias – Laboratory (matrix interference) | MS/MSD: 1 per 20 samples or fewer of each matrix | %R within statistically derived control limits developed by the laboratory if not specifically stated in the NFGs  RPD within statistically derived control limits developed by the laboratory if not specifically stated in the NFGs |
| Accuracy/Bias (Laboratory Contamination) | Laboratory Blanks include:   * Preparation (Method) blank: 1 per distillation batch * Instrument blank: at beginning of analytical run (ICB), and hourly and after every CCV (CCB) | * Method: analyte concentrations < RL * Instrument: analyte concentrations < RL |
| Overall Accuracy/Bias (Contamination) | Field Blanks include:   * Equipment Blank – 1 field blank per 20 samples, minimum 1 field blank per day for non-dedicated equipment | All analyte concentrations < RL |
| Sensitivity (method) | Review Laboratory RLs and MDLs against action limits1 | Action Level at least 3 to 10x > RL, if feasible |
| Completeness | Review data package for required elements | Refer to Worksheet #34 |

Notes:

1 Laboratory RLs and MDLs will be reviewed prior to award of an analytical services subcontract to a laboratory. Laboratory RLs and MDLs will be compared with RSLs or other appropriate action levels in the DQOs and sampling design prepared for each site.

|  |  |
| --- | --- |
| %R | percent recovery |
| CCB | continuing calibration blank |
| CCV | continuing calibration verification |
| ICB | initial calibration blank |
| ICV | Initial Calibration Verification |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| NFG | National Functional Guideline |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |

## WORKSHEET #12.9: MEASUREMENT PERFORMANCE CRITERIA FOR DIOXINS/FURANS BY HRGC/HRMS

**Matrix:** Water, Soil/Sediment, Sludge, Tissue, Ash, Oil/Oily matrices  
**Analytical Group/Method:** Dioxins/Furans (Chlorinated dibenzo-p-dioxins /Chlorinated dibenzofurans) / SW-846 8290A  
**Concentration Level:** Low

|  |  |  |
| --- | --- | --- |
| **Data Quality Indicators (DQIs)** | **QC Sample or Measurement Performance Activity** | **Measurement Performance Criteria** |
| Precision - Overall | Field Duplicates: 1 per 20 field samples or fewer per matrix  (Required for water, drinking water, and soil/sediment) | Water RPD: ≤30% Soil RPD: ≤50% |
| Accuracy/Bias – Laboratory | Labeled compounds added to each field and QC sample | %R within method control limits |
| Precision and Accuracy/Bias - Laboratory | LCS and LCSD: 1 per analysis batch of up to 20 samples of the same matrix  MSD and Lab Duplicate[[17]](#footnote-18): not required | %R within statistically derived control limits developed by the laboratory  RPD within statistically derived control limits developed by the laboratory |
| Accuracy/Bias – Laboratory (matrix interference) | MS: not required | Not applicable |
| Accuracy/Bias (Laboratory Contamination) | Laboratory Blanks include:   * Method blank: 1 per extraction batch Instrument blank: 1 per analytical sequence | Method blank: Analyte concentrations < ½ RL except for OCDD and OCDF which are allowed concentrations of < 3x RL.  Instrument blank: All analyte concentrations < ½ RL |
| Overall Accuracy/Bias (Contamination) | Field Blanks include:   * Equipment Blank | All analyte concentrations < RL |
| Sensitivity (method) | Review Laboratory RLs and MDLs against action limits[[18]](#footnote-19) | Action Level at least 3 to 10x > RL, if feasible |
| Completeness | Review data package for required elements | Refer to Worksheet #34 |

|  |  |
| --- | --- |
| %R | percent recovery |
| CRQL | Contract Required Quantitation Limit |
| HRGC | High Resolution Gas Chromatography |
| HRMS | High Resolution Mass Spectrometry |
| LCS | Laboratory Control Sample |
| LCSD | Laboratory Control Sample Duplicate |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| OCDD | Octachlorinated dibenzo-p-dioxin |
| OCDF | Octachlorinated dibenzofuran |
| QC | Quality Control |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |

## WORKSHEET #12.10: MEASUREMENT PERFORMANCE CRITERIA FOR CHLORINATED BIPHENYL CONGENERS BY HRGC/HRMS

**Matrix:** Water, Soil/Sediment, Sludge, Tissue, Ash, Oil/Oily matrices   
**Analytical Group/Method:** Chlorinated Biphenyl Congeners/EPA 1668C  
**Concentration Level:** Low

|  |  |  |
| --- | --- | --- |
| **Data Quality Indicators (DQIs)** | **QC Sample or Measurement Performance Activity** | **Measurement Performance Criteria** |
| Precision - Overall | Field Duplicates: 1 per 20 field samples or fewer per matrix | Water RPD: ≤30% Soil RPD: ≤50% |
| Precision - Laboratory | LCSD: MSD and Lab Duplicate not required[[19]](#footnote-20) | LCS/LCSD: 30% RPD |
| Accuracy/Bias – Laboratory | Labeled congeners added to each field and QC sample | %R within method control limits |
| Accuracy/Bias - Laboratory | LCS and LCSD: 1 per analysis batch of up to 20 samples of the same matrix | %R within statistically derived laboratory acceptance limits |
| Accuracy/Bias – Laboratory (matrix interference) | MS: not required | Not applicable |
| Accuracy/Bias (Laboratory Contamination) | Laboratory Blanks include:   * Method blank: 1 per extraction batch * Instrument blank: 1 per analytical sequence | Method and Instrument blanks: Concentrations for the 12 Toxic CBC congeners3[[20]](#footnote-21) < ½ RSL |
| Overall Accuracy/Bias (Contamination) | Field Blanks include Equipment Blank | All analyte concentrations < RSL |
| Sensitivity (method) | Review Laboratory RSLs and MDLs against action limits[[21]](#footnote-22) | Action Level at least 3 to 10x > RSL, if feasible |
| Completeness | Review data package for required elements | Refer to Worksheet #34 |

Notes:

|  |  |
| --- | --- |
| %R | percent recovery |
| CBC | Chlorinated Biphenyl Congener |
| HRGC | High Resolution Gas Chromatography |
| HRMS | High Resolution Mass Spectrometry |
| LCS | Laboratory Control Sample |
| LCSD | Laboratory Control Sample Duplicate |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| QC | Quality Control |
| RPD | Relative Percent Difference |
| RSL | Regional Screening Level |

## WORKSHEET #13: SECONDARY DATA USES AND LIMITATIONS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Secondary Data** | **Data Source (originating organization, report title and date)** | **Data Generator(s) (originating organization, data types, data generation / collection dates)** | **How Data Wi****ll Be Used** | **Limitations on Data Use** |
| Background Site Data | EPA Region 3, various states and regional agencies, consultants, and historical reports documenting site activities | EPA Region 3, and regional agencies and associated consultants. Analytical data types may include results for soil, sediment, groundwater, surface water, air, source waste, and investigative-derived waste (IDW). Multiple collection dates. | Analytical results will be used to evaluate the site and/or data gaps that will need to be completed to meet the needs of the Project Work Scope (PWS). | Limitations based on data quality, presence of data validation reports, and level of Quality Control (QC) available for review. Field screening vs. laboratory data and associated data validation qualifiers. |

Notes:

***The secondary data sources, uses, and limitations included in this table are common to most brownfields projects. However, this table is neither prescriptive nor comprehensive. Please modify the information to accurately describe the secondary data sources, uses, and limitations needed for the project as well as the policies and procedures of the organizations involved in the project.***

## WORKSHEET #14/16: PROJECT TASKS & SCHEDULE

### Documentation and Records

***The QAPP should describe the project’s environmental information management process, tracing the path of the environmental information from their generation to their final use or storage (e.g., the field, the office, the laboratory).***

### Field Documentation and Records

This section should discuss record keeping in the field. This may be through a combination of logbooks, preprinted forms, photographs, or other documentation. Examples of information to be maintained is provided below.

#### Field Logbooks

***Field logbooks should be used to document where, when, how, and from whom any vital project information was obtained. Logbook entries should be complete and accurate enough to permit reconstruction of field activities. Maintain a separate logbook for each sampling event or site. Logbooks should have consecutively numbered pages. All entries should be legible, written in black ink, and signed by the individual making the entries. Use factual, objective language.***

***Describe how field logbooks will be used and maintained. If electronic field logs are used, provide details on the information that is recorded, the hardware/software configuration used, and the procedures for data storage/retrieval.***

At a minimum, the following information will be recorded during the collection of each sample:

***Edit this list as necessary.***

* + - * Sample location and description
      * Site or sampling area sketch showing sample location and measured distances
      * Sampler's name(s)
      * Date and time of sample collection
      * Designation of sample as composite or grab
      * Type of sample (soil, sediment or water)
      * Type of sampling equipment used
      * Field instrument readings and calibration
      * Field observations and details related to analysis or integrity of samples (e.g., weather conditions, noticeable odors, colors, etc.)
      * Preliminary sample descriptions (e.g., for soils: clay loam, very wet; for water: clear water with strong ammonia-like odor)
      * Sample preservation
      * Lot numbers of the sample containers, sample identification numbers and any explanatory codes, and chain-of-custody form numbers
      * Shipping arrangements (overnight air bill number)
      * Name(s) of recipient laboratory(ies)

In addition to the sampling information, the following specific information will also be recorded in the field records for each day of sampling:

***Edit this list as necessary.***

* + - * Team members and their responsibilities
      * Time of arrival/entry on site and time of site departure
      * Other personnel on site
      * Summary of any meetings or discussions with tribal, contractor, or federal agency personnel
      * Deviations from sampling plans, site safety plans, and QAPP procedures
      * Changes in personnel and responsibilities with reasons for the changes
      * Levels of safety protection
      * Calibration readings for any equipment used and equipment model and serial number

***It is helpful to develop a checklist of the field notes, following the suggestions above and using only those that are appropriate, to be included in project field notes.***

#### Field Data Records

Describe how real-time measurements are recorded in the field using electronic data loggers or logbooks. Describe how these data are organized into standard formats and retained in permanent files.

#### Sample Handling, Custody, and Disposal

Procedures for sample handling, chain of custody, and investigation derived waste (IDW) disposal are Included on Worksheet #26/27.

### Laboratory Documentation and Records

***Describe the requirements for analytical data deliverables, including, but not limited to, analytical data report contents, turnaround time (TAT), and records retention schedule.***

The analytical data deliverable package for screening and definitive data will include the following:

***Edit this list as necessary.***

* Sample documentation (location, date and time of collection and analysis, etc.)
* Chain of custody
* Initial and continuing calibration
* Determination and documentation of detection limits
* Analyte(s) identification (include chromatograms)
* Analyte(s) quantitation
* Raw data
* QC blanks
* Matrix spike recoveries
* Quality Control sample results
* Duplicate results

Concentrations in liquids and air are expressed in terms of weight per unit volume (e.g., micrograms per liter [µg/L], milligrams per liter [mg/L], picograms per liter [pg/L], or, for air, micrograms per cubic meter [µg/m3] or parts per billion by volume [ppbv]). Concentrations in solid or semisolid matrices are expressed in terms of weight per unit weight of sample (e.g., micrograms per kilogram [µg/kg], milligrams per kilogram [mg/kg], or nanograms per kilogram [ng/kg]). Solid and semisolid matrices will also be reported on a dry weight basis except for unknown waste or product samples where sample drying may pose a hazard in the laboratory. Sample reporting limits must take into account all appropriate sample weights/volumes, percent moisture, dilution, and/or extraction concentration factors.

The target TAT for most subcontracted laboratories is [XX] business days for data packages. Subcontracted laboratories will retain all data related to sample preparation, analysis, and general observations in appropriate hardbound laboratory notebooks, hardcopy, and computer files for a period of at least [X] years unless otherwise specified in the subcontract agreement.

### Data Management Tasks

Describe the project data management process, tracing the path of the data from their generation to their final use or storage (e.g., the field, the office, the laboratory). Describe or reference the standard record-keeping procedures, document control system, and the approach used for data storage and retrieval on electronic media. Discuss the control mechanism for detecting and correcting errors and for preventing loss of data during data reduction, data reporting, and data entry to forms, reports, and databases. Provide examples of any forms or checklists to be used.

#### Data Reduction

Data reduction is the process for collecting and transforming measurements, through mathematical and/or statistical formulas, into final reportable measurements. The calculations may be performed manually or electronically. This section describes the quality assurance processes that will be applied during data reduction to ensure that the data collected at the site and the laboratory data are accurately reported.

#### Field Data Reduction

***The following text presents an example of field data reduction procedures to perform calculations and assess the validity of outliers. However, this example is neither prescriptive nor comprehensive. The actual organization-specific procedures that are followed must be described.***

For field measurement data that require calculations to obtain final concentrations/values (e.g., well purge volumes), the equations used, and the calculations performed will be recorded in the appropriate field log. The field team member performing the field measurement will check all calculations at least once.Occasionally, a field measurement will result in an outlier with a value significantly outside the expected range for most field conditions (e.g., a zero reading for specific conductance). During the field measurements, the field team, based on their experience, will attempt to identify outliers. When outliers are identified during a field effort, the outlier will be recorded as any other field measurement; field instrumentation and calibration will be checked, as appropriate; and at least two additional measurements will be made and recorded to verify or invalidate the suspected outlier. After this check, if the value remains the same, it is considered a valid measurement. If the value is determined invalid, the other measurements will be used.

#### Laboratory Data Reduction

***The following text presents an example of laboratory data reduction procedures. However, this example is neither prescriptive nor comprehensive. The actual organization-specific procedures that are followed must be described.***

The responsibility for data reduction is with the person generating the data (typically the laboratory analyst) and consists of calculating concentrations in samples from the raw data. The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings, and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values. Copies of all raw data and the calculations used to generate the final results, such as bound laboratory notebooks, strip-charts, chromatograms, spreadsheets, and computer record files, are retained on file at the laboratory and included as part of a Level 4 type of data package.

Calculations and data reduction steps for various methods are summarized in the respective laboratory SOPs or QAM.

### Data Review

Data review is performed to assess whether the quality control requirements are met. Data review will be performed on [XYZ %] of the data deliverables.

#### Field Data Review

***The following text presents an example of field data review procedures. However, this example is neither prescriptive nor comprehensive. The actual organization-specific procedures that are followed must be described.***

The field technician reviews the completeness of the data records continually. When the field technician has completed the entries for the week, a peer or supervisor will perform a secondary review. The extent of the review will be commensurate with the type and quantity of data produced. For small data sets, all of the results may be checked, but for larger data sets a percentage of the data may be checked at the discretion of the Project Manager or QA Manager. The secondary reviewer will verify that the data records are complete. After the secondary reviewer has verified the data are complete, or taken corrective action to correct an entry, the reviewer will sign and date the data collection form.

#### Laboratory Data Review

***The following text presents an example of laboratory data review procedures. However, this example is neither prescriptive nor comprehensive. The actual organization-specific procedures that are followed must be described.***

The individual analyst reviews the quality of data through calibration checks and QC sample results. The analyst initiates data review during, immediately following, and after the completed analysis. The laboratory supervisor or a different analyst/data specialist performs a secondary (peer) review of the data. The peer reviewer should have training for this task.

### Assessment and Audit Tasks

***Audits and assessments are a necessary aspect of quality management. This is a QA action, i.e., an action that takes place outside the project execution itself.***

***Assessments are conducted with the express aim of determining the status of a particular subject in order to improve objective quality and client (internal and external) satisfaction. Assessments should be fair and impartial and are not meant to be adversarial or punitive.***

***Describe the assessments and audits which will be used to implement the QA Program, including the frequency and type. This would include oversight by the Quality Assurance Manager or the person assigned QA responsibilities. Indicate how often a QA review of the different aspects of the project, including audits of field and laboratory procedures, use of performance evaluation samples, review of laboratory and field data, etc., will take place. Discuss how response actions to assessment findings, including corrective actions for deficiencies and other non-conforming conditions, are to be addressed and by whom. Include details on how the corrective actions will be verified and documented.***

### Audits

***An audit is a planned and documented investigative evaluation of an item, system, process, project, or result to determine the adequacy of and compliance with established contract and/or client requirements, procedures, instructions, drawings, QA plans, and other applicable documents. This type of assessment is termed a “systems audit.” Audits should be scheduled with sufficient lead-time so that all appropriate records are available at the time of the audit.***

### Assessments

***Assessments are conducted with the express aim of determining the status of a particular subject in order to improve objective quality and client (internal and external) satisfaction. Assessments should be fair and impartial and are not meant to be adversarial or punitive.***

### Data Review, Validation, and Verification Tasks

Data quality assessment is performed by evaluating the results of data review, data verification, and/or data validation to determine the usability of the data for the original project objectives. Data review, data verification, and data validation are each separate levels of review that can be performed by themselves or in conjunction with each other. Each of these levels of review is defined below. While it is possible to apply these levels of review to field data, they are almost always associated only with analytical data from laboratories for field

### Data Review, Verification, and Validation

***State the criteria used to review and validate -- that is, accept, reject, or qualify -- data, in an objective and consistent manner. The following example text provides an example of data review and evaluation criteria. It is neither prescriptive or comprehensive. Organization-specific procedures must be included.***

***Include the data validation criteria that will be used such as* EPA *Contract Laboratory Program National Functional Guidelines for Organic Superfund Methods Data Review,* EPA/540/R-20-005*, November* 2020; *Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Methods Data Review,* EPA/542/R-20-006*, November* 2020; *National Functional Guidelines for High Resolution Superfund Methods Data Review*, EPA/542-R-20-007, *November* 2020; *Guidance on Environmental Data Verification and Data Validation QA/G-8,* EPA/240/R-02/004, November 2002; and *Quality Assurance/Quality Control Guidance for Removal Activities, Interim Final,* Office of Solid Waste and Emergency Response (OSWER) Directive 9360.4-01, April 1990.**

Data review and evaluation is performed on all data to assess whether the quality control requirements for field duplicates, laboratory duplicates, field blanks, trip blanks, surrogates, matrix spikes, percent solids, laboratory blanks, and laboratory control samples were met. Data review and evaluation will be performed on [XYZ %] of the laboratory deliverables generated during this program.

### Data Verification and Validation Methods

***Describe the process to be used for verifying and validating data, including what organizations or individuals will be responsible for what aspects of data review and what the review will include. This section should also discuss how data that do not meet data quality objectives will be designated, flagged, or otherwise handled. Possible corrective actions associated with the rejection of data, such as reanalysis or resampling, also need to be addressed.***

### Project Schedule/Timeline Table

***Include a project schedule in either text, graphical, or tabular format. The timeline should include estimated start and completion dates for specific project activities and may include QA assessments that will be performed during the course of the project. Time for document review and implementation of effective corrective action procedures, as necessary, should be budgeted in the project schedule. Discuss any resource and time constraints, including seasonal sampling restrictions and considerations. How will project participants be notified of project schedule delays?***

## WORKSHEET #15: PROJECT ACTION LIMITS, LABORATORY-SPECIFIC DETECTION/QUANTITATION LIMITS

Worksheets in this section provide the Quantitation Limits for the Target Analyte Lists (TAL) commonly encountered in brownfields assessments. QC criteria listed for analyses were obtained from the EPA *National Functional Guidelines for Organic Superfund Methods Data Review* (EPA 2020a) and EPA *National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA 2020b) which are listed as acceptance criteria. In addition, Reporting Limits (RL) for dioxins/furans and the chlorinated biphenyl congeners (CBC) are included in tables in this section for the EPA HRSM02.1 SOW (EPA 2020c) and method QC criteria were obtained from EPA *National Functional Guidelines for High Resolution Superfund Methods Data Review* (EPA 2020c).

***Regional Screening Levels (RSLs), which typically pertain to EPA screening levels, have been left blank in the worksheets in this section. For brownfield assessments, project action limits (PAL) must be defined during the project planning process and assist in selection of appropriate methods and quantitation limits***

***TALs, RLs, and QC samples will be identified during the project planning process. QC acceptance criteria may vary based on the analytical method and individual laboratory SOPs.***

***Laboratory RLs and MDLs must be compared against the PALs to ensure that the requested analysis will provide adequate sensitivity for the sampling project. Some PALs may not be achievable using current analytical methods and technologies.***

***Delete all tables for analytes and analytical methods that are not needed for the project.***

The recovery and precision criteria for QC samples presented in the tables below reflect Superfund CLP program values. As part of a laboratory’s QA program, most non-CLP analyses and laboratory SOPs require analysis of LCS, which are spiked with all target compounds, rather than a select short list of target compounds. Statistically derived laboratory control limits or NFG criteria will use all non-CLP methods to assess accuracy and precision. Those control limits will be used for data validation.

### References

EPA2020a. EPA National Functional Guidelines for Organic Superfund Methods Data Review. EPA/540/R-20-005. November.

EPA 2020b. EPANational Functional Guidelines for Inorganic Superfund Methods Data Review.EPA/542/R-20-006. November.

EPA 2020c. EPA National Functional Guidelines for High Resolution Superfund Methods Data Review, EPA/542-R-20-007. November

## WORKSHEET #15.1: PROJECT ACTION LIMITS AND ACHIEVABLE LABORATORY LIMITS[[22]](#footnote-23) – TARGET ANALYTE LIST (TAL) VOCS (SOIL/SEDIMENT/WASTE)

| **Analyte** | **CAS Number** | **Project Action Limit** | **Project QL** | **Lab RL (varies by lab) Low Soil/Sediment/Waste (µg/kg)** | **Lab MDL (varies by lab) Low Soil/Sediment/Waste (µg/kg)** | **Lab RL (varies by lab)Lab RL (varies by lab) Medium Soil/Sediment/Waste (µg/kg)** | **Lab MDL (varies by lab)Medium Soil/Sediment/Waste (µg/kg)** | **LCS/MS/MSD[[23]](#footnote-24) Precision Soil %R** | **LCS/MS/MSD Precision Soil RPD** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1,1,1-Trichloroethane | 71-55-6 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 76-13-1 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,1,2-Trichloroethane | 79-00-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,1-Dichloroethane | 75-34-3 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,1-Dichloroethene | 75-35-4 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,2,3-Trichlorobenzene | 87-61-6 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,2,3-Trichloropropane | 96-18-4 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,2,4-Trichlorobenzene | 120-82-1 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,2,4-Trimethylbenzene | 95-63-6 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,2-Dibromo-3-Chloropropane | 96-12-8 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,2-Dibromoethane | 106-93-4 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,2-Dichlorobenzene | 95-50-1 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,2-Dichloroethane | 107-06-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,2-Dichloropropane | 78-87-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,3-Dichlorobenzene | 541-73-1 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,3,5-Trimethylbenzene | 108-67-8 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,4-Dichlorobenzene | 106-46-7 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 2-Butanone | 78-93-3 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 2-Hexanone | 591-78-6 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 4-Methyl-2-pentanone | 108-10-1 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Acetone | 67-64-1 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Benzene | 71-43-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Bromochloromethane | 74-97-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Bromodichloromethane | 75-27-4 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Bromoform | 75-25-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Bromomethane | 74-83-9 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Carbon disulfide | 75-15-0 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Carbon Tetrachloride | 56-23-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Chlorobenzene | 108-90-7 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Chloroethane | 75-00-3 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Chloroform | 67-66-3 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Chloromethane | 74-87-3 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| cis-1,2-Dichloroethene | 156-59-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| cis-1,3-Dichloropropene | 10061-01-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Cyclohexane | 110-82-7 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Dibromochloromethane | 124-48-1 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Dichlorodifluoromethane | 75-71-8 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Ethylbenzene | 100-41-4 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Isopropyl Benzene | 98-82-8 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| m,p-Xylene | 179601-23-1 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Methyl acetate | 79-20-9 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Methylcyclohexane | 108-87-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Methylene Chloride | 75-09-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Methyl-tert-butyl ether | 1634-04-4 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| o-Xylene | 95-47-6 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Styrene | 100-42-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Tetrachloroethene | 127-18-4 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Toluene | 108-88-3 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| trans-1,2-Dichloroethene | 156-60-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| trans-1,3-Dichloropropene | 10061-02-6 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Trichloroethene | 79-01-6 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Trichlorofluoromethane | 75-69-4 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Vinyl Chloride | 75-01-4 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |

Notes:

Achievable Laboratory Limits are columns labeled Lab RL and Lab MDL.

Accuracy and Precision Criteria are columns labeled LCS/MS/MSD Precision.

|  |  |
| --- | --- |
| %R | percent recovery |
| µg/kg | microgram per kilogram |
| CAS | Chemical Abstracts Service |
| CLP | Contract Laboratory Program |
| CRQL | Contract Required Quantitation Limit |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| NA | Not Applicable |
| NFG | National Functional Guidelines |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| TBD | To Be Determined |

## WORKSHEET #15.2: PROJECT ACTION LIMITS AND ACHIEVABLE LABORATORY LIMITS[[24]](#footnote-25) – TAL VOCS (WATER)

| **Analyte** | **CAS Number** | **Project Action Limit** | **Project QL** | **Lab RL (varies by lab)Trace Water by SIM (µg/L)** | **Lab MDL (varies by lab) Trace Water by SIM (µg/L)** | **Lab RL (varies by lab) Trace Water (µg/L)** | **Lab MDL (varies by lab) Trace Water (µg/L)** | **Lab RL (varies by lab) Low Water (µg/L)** | **Lab MDL (varies by lab) Low Water (µg/L)** | **Lab RL**  **(varies by lab)TCLP Leachate (µg/L)** | **Lab MDL (varies by lab) TCLP Leachate (µg/L)** | **LCS/MS/MSD Precision[[25]](#footnote-26) Water %R** | **LCS/MS/MSD Precision Water RPD** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1,1,1-Trichloroethane | 71-55-6 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 76-13-1 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,1,2-Trichloroethane | 79-00-5 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,1-Dichloroethane | 75-34-3 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,1-Dichloroethene | 75-35-4 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,2,3-Trichlorobenzene | 87-61-6 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,2,3-Trichloropropane | 96-18-4 | TBD |  | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,2,4-Trichlorobenzene | 120-82-1 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,2,4-Trimethylbenzene | 95-63-6 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,2-Dibromo-3-Chloropropane | 96-12-8 | TBD |  | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,2-Dibromoethane | 106-93-4 | TBD |  | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,2-Dichlorobenzene | 95-50-1 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,2-Dichloroethane | 107-06-2 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,2-Dichloropropane | 78-87-5 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,3-Dichlorobenzene | 541-73-1 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,3,5-Trimethylbenzene | 108-67-8 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,4-Dichlorobenzene | 106-46-7 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 2-Butanone | 78-93-3 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 2-Hexanone | 591-78-6 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 4-Methyl-2-pentanone | 108-10-1 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Acetone | 67-64-1 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Benzene | 71-43-2 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Bromochloromethane | 74-97-5 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Bromodichloromethane | 75-27-4 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Bromoform | 75-25-2 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Bromomethane | 74-83-9 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Carbon disulfide | 75-15-0 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Carbon Tetrachloride | 56-23-5 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Chlorobenzene | 108-90-7 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Chloroethane | 75-00-3 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Chloroform | 67-66-3 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Chloromethane | 74-87-3 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| cis-1,2-Dichloroethene | 156-59-2 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| cis-1,3-Dichloropropene | 10061-01-5 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Cyclohexane | 110-82-7 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Dibromochloromethane | 124-48-1 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Dichlorodifluoromethane | 75-71-8 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Ethylbenzene | 100-41-4 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Isopropyl Benzene | 98-82-8 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| m,p-Xylene | 179601-23-1 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Methyl acetate | 79-20-9 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Methylcyclohexane | 108-87-2 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Methylene Chloride | 75-09-2 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Methyl-tert-butyl ether | 1634-04-4 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| o-Xylene | 95-47-6 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Styrene | 100-42-5 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Tetrachloroethene | 127-18-4 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Toluene | 108-88-3 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| trans-1,2-Dichloroethene | 156-60-5 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| trans-1,3-Dichloropropene | 10061-02-6 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Trichloroethene | 79-01-6 | TBD |  | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Trichlorofluoromethane | 75-69-4 | TBD |  | -- | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Vinyl Chloride | 75-01-4 | TBD |  | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |

Notes:

Project Action Limits (PALs) vary by matrix and data use; the PALs will be defined as part of the project planning process.

Laboratory RLs and MDLs should be reviewed during the project planning to ensure that laboratories can achieve the project’s quality objectives.

Achievable Laboratory Limits are columns labeled Lab RL and Lab MDL.

Accuracy and Precision Criteria are columns labeled LCS/MS/MSD Precision.

|  |  |
| --- | --- |
| -- | Analyte not reported by this method |
| %R | percent recovery |
| µg/L | microgram per liter |
| CAS | Chemical Abstracts Service |
| CLP | Contract Laboratory Program |
| CRQL | Contract Required Quantitation Limit |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| NFG | National Functional Guidelines |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| SIM | Selected Ion Monitoring |
| TAL | Target Analyte List |
| TCLP | Toxicity characteristic leaching procedure |
| TBD | To Be Determined |

## WORKSHEET #15.3: PROJECT ACTION LIMITS AND ACHIEVABLE LABORATORY LIMITS[[26]](#footnote-27) – TAL SVOCS (SOIL)

| **Analyte** | **CAS Number** | **Project Action Level** | **Project QL** | **Lab RL (varies by lab) Low Soil/Sediment/Waste (µg/kg)** | **Lab RL (varies by lab) Med Soil (µg/kg)** | **Lab RL (varies by lab) Soil by SIM (µg/kg)** | **Lab MDL (varies by lab) Soil (µg/kg)** | **LCS/MS/MSD Recovery Limits[[27]](#footnote-28) Soil %R** | **LCS/MS/MSD Precision Soil RPD** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1,4-Dioxane | 123-91-1 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Pyridine | 110-86-1 | TBD | TBD | -- | -- | -- | TBD | TBD | TBD |
| Benzaldehyde | 100-52-7 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Phenol | 108-95-2 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Bis(2-chloroethyl)ether | 111-44-4 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 2-Chlorophenol | 95-57-8 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 2-Methylphenol | 95-48-7 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 2,2'-oxybis(1-Chloropropane) | 108-60-1 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Acetophenone | 98-86-2 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 3-Methylphenol | 108-39-4 | TBD | TBD | -- | -- | -- | TBD | TBD | TBD |
| 4-Methylphenol | 106-44-5 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| N-Nitroso-di-N-propylamine | 621-64-7 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Hexachloroethane | 67-72-1 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Nitrobenzene | 98-95-3 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Isophorone | 78-59-1 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 2-Nitrophenol | 88-75-5 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 2,4-Dimethylphenol | 105-67-9 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Bis(2-chloroethoxy)methane | 111-91-1 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 2,4-Dichlorophenol | 120-83-2 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Naphthalene | 91-20-3 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 4-Chloroaniline | 106-47-8 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Hexachlorobutadiene | 87-68-3 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Caprolactam | 105-60-2 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 4-Chloro-3-methylphenol | 59-50-7 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1-Methylnapthalene | 90-12-0 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 2-Methylnaphthalene | 91-57-6 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Hexachlorocyclopentadiene | 77-47-4 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 2,4,6-Trichlorophenol | 88-06-2 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 2,4,5-Trichlorophenol | 95-95-4 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 1,1'-Biphenyl | 92-52-4 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 2-Chloronaphthalene | 91-58-7 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 2-Nitroaniline | 88-74-4 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Dimethylphthalate | 131-11-3 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 2,6-Dinitrotoluene | 606-20-2 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Acenaphthylene | 208-96-8 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 3-Nitroaniline | 99-09-2 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Acenaphthene | 83-32-9 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 2,4-Dinitrophenol | 51-28-5 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 4-Nitrophenol | 100-02-7 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 2,4-Dinitrotoluene | 121-14-2 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Dibenzofuran | 132-64-9 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Diethylphthalate | 84-66-2 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 4-Chlorophenyl-phenylether | 7005-72-3 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Fluorene | 86-73-7 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 4-Nitroaniline | 100-01-6 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 4,6-Dinitro-2-methylphenol | 534-52-1 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| N-Nitrosodiphenylamine | 86-30-6 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 4-Bromophenyl-phenylether | 101-55-3 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Hexachlorobenzene | 118-74-1 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Atrazine | 1912-24-9 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Pentachlorophenol | 87-86-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Phenanthrene | 85-01-8 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Anthracene | 120-12-7 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Carbazole | 86-74-8 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Di-n-butylphthalate | 84-74-2 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Fluoranthene | 206-44-0 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Pyrene | 129-00-0 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Butylbenzylphthalate | 85-68-7 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 3,3'-Dichlorobenzidine | 91-94-1 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| bis(2-ethylhexyl)Phthalate | 117-81-7 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Benzo(a)anthracene | 56-55-3 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Chrysene | 218-01-9 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Di-n-octylphthalate | 117-84-0 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| Benzo(b)fluoranthene | 205-99-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Benzo(k)fluoranthene | 207-08-9 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Benzo(a)pyrene | 50-32-8 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Indeno(1,2,3-c,d)pyrene | 193-39-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Dibenzo(a,h)anthracene | 53-70-3 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Benzo(g,h,i)perylene | 191-24-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 1,2,4,5-Tetrachlorobenzene | 95-94-3 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |
| 2,3,4,6-Tetrachlorophenol | 58-90-1 | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD |

Notes:

Project Action Limits (PALs) vary by matrix and data use; the PALs will be defined as part of the project planning process.

Laboratory RLs and MDLs should be reviewed during the project planning to ensure that laboratories can achieve the project’s quality objectives.

Achievable Laboratory Limits are columns labeled Lab RL and Lab MDL.

Accuracy and Precision Criteria are columns labeled LCS/MS/MSD Precision

|  |  |
| --- | --- |
| -- | Analyte not reported by this method |
| %R | percent recovery |
| µg/kg | microgram per kilogram |
| CAS | Chemical Abstracts Service |
| CLP | Contract Laboratory Program |
| CRQL | Contract Required Quantitation Limit |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| NFG | National Functional Guidelines |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| SIM | Selected Ion Monitoring |
| TBD | To Be Determined |

## WORKSHEET #15.4: PROJECT ACTION LIMITS AND ACHIEVABLE LABORATORY LIMITS[[28]](#footnote-29) – TAL SVOCS (WATER)

| **Analyte** | **CAS Number** | **Project Action Limit** | **Project QL** | **Lab RL (varies by lab) Aqueous/ Water/SPLP Leachate (µg/L)** | **Lab RL (varies by lab) Low Water by SIM (µg/L)** | **Lab RL (varies by lab)**  **TCLP Leachate (µg/L)** | **Lab MDL (varies by lab) Water (µg/L)** | | **LCS/MS/MSD Recovery Limits[[29]](#footnote-30) Water %R** | **LCS/MS/MSD Precision Water RPD** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1,4-Dioxane | 123-91-1 | TBD | TBD | TBD | TBD | -- | TBD | | TBD | TBD |
| Pyridine | 110-86-1 | TBD | TBD | -- | -- | TBD | TBD | | TBD | TBD |
| Benzaldehyde | 100-52-7 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| Phenol | 108-95-2 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| Bis(2-chloroethyl)ether | 111-44-4 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| 2-Chlorophenol | 95-57-8 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| 2-Methylphenol | 95-48-7 | TBD | TBD | TBD | -- | TBD | TBD | | TBD | TBD |
| 2,2'-oxybis(1-Chloropropane) | 108-60-1 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| Acetophenone | 98-86-2 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| 3-Methylphenol | 108-39-4 | TBD | TBD | -- | -- | TBD | TBD | | TBD | TBD |
| 4-Methylphenol | 106-44-5 | TBD | TBD | TBD | -- | TBD | TBD | | TBD | TBD |
| N-Nitroso-di-N-propylamine | 621-64-7 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| Hexachloroethane | 67-72-1 | TBD | TBD | TBD | -- | TBD | TBD | | TBD | TBD |
| Nitrobenzene | 98-95-3 | TBD | TBD | TBD | -- | TBD | TBD | | TBD | TBD |
| Isophorone | 78-59-1 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| 2-Nitrophenol | 88-75-5 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| 2,4-Dimethylphenol | 105-67-9 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| Bis(2-chloroethoxy)methane | 111-91-1 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| 2,4-Dichlorophenol | 120-83-2 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| Naphthalene | 91-20-3 | TBD | TBD | TBD | TBD | -- | TBD | | TBD | TBD |
| 4-Chloroaniline | 106-47-8 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| Hexachlorobutadiene | 87-68-3 | TBD | TBD | TBD | -- | TBD | TBD | | TBD | TBD |
| Caprolactam | 105-60-2 | TBD | TBD | TBD | -- | -- | TBD | | TBD | TBD |
| 4-Chloro-3-methylphenol | 59-50-7 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| 1-Methynaphthalene | 90-12-0 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| 2-Methylnaphthalene | 91-57-6 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| Hexachlorocyclopentadiene | 77-47-4 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| 2,4,6-Trichlorophenol | 88-06-2 | TBD | TBD | TBD | -- | TBD | TBD | TBD | | TBD |
| 2,4,5-Trichlorophenol | 95-95-4 | TBD | TBD | TBD | -- | TBD | TBD | TBD | | TBD |
| 1,1'-Biphenyl | 92-52-4 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| 2-Chloronaphthalene | 91-58-7 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| 2-Nitroaniline | 88-74-4 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| Dimethylphthalate | 131-11-3 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| 2,6-Dinitrotoluene | 606-20-2 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| Acenaphthylene | 208-96-8 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| 3-Nitroaniline | 99-09-2 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| Acenaphthene | 83-32-9 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| 2,4-Dinitrophenol | 51-28-5 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| 4-Nitrophenol | 100-02-7 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| 2,4-Dinitrotoluene | 121-14-2 | TBD | TBD | TBD | -- | TBD | TBD | TBD | | TBD |
| Dibenzofuran | 132-64-9 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| Diethylphthalate | 84-66-2 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| 4-Chlorophenyl-phenylether | 7005-72-3 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| Fluorene | 86-73-7 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| 4-Nitroaniline | 100-01-6 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| 4,6-Dinitro-2-methylphenol | 534-52-1 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| N-Nitrosodiphenylamine | 86-30-6 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| 4-Bromophenyl-phenylether | 101-55-3 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| Hexachlorobenzene | 118-74-1 | TBD | TBD | TBD | -- | TBD | TBD | TBD | | TBD |
| Atrazine | 1912-24-9 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| Pentachlorophenol | 87-86-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | | TBD |
| Phenanthrene | 85-01-8 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | | TBD |
| Anthracene | 120-12-7 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| Carbazole | 86-74-8 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| Di-n-butylphthalate | 84-74-2 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| Fluoranthene | 206-44-0 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| Pyrene | 129-00-0 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| Butylbenzylphthalate | 85-68-7 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| 3,3'-Dichlorobenzidine | 91-94-1 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| bis(2-ethylhexyl)Phthalate | 117-81-7 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| Benzo(a)anthracene | 56-55-3 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| Chrysene | 218-01-9 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| Di-n-octylphthalate | 117-84-0 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| Benzo(b)fluoranthene | 205-99-2 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| Benzo(k)fluoranthene | 207-08-9 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| Benzo(a)pyrene | 50-32-8 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| Indeno(1,2,3-c,d)pyrene | 193-39-5 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| Dibenzo(a,h)anthracene | 53-70-3 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| Benzo(g,h,i)perylene | 191-24-2 | TBD | TBD | TBD | TBD | -- | TBD | TBD | | TBD |
| 1,2,4,5-Tetrachlorobenzene | 95-94-3 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |
| 2,3,4,6-Tetrachlorophenol | 58-90-1 | TBD | TBD | TBD | -- | -- | TBD | TBD | | TBD |

Notes:

Project Action Limits (PALs) vary by matrix and data use; the PALs will be defined as part of the project planning process.

Laboratory RLs and MDLs should be reviewed during the project planning to ensure that laboratories can achieve the project’s quality objectives.

Achievable Laboratory Limits are columns labeled Lab RL and Lab MDL.

Accuracy and Precision Criteria are columns labeled LCS/MS/MSD Recovery and Precision.

|  |  |
| --- | --- |
| -- | Analyte not reported by this method |
| %R | percent recovery |
| µg/L | microgram per liter |
| CAS | Chemical Abstracts Service |
| CLP | Contract Laboratory Program |
| CRQL | Contract Required Quantitation Limit |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| NFG | National Functional Guidelines |
| RL | Reporting limit |
| RPD | relative percent difference |
| SIM | Selected Ion Monitoring |
| SPLP | Synthetic Precipitation Leaching Procedure |
| TBD | To Be Determined |
| TCLP | Toxicity characteristic leaching procedure |

## WORKSHEET #15.5: PROJECT ACTION LIMITS AND ACHIEVABLE LABORATORY LIMITS[[30]](#footnote-31) – TAL OC PESTICIDES (SOIL/WATER/WIPE/TCLP)

| **Analyte** | **CAS Number** | **Project Action Limit** | **Project QL** | **Lab RL (varies by lab) Soil/ Sediment/Waste (µg/kg)** | **Lab MDL (varies by lab) Soil (µg/kg)** | **Lab RL (varies by lab) Aqueous/Water/ SPLP Leachate (µg/L)** | **Lab RL (varies by lab) TCLP Leachate**  **(µg/L)** | **Lab RL**  **(varies by lab)**  **Wipe**  **(µg)** | **Lab RL (varies by lab) Wipe (µg/cm2) Lab MDL (varies by lab) Aqueous/ Water/ SPLP Leachate (µg/L)** | | **LCS/MS/MSD Recovery Limits[[31]](#footnote-32) LCS %R** | **LCS/MS/MSD Recovery Limits Soil MS/MSD %R** | **LCS/MS/MSD Recovery Limits Water MS/MSD %R** | **MS/MSD Precision Soil / Water RPD** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4,4’-DDD | 72-54-8 | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| 4,4’-DDE | 72-55-9 | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD | 50-150 | TBD | TBD | TBD |
| 4,4’-DDT | 50-29-3 | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD | TBD | 23-134 | 38-127 | ≤ 50 / ≤ 27 |
| Aldrin | 309-00-2 | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD | TBD | 34-132 | 40-120 | ≤ 43 / ≤ 22 |
| alpha-BHC | 319-84-6 | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| alpha-Chlordane (cis-chlordane) | 5103-71-9 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| beta-BHC | 319-85-7 | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| delta-BHC | 319-86-8 | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Dieldrin | 60-57-1 | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD | 30-130 | 31-134 | 52-126 | ≤ 38 / ≤ 18 |
| Endosulfan I | 959-98-8 | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Endosulfan II | 33213-65-9 | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Endosulfan sulfate | 1031-07-8 | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD | 50-120 | TBD | TBD | TBD |
| Endrin | 72-20-8 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 50-120 | 42-139 | 56-121 | ≤ 45 / ≤ 21 |
| Endrin aldehyde | 7421-93-4 | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD | TBD | TBD | TBD | 30 |
| Endrin ketone | 53494-70-5 | TBD | TBD | TBD | TBD | TBD | -- | TBD | TBD | TBD | TBD | TBD | TBD | 30 |
| gamma-BHC (Lindane) | 58-89-9 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 50-120 | 46-127 | 56-123 | ≤ 50 / ≤15 |
| gamma-Chlordane (trans-chlordane) | 5103-74-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 30-130 | TBD | TBD | TBD |
| Heptachlor | 76-44-8 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 35-130 | 40-131 | ≤ 31 / ≤ 20 |
| Heptachlor Epoxide | 1024-57-3 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 50-150 | TBD | TBD | TBD |
| Methoxychlor | 72-43-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Toxaphene | 8001-35-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |

Notes:

Project Action Limits (PALs) vary by matrix and data use; the PALs will be defined as part of the project planning process.

Laboratory RLs and MDLs should be reviewed during the project planning to ensure that laboratories can achieve the project’s quality objectives.

Achievable Laboratory Limits are columns labeled Lab RL and Lab MDL.

Accuracy and Precision Criteria are columns labeled LCS/MS/MSD Recovery Limits and MS/MSD Precision.

|  |  |
| --- | --- |
| -- | Analyte not reported by this method |
| %R | percent recovery |
| µg | microgram |
| µg/cm2 | microgram per cubic centimeter |
| µg/L | microgram per liter |
| µg/kg | microgram per kilogram |
| CAS | Chemical Abstracts Service |
| CLP | Contract Laboratory Program |
| CRQL | Contract Required Quantitation Limit |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| NFG | National Functional Guidelines |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| SPLP | Synthetic Precipitation Leaching Procedure |
| TBD | To Be Determined |
| TCLP | Toxicity characteristic leaching procedure |

## WORKSHEET #15.6: PROJECT ACTION LIMITS AND ACHIEVABLE LABORATORY LIMITS\*[[32]](#footnote-33) – TAL PCB (SOIL/WATER/WIPE)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Analyte** | **CAS Number** | **Project Action Limit** | **Project QL** | **Lab RL (varies by lab) Soil/ Sediment/ Waste (µg/kg)** | **Lab MDL (varies by lab) Soil/ Sediment/ Waste (µg/kg)** | **Lab RL (varies by lab) Aqueous/ Water (µg/L)** | **Lab MDL (varies by lab) Aqueous/ Water (µg/L)** | **Lab RL**  **(varies by lab) Wipe (µg)** | **Lab RL (varies by lab) Wipe (µg/cm2)** | **LCS/MS/MSD Recovery Limits\*\*[[33]](#footnote-34) LCS %R** | **LCS/MS/MSD Recovery Limits\*\* Soil MS/MSD %R** | **LCS/MS/MSD Recovery Limits\*\* Water MS/MSD %R** | **MS/MSD Precision\*\* Soil / Water RPD** |
| Aroclor 1016 | 12674-11-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 50-150 | 29-135 | 29-135 | ≤ 15 |
| Aroclor 1221 | 11104-28-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Aroclor 1232 | 11141-16-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Aroclor 1242 | 53469-21-9 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Aroclor 1248 | 12672-29-6 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Aroclor 1254 | 11097-69-1 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Aroclor 1260 | 11096-82-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 50-150 | 29-135 | 29-135 | ≤ 20 |
| Aroclor 1262 | 37324-23-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| Aroclor 1268 | 11100-14-4 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |

Notes:

Achievable Laboratory Limits are columns labeled Lab RL and Lab MDL.

Accuracy and Precision Criteria are columns labeled LCS/MS/MSD Recovery and MS/MSD Precision

Project Action Limits (PALs) vary by matrix and data use; the PALs will be defined as part of the project planning process.

Laboratory RLs and MDLs should be reviewed during the project planning to ensure that laboratories can achieve the project’s quality objectives..

|  |  |
| --- | --- |
| %R | percent recovery |
| µg | microgram |
| µg/cm2 | microgram per cubic centimeter |
| µg/kg | microgram per kilogram |
| µg/L | microgram per liter |
| CAS | Chemical Abstracts Service |
| CLP | Contract Laboratory Program |
| CRQL | Contract Required Quantitation Limit |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| NFG | National Functional Guidelines |
| RL | Reporting Limit |
| RPD | relative percent difference |
| TBD | To Be Determined |

## WORKSHEET #15.7: PROJECT ACTION LIMITS AND ACHIEVABLE LABORATORY LIMITS[[34]](#footnote-35) – TAL HERBICIDES BY SW-846 8151A (SOIL/WATER)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Analyte** | **CAS Number** | **Project Action Limit** | **Project QL** | **Project RL Soil (µg/kg)** | **Lab MDL (varies by lab) Soil (µg/kg)** | **Project RL Water (µg/L)** | **Lab MDL (varies by lab) Water (µg/L)** | **LCS/MS/MSD Recovery Limits[[35]](#footnote-36) Soil %R** | **LCS/MS/MSD Recovery Limits Water %R** | **MS/MSD Precision Soil/Water RPD** |
| Dalapon | 75-99-0 | TBD | TBD | 167 | TBD | 5.00 | TBD | 50-150 | 30-150 | ≤ 30 |
| 4-Nitrophenol | 100-02-1 | TBD | TBD | 83.3 | TBD | 2.50 | TBD | 50-150 | 30-150 | ≤ 30 |
| Dicamba | 1918-00-9 | TBD | TBD | 83.3 | TBD | 2.50 | TBD | 50-150 | 30-150 | ≤ 30 |
| Dichloroprop | 120-36-5 | TBD | TBD | 333 | TBD | 10.0 | TBD | 50-150 | 30-150 | ≤ 30 |
| 2,4-D | 94-75-7 | TBD | TBD | 167 | TBD | 5.00 | TBD | 50-150 | 30-150 | ≤ 30 |
| Pentachlorophenol | 87-86-5 | TBD | TBD | 16.7 | TBD | 0.50 | TBD | 50-150 | 30-150 | ≤ 30 |
| 2,4,5-T-P (Silvex) | 93-72-1 | TBD | TBD | 33.3 | TBD | 1.00 | TBD | 50-150 | 30-150 | ≤ 30 |
| 2,4,5-T | 93-76-5 | TBD | TBD | 33.3 | TBD | 5.00 | TBD | 50-150 | 30-150 | ≤ 30 |
| Dinoseb | 88-85-7 | TBD | TBD | 1500 | TBD | 2.50 | TBD | 50-150 | 30-150 | ≤ 30 |
| 2,4-DB | 94-82-6 | TBD | TBD | 333 | TBD | 10.0 | TBD | 50-150 | 30-150 | ≤ 30 |

Notes:

RSLs and MDLs for Tier IV laboratories will be reviewed during the site scoping process.

These RLs are suggested project values and may be modified and documented in the site-specific plan. Actual laboratory RLs should be used. Project RLs and Lab MDLs are achievable laboratory limits.

Achievable Laboratory Limits are columns labeled Lab RL and Lab MDL.

Accuracy and Precision Criteria are columns labeled LCS/MS/MSD Recovery Limits and MS/MSD Precision.

|  |  |
| --- | --- |
| %R | percent recovery |
| µg/kg | microgram per kilogram |
| µg/L | microgram per liter |
| CAS | Chemical Abstracts Service |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| RL | Reporting Limit |
| RPD | relative percent difference |
| TBD | To Be Determined |

## WORKSHEET #15.8: REFERENCE LIMITS AND EVALUATION TABLE – GRO, DRO, AND ORO BY SW-846 8015C (SOIL/WATER)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Analyte** | **CAS Number** | **Project Action Limit** | **Project QL** | **Project RL Soil (mg/kg)[[36]](#footnote-37)** | **MDL (varies by lab) Soil (mg/kg)** | **Project RL Water (mg/L)** | **MDL (varies by lab) Water (mg/L)** | **LCS/MS/MSD Recovery Limits Soil %R** | **LCS/MS/MSD Recovery Limits Water %R** | **LCS/MS/MSD Precision Soil/Water RPD** |
| Gasoline Range Organics (GRO) | 8006-61-9 | TBD | TBD | 1.2 | TBD | 25 | TBD | 85-153 | 79-149 | ≤ 30 |
| Diesel Range Organics (DRO) | 68334-30-5 | TBD | TBD | 4.0 | TBD | 0.25 | TBD | 56-115 | 50-115 | ≤ 30 |
| Oil Range Organics (ORO) | none | TBD | TBD | 4.0 | TBD | 0.25 | TBD | 56-115 | 50-115 | ≤ 30 |

Notes:

Achievable Laboratory Limits are columns labeled Project RL and MDL

Accuracy and Precision Criteria are columns labeled LCS/MS/MSD Recovery Limits and LCS/MS/MSD Precision.

|  |  |
| --- | --- |
| %R | percent recovery |
| CAS | Chemical Abstracts Service |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| mg/kg | milligram per kilogram |
| mg/L | milligram per liter |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| PAL | Project Action Limits |
| RL | Reporting Limit |
| RPD | relative percent difference |
| TBD | To Be Determined |

## WORKSHEET #15.9: PROJECT ACTION LIMITS AND ACHIEVABLE LABORATORY LIMITS[[37]](#footnote-38) – TAL INORGANICS (SOIL/SEDIMENT/WASTE)

| **Analyte** | **CAS Number** | **Project Action Limit** | **Project QL** | **Lab RL (varies by lab) Soil/ Sediment/ Waste by ICP- AES (mg/kg)** | **Lab MDL (varies by lab) Soil/ Sediment/ Waste by ICP- AES (mg/kg)** | **Lab RL (varies by lab) Soil/ Sediment/ Waste by ICP-MS (mg/kg)** | **Lab MDL (varies by lab) Soil/Sediment/ Waste by ICP-MS (mg/kg)** | **LCS and MS Recovery Limits[[38]](#footnote-39) LCS %R** | **LCS and MS Recovery Limits Soil/ Sediment/ Waste by ICP- AES or ICP- MS %R** | **LCS and MS Recovery Limits Soil Non-ICP %R** | **Lab Duplicate Precision Soil RPD[[39]](#footnote-40)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Aluminum | 7429-90-5 | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Antimony | 7440-36-0 | TBD | TBD | TBD | TBD | TBD | TBD | 50-150[[40]](#footnote-41) | 75-125 | TBD | ≤ 20% |
| Arsenic | 7440-38-2 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Barium | 7440-39-3 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Beryllium | 7440-41-7 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Cadmium | 7440-43-9 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Calcium | 7440-70-2 | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Chromium | 7440-47-3 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Cobalt | 7440-48-4 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Copper | 7440-50-8 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Iron | 7439-89-6 | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Lead | 7439-92-1 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Magnesium | 7439-95-4 | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Manganese | 7439-96-5 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Mercury[[41]](#footnote-42) | 7439-97-6 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 75-125 | ≤ 20% |
| Nickel | 7440-02-0 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Potassium | 7440-09-7 | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Selenium | 7782-49-2 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Silver | 7440-22-4 | TBD | TBD | TBD | TBD | TBD | TBD | 50-150 | 75-125 | TBD | ≤ 20% |
| Sodium | 7440-23-5 | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Thallium | 7440-28-0 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Vanadium | 7440-62-2 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Zinc | 7440-66-6 | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Cyanide[[42]](#footnote-43) | 57-12-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 75-125 | 75-125 | ≤ 20% |

Notes:

Accuracy and Precision criteria presented in this table are for CLP methods.

Achievable Laboratory Limits are columns labeled Lab RL and Lab MDL

Accuracy and Precision Criteria are columns labeled LCS and MS Recovery Limits or Lab Duplicate Precision.

|  |  |
| --- | --- |
| -- | Analyte not performed by this method |
| %R | percent recovery |
| CAS | Chemical Abstracts Service |
| CLP | Contract Laboratory Program |
| CRQL | Contract Required Quantitation Limit |
| ICP-AES | Inductively Coupled Plasma-Atomic Emission Spectroscopy |
| ICP-MS | Inductively Coupled Plasma-Mass spectrometry |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| mg/L | milligram per liter |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| NA | Not Applicable |
| RL | Reporting Limit |
| RPD | relative percent difference |
| TBD | To Be Determined |

## 

## WORKSHEET #15.10: PROJECT ACTION LIMITS AND ACHIEVABLE LABORATORY LIMITS[[43]](#footnote-44) – TAL INORGANICS (AQUEOUS/WATER/SPLP LEACHATE/WIPE/TCLP)

| **Analyte** | **CAS Number** | **Project Action Limit** | **Project QL** | **Lab RL (varies by lab) Aqueous/ Water/SPLP Leachate by ICP-AES (µg/L)** | **Lab MDL (varies by lab) Aqueous/ Water/SPLP Leachate by ICP-AES (µg/L)** | **Lab RL (varies by lab) Aqueous/ Water/SPLP Leachate by ICP-MS (µg/L)** | **Lab MDL (varies by lab) Aqueous/ Water/SPLP Leachate by ICP-MS (µg/L)** | **Lab RL (varies by lab) TCLP by ICP-AES (µg/L)** | **Lab RL (varies by lab) Wipe by ICP-AES (µg)** | **LCS and MS Recovery Limits[[44]](#footnote-45) LCS %R** | **LCS and MS Recovery Limits Aqueous/ Water/SPLP Leachate by ICP- AES or ICP-MS %R** | **LCS and MS Recovery Limits Water Non-ICP %R** | **Lab Duplicate Precision Aqueous/ Water/SPLP Leachate RPD[[45]](#footnote-46)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Aluminum | 7429-90-5 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Antimony | 7440-36-0 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 50-150[[46]](#footnote-47) | 75-125 | TBD | ≤ 20% |
| Arsenic | 7440-38-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Barium | 7440-39-3 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Beryllium | 7440-41-7 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Cadmium | 7440-43-9 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Calcium | 7440-70-2 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Chromium | 7440-47-3 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Cobalt | 7440-48-4 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Copper | 7440-50-8 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Iron | 7439-89-6 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Lead | 7439-92-1 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Magnesium | 7439-95-4 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Manganese | 7439-96-5 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Mercury[[47]](#footnote-48) | 7439-97-6 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 75-1253 | 75-125 | ≤ 20% |
| Nickel | 7440-02-0 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Potassium | 7440-09-7 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Selenium | 7782-49-2 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Silver | 7440-22-4 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD | 50-150 | 75-125 | TBD | ≤ 20% |
| Sodium | 7440-23-5 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Thallium | 7440-28-0 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Vanadium | 7440-62-2 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Zinc | 7440-66-6 | TBD | TBD | TBD | TBD | TBD | TBD | -- | TBD | 70-130 | 75-125 | TBD | ≤ 20% |
| Cyanide[[48]](#footnote-49) | 57-12-5 | TBD | TBD | TBD | TBD | TBD | TBD | TBD3 | -- | TBD | 75-125 | 75-125 | ≤ 20% |

Notes:

Accuracy and Precision criteria presented in this table are for CLP methods.

Achievable Laboratory Limits are columns labeled Lab RLs and Lab MDL.

Accuracy and Precision Criteria are columns labeled LCS and MS Recovery Limits or Lab Duplicate Precision.

|  |  |
| --- | --- |
| -- | Analyte not performed by this method |
| %R | percent recovery |
| CAS | Chemical Abstracts Service |
| CLP | Contract Laboratory Program |
| CRQL | Contract Required Quantitation Limit |
| ICP-AES | Inductively Coupled Plasma-Atomic  Emission Spectroscopy |
| ICP-MS | Inductively Coupled Plasma-Mass Spectrometry |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| µg | microgram |
| µg/L | microgram per liter |
| RL | Reporting Limit |
| RPD | relative percent difference |
| SPLP | Synthetic Precipitation Leaching Procedure |
| TBD | To Be Determined |
| TCLP | Toxicity characteristic leaching procedure |

## WORKSHEET #15.11: PROJECT ACTION LIMITS AND ACHIEVABLE LABORATORY LIMITS[[49]](#footnote-50) – ANIONS BY ION CHROMATOGRAPHY (SOIL/SEDIMENT/AQUEOUS/WATER)

| **Analyte** | **CAS Number** | **Project Action Limit** | **Project QL** | **Lab RL (varies by lab) Soil/Sediment (mg/kg)** | **Lab MDL (varies by lab) Soil/Sediment (mg/kg)** | **Lab RL (varies by lab) Aqueous/Water (mg/L)** | **Lab MDL (varies by lab) Aqueous/Water (mg/L)** | **LCS and MS Recovery Limits LCS %R** | **LCS and MS Recovery Limits[[50]](#footnote-51) Soil/Sediment/ Aqueous/ Water MS %R** | **Lab Duplicate Precision RPD** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bromide | 24959-67-9 | TBD | TBD | TBD | TBD | TBD | TBD | 80-120 | 80-120 | ≤ 20% |
| Chloride | 16887-00-6 | TBD | TBD | TBD | TBD | TBD | TBD | 80-120 | 80-120 | ≤ 20% |
| Fluoride | 16984-48-8 | TBD | TBD | TBD | TBD | TBD | TBD | 80-120 | 80-120 | ≤ 20% |
| Nitrate | 14797-55-8 | TBD | TBD | TBD | TBD | TBD | TBD | 80-120 | 80-120 | ≤ 20% |
| Nitrite | 14797-65-0 | TBD | TBD | TBD | TBD | TBD | TBD | 80-120 | 80-120 | ≤ 20% |
| Orthophosphate | 14265-44-2 | TBD | TBD | TBD | TBD | TBD | TBD | 80-120 | 80-120 | ≤ 20% |
| Sulfate | 14808-79-8 | TBD | TBD | TBD | TBD | TBD | TBD | 80-120 | 80-120 | ≤ 20% |

Notes:

Project Action Limits (PALs) vary by matrix and data use; the PALs will be defined as part of the project planning process.

Laboratory RLs and MDLs should be reviewed during the project planning to ensure that laboratories can achieve the project’s quality objectives.

Achievable Laboratory Limits are columns labeled Lab RLs and Lab MDLs.

Accuracy and Precision Criteria are columns labeled LCS and MS Recovery Limits or Lab Duplicate Precision.

Accuracy and Precision Criteria presented in this table are for CLP methods.

|  |  |
| --- | --- |
| %R | percent recovery |
| CAS | Chemical Abstracts Service |
| CLP | Contract Laboratory Program |
| CRQL | Contract Required Quantitation Limit |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| mg/kg | milligram per kilogram |
| mg/L | milligram per liter |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| NFG | National Functional Guidelines |
| RPD | relative percent difference |
| TBD | To Be Determined |

## 

## WORKSHEET #15.12: PROJECT ACTION LIMIT AND ACHIEVABLE LABORATORY LIMITS[[51]](#footnote-52) – HEXAVALENT CHROMIUM BY ION CHROMATOGRAPHY (AQUEOUS/WATER)

| **Analyte** | **CAS Number** | **Project Action Limit** | **Project QL** | **Lab RL (varies by lab) Aqueous/Water (µg/L)** | **Lab MDL (varies by lab) Aqueous/Water (µg/L)** | **LCS and MS Recovery Limits LCS %R** | **LCS and MS Recovery Limits Aqueous/Water MS %R** | **Lab Duplicate Precision RPD** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Hexavalent Chromium | 18540-29-9 | TBD | TBD | TBD | TBD | 70-130 | 75-125 | ≤ 20% # |

Notes:

MS/MSDs will be based on statistically derived limits and will vary between laboratories. In the absence of laboratory limits, use NFG guidelines, if applicable.

Project Action Limits (PALs) vary by matrix and data use; the PALs will be defined as part of the project planning process.

Lab RLs and Lab MDLs are achievable laboratory limits.

Laboratory RLs and MDLs should be reviewed during the project planning to ensure that laboratories can achieve the project’s quality objectives.

Accuracy and Precision criteria presented in this table are for CLP methods.

Achievable Laboratory Limits are columns labeled Lab RLs and Lab MDLs.

Accuracy and Precision Criteria are columns labeled LCS and MS Recovery Limits or Lab Duplicate Precision,

|  |  |
| --- | --- |
| %R | percent recovery |
| CAS | Chemical Abstracts Service |
| CLP | Contract Laboratory Program |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| NFG | National Functional Guidelines |
| µg/L | micrograms per liter |
| RL | Reporting Limits |
| RPD | relative percent difference |
| TBD | To Be Determined |

## WORKSHEET #15.13: PROJECT ACTION LIMIT AND ACHIEVABLE LABORATORY LIMITS[[52]](#footnote-53) – TOTAL ORGANIC CARBON (SOIL/SEDIMENT/WASTE/AQUEOUS/WATER)

| **Analyte** | **CAS Number** | **Project Action Limit** | **Project QL** | **Lab RL (varies by lab) Aqueous/ Water (mg/L)** | **Lab MDL (varies by lab) Aqueous/ Water (mg/L)** | **Lab RL (varies by lab) Soil/ Sediment/ Waste (mg/kg)** | **Lab MDL (varies by lab) Soil/ Sediment/ Waste (mg/kg)** | **LCS and MS Recovery Limits[[53]](#footnote-54) LCS %R** | **LCS and MS Recovery Limits Soil/Sediment/Waste/ Aqueous/Water MS %R** | **Lab Duplicate Precision RPD** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Total Organic Carbon | 7440-44-0 | TBD | TBD | TBD | TBD | TBD | TBD | 75-125 | 70-130 | ≤ 20% # |

Notes:

Project Action Limits (PALs) vary by matrix and data use; the PALs will be defined as part of the project planning process.

Laboratory RLs and MDLs should be reviewed during the project planning to ensure that laboratories can achieve the project’s quality objectives.

Achievable Laboratory Limits are columns labeled Lab RLs and Lab MDL.

Accuracy and Precision Criteria presented in this table are for CLP methods.

Accuracy and Precision Criteria are columns labeled LCS and MS Recovery Limits or Lab Duplicate Precision.

|  |  |
| --- | --- |
| %R | percent recovery |
| CAS | Chemical Abstracts Service |
| CLP | Contract Laboratory Program |
| LCS | Laboratory Control Sample |
| MDL | Method Detection Limit |
| mg/kg | milligram per kilogram |
| mg/L | milligram per liter |
| NFG | National Functional Guidelines |
| RL | Reporting Limits |
| RPD | relative percent difference |
| TBD | To Be Determined |

## WORKSHEET #15.14: REFERENCE LIMITS AND EVALUATION TABLE – DIOXIN/FURANS BY SW846 8290A (SOLID/WATER)

| **Analyte** | **CAS Number** | **Project Action Limit** | **Project QL** | **Lab RL (varies by lab) Solid[[54]](#footnote-55) (ng/kg)** | **Lab MDL (varies by lab) Solid (ng/kg)** | **Lab RL (varies by lab) Water (pg/L)** | **Lab MDL (varies by lab) Water (pg/L)** | **LCS and LCSD Recovery Limits[[55]](#footnote-56) All Matrices %R** | **LCS/LCSD Precision All Matrices RPD** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2378-TCDD | 1746-01-6 | TBD | TBD | TBD | TBD | TBD | TBD | 67-158 | ≤ 30 % |
| 12378-PeCDD | 40321-76-4 | TBD | TBD | TBD | TBD | TBD | TBD | 70-142 | ≤ 30 % |
| 123678-HxCDD | 57653-85-7 | TBD | TBD | TBD | TBD | TBD | TBD | 76-134 | ≤ 30 % |
| 123478-HxCDD | 39227-28-6 | TBD | TBD | TBD | TBD | TBD | TBD | 70-164 | ≤ 30 % |
| 123789-HxCDD | 19408-74-3 | TBD | TBD | TBD | TBD | TBD | TBD | 64-162 | ≤ 30 % |
| 1234678-HpCDD | 35822-46-9 | TBD | TBD | TBD | TBD | TBD | TBD | 70-140 | ≤ 30 % |
| OCDD | 3268-87-9 | TBD | TBD | TBD | TBD | TBD | TBD | 78-144 | ≤ 30 % |
| 2378-TCDF | 51207-31-9 | TBD | TBD | TBD | TBD | TBD | TBD | 75-158 | ≤ 30 % |
| 12378-PeCDF | 57117-41-6 | TBD | TBD | TBD | TBD | TBD | TBD | 80-134 | ≤ 30 % |
| 23478-PeCDF | 57117-31-4 | TBD | TBD | TBD | TBD | TBD | TBD | 68-160 | ≤ 30 % |
| 123678-HxCDF | 57117-44-9 | TBD | TBD | TBD | TBD | TBD | TBD | 84-130 | ≤ 30 % |
| 123789-HxCDF | 72918-21-9 | TBD | TBD | TBD | TBD | TBD | TBD | 78-130 | ≤ 30 % |
| 123478-HxCDF | 70648-26-9 | TBD | TBD | TBD | TBD | TBD | TBD | 72-134 | ≤ 30 % |
| 234678-HxCDF | 60851-34-5 | TBD | TBD | TBD | TBD | TBD | TBD | 70-156 | ≤ 30 % |
| 1234678-HpCDF | 67562-39-4 | TBD | TBD | TBD | TBD | TBD | TBD | 82-132 | ≤ 30 % |
| 1234789-HpCDF | 55673-89-7 | TBD | TBD | TBD | TBD | TBD | TBD | 78-138 | ≤ 30 % |
| OCDF | 39001-02-0 | TBD | TBD | TBD | TBD | TBD | TBD | 63-170 | ≤ 30 % |
| Total Tetra-Dioxins | NA | TBD | TBD | NA | NA | NA | NA | NA | NA |
| Total Penta-Dioxins | NA | TBD | TBD | NA | NA | NA | NA | NA | NA |
| Total Hexa-Dioxins | NA | TBD | TBD | NA | NA | NA | NA | NA | NA |
| Total Hepta-Dioxins | NA | TBD | TBD | NA | NA | NA | NA | NA | NA |
| Total Tetra-Furans | NA | TBD | TBD | NA | NA | NA | NA | NA | NA |
| Total Penta-Furans | NA | TBD | TBD | NA | NA | NA | NA | NA | NA |
| Total Hexa-Furans | NA | TBD | TBD | NA | NA | NA | NA | NA | NA |
| Total Hepta-Furans | NA | TBD | TBD | NA | NA | NA | NA | NA | NA |

Notes:

Achievable Laboratory Limits are columns labeled Lab RLs and Lab MDL

Accuracy and Precision Criteria are columns labeled LCS and LCSD Recovery Limits or LCS/LCSD Precision.

|  |  |
| --- | --- |
| %R | percent recovery |
| CAS | Chemical Abstracts Service |
| CLP | Contract Laboratory Program |
| HRSM02.1 | High Resolution Superfund Method version 2.1 |
| LCS | Laboratory Control Sample |
| LCSD | Laboratory Control Sample Duplicate |
| MDL | Method Detection Limit |
| NA | Not Applicable |
| ng/kg | nanograms per kilogram |
| pg/L | picograms per liter |
| RPD | relative percent difference |
| TBD | To Be Determined |

## WORKSHEET #15.15: REFERENCE LIMITS AND EVALUATION TABLE – CHLORINATED BIPHENYL CONGENERS BY EPA 1668C (SOLID/WATER)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Partial Analyte List (WHO List)[[56]](#footnote-57)** | **CAS Number** | **Project Action Limit** | **Project QL** | **Lab RL (varies by lab) Solid[[57]](#footnote-58) (ng/kg)** | **Lab MDL (varies by lab) Solid (ng/kg)** | **Lab RL (varies by lab) Water (pg/L)** | **Lab MDL (varies by lab) Water (pg/L)** | **LCS and LCSD Recovery Limits[[58]](#footnote-59) All Matrices %R** | **LCS/LCSD Precision All Matrices RPD** |
| PCB-77 | 32598-13-3 |  | TBD | 2.0 | TBD | 20 | TBD | 60-135 | ≤ 30 % |
| PCB-81 | 70362-50-4 |  | TBD | 2.0 | TBD | 20 | TBD | 60-135 | ≤ 30 % |
| PCB-105 | 32598-14-4 |  | TBD | 2.0 | TBD | 20 | TBD | 60-135 | ≤ 30 % |
| PCB-114 | 74472-37-0 |  | TBD | 2.0 | TBD | 20 | TBD | 60-135 | ≤ 30 % |
| PCB-118 | 31508-00-6 |  | TBD | 2.0 | TBD | 20 | TBD | 60-135 | ≤ 30 % |
| PCB-123 | 65510-44-3 |  | TBD | 2.0 | TBD | 20 | TBD | 60-135 | ≤ 30 % |
| PCB-126 | 57465-28-8 |  | TBD | 2.0 | TBD | 20 | TBD | 60-135 | ≤ 30 % |
| PCB-156 | 38380-08-4 |  | TBD | 2.0 | TBD | 20 | TBD | 60-135 | ≤ 30 % |
| PCB-157 | 69782-90-7 |  | TBD | 2.0 | TBD | 20 | TBD | 60-135 | ≤ 30 % |
| PCB-167 | 52663-72-6 |  | TBD | 2.0 | TBD | 20 | TBD | 60-135 | ≤ 30 % |
| PCB-169 | 32774-16-6 |  | TBD | 2.0 | TBD | 20 | TBD | 60-135 | ≤ 30 % |
| PCB-189 | 39635-31-9 |  | TBD | 2.0 | TBD | 20 | TBD | 60-135 | ≤ 30 % |

Notes:

Achievable Laboratory Limits are columns labeled Lab RLs and Lab MDL

Accuracy and Precision Criteria are columns labeled LCS and LCSD Recovery Limits or LCS/LCSD Precision.

|  |  |
| --- | --- |
| %R | percent recovery |
| CAS | Chemical Abstracts Service |
| CLP | Contract Laboratory Program |
| HRSM02.1 | High Resolution Superfund Method version 2.1 |
| LCS | Laboratory Control Sample |
| LCSD | Laboratory Control Sample Duplicate |
| MDL | Method Detection Limit |
| ng/kg | nanograms per kilogram |
| PCB | Polychlorinated Biphenyl |
| pg/L | picograms per liter |
| RPD | relative percent difference |
| SOW | Statement of Work |
| TBD | To Be Determined |
| WHO | World Health Organization |

## WORKSHEET #17 & 18: SAMPLING DESIGN, RATIONALE, LOCATIONS, AND METHODS

### Sampling Design

***Each site involving environmental field sampling requires a site-specific sampling design and rationale, which specifies data collection activities and QA/QC measures specific to the site. This worksheet presents the rationale for each field activity planned for the field investigation; and specifically, the sampling design and rationale in terms of the matrices to be sampled, analyses planned along with their respective concentration levels, sampling locations (including QC, critical, and background samples), the estimated number of samples to be collected, and sampling frequency (if recurring sampling rounds are planned). This information is crucial to plan approval and should be closely related to previously discussed DQOs Separate worksheets must be prepared for each site using the same alphanumeric numbering convention as previous worksheets (17a, 17b, 17c, etc.) and should describe the following:***

* ***The physical boundaries for the area under study, including maps or diagrams.***
* ***The environmental media populations to be represented by the data.***
* ***The time period being represented by the collected data.***
* ***The descriptions and basis for dividing the site into sampling areas (e.g., decision units, exposure units) that support site DQOs.***
* ***The basis for the numbers and placement of samples within sampling areas.***
* ***If sampling locations are known, descriptions of how actual sample positions will be located once in the field (include maps or diagrams).***
* ***If a sample cannot be collected where planned, the decision process for changing the location.***
* ***If sample locations will be determined in the field, the decision process for doing so.***
* ***Contingencies in the event that field conditions are different than expected and could have an effect on the sampling design.***

***To the extent possible based on available information, this worksheet should include the following:***

* ***Brief history of the property use.***
* ***Proposed reuse/redevelopment, if known.***
* ***Identification of the applicable state standards being used (commercial/industrial, residential, or recreational).***
* ***Direction of groundwater flow and source or reference for groundwater flow direction, if available.***
* ***Number of samples to be collected.***
* ***Type of samples to be collected.***
* ***Location of samples to be collected (may specify “TBD at the discretion of the Project Manager”) and rationale for sample locations.***
* ***Table showing samples to be collected, media, analyses, field QC/laboratory QC samples, and total number of samples for each medium.***
* ***Site location map.***
* ***Site features map (showing all site features, including buildings, former building locations, loading docks, concrete slabs, former transformers, locations of known spills, known and existing monitoring wells, grass, and waste piles).***

***The following examples provide media-specific information for soil, sediment, and water. Other media should be added as needed.***

### Sampling Locations and Methods

***Sampling locations, analytical methods, and associated SOP References may be presented in a tabular format, as well as the rationale for the sample locations. Sampling locations for many sites are pre-determined and can be displayed on a site plan. The following information should be included:***

* ***Sample IDs with depths (if known).***
* ***Sample matrix (for example, soil, sediment, or groundwater).***
* ***QC Sample Type (for example, field duplicate, MS/MSD, or trip blanks).***
* ***Analyte (for example, lead) or Analytical Group (for example, VOCs or PCBs).***
* ***Sampling SOPs (incorporated by reference).***

***The following table format may be used to incorporate this information:***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sample ID** | **Matrix[[59]](#footnote-60)** | **Depth (ft bgs)** | **Type[[60]](#footnote-61)** | **Analysis** | **Comments** | **SOP Reference** |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

Notes:

|  |  |
| --- | --- |
| ft bgs | Feet below ground surface |
| PCB | Polychlorinated biphenyl |
| TBD | To be determined |
| VOC | Volatile organic compounds |

## 

## WORKSHEET #19 & 30: SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES

Worksheet #19 & 30 tabulates the sample containers and preservation requirements for each analysis and matrix type based on CLP bottleware and preservation requirements and/or SW-846 Chapter 3 (Inorganics) and Chapter 4 (Organics) requirements. Technical holding times for sample preparation and analysis are also listed in this worksheet.

Except for VOCs and GRO in soil, sample preparation methods are not listed. To include the numerous organic and inorganic preparation methods would needlessly add to the complexity of this worksheet. VOC preparation method SW-846 5035A includes sampling and preservation requirements and, therefore, is referenced in this worksheet. Site-specific plans will identify the appropriate preparation methods.

***Much of the information in this table is common to all projects. However, organization-specific procedures and policies should be incorporated as needed. Additionally, please delete any information that is not applicable to the project. For example, if metals and VOCs in water are not analytes of interest for the project, the information for these should be deleted to streamline the table.***

***Identify the project personnel responsible for the acceptance and inspection of sample containers.***

| **Analytical Group (Concentration Level)** | **Matrix** | **Analytical Method** | **Containers (number, size, type per sample)** | **Preservation Requirements (chemical, temperature, light protected)** | **Technical Hold Time (Sample Preparation)** | **Technical Hold Time (Analysis)** |
| --- | --- | --- | --- | --- | --- | --- |
| VOCs (Low/Med) | Soil | SW-846 5035A/ 8260C/D | Three 5-gram EnCore (or equivalent) samplers *and Percent Solids vial below* | Iced to ≤6ºC, not frozen or frozen to < -7 ºC | NA | 48 hours; 14 days if frozen |
| Percent solids for soil VOCs only | Soil | NA | One 40-mL VOA vial, one 4-oz glass jar, or 10-gram core tube. | Iced to ≤6ºC, not frozen or frozen to < -7 ºC | NA | NA |
| VOCs (Low/Med)  *Field Preserved* | Soil | SW-846 5035A/ 8260C/D | 5-gram soil cores extruded (e.g., using a Terra-Core sampler) into two 40-mL amber VOA vials with NaHSO4 and a stir bar plus one 40-mL VOA vial with MeOH | 40-mL VOA vials with 5 mL NaHSO4 and 40-mL VOA vial with MeOH then Iced to ≤6ºC, not frozen | Transfer soil cores to VOA vials containing preservatives in the field | 14 days from collection |
| VOCs (Trace/Low) | Water | SW-846 8260C/D | Three 40-mL amber glass VOA vials | HCl pH<2, Iced to ≤6ºC, not frozen | None | 14 days from collection |
| VOCs (Trace/Low) | Water | SW-846 8260C/D | Three 40-mL amber glass VOA vials, PTFE septum lid | Iced to ≤6ºC, not frozen (sample collected in un-preserved VOA vial if sample effervesces in presence of HCl) | None | 7 days from collection |
| GRO  *Option 1: EnCore samplers* | Soil | SW-846 5035A\* /8015C/D | Two 5-gram EnCore samplers | Iced to ≤6ºC, not frozen | None | 14 days from collection |
| Percent solids for soil GRO only | Soil | NA | One 40-mL VOA vial, dry with no headspace | Iced to ≤6ºC, not frozen | None | None |
| GRO (Low)  *Option 2- Field Preserved* | Soil | SW-846 5035A\* /8015C/D | 5-gram soil cores extruded (e.g., using a Terra-Core sampler) into two VOA vials each containing 5 mL MeOH. | 5-mL MeOH, Iced to ≤6ºC, not frozen | Transfer soil cores to VOA vials containing preservatives in the field | 14 days from collection |
| GRO (Low) | Water | SW-846 8015C/D | Three 40-mL VOA vial, PTFE septum lid | HCl pH<2, Iced to ≤6ºC, not frozen | None | 14 days |
| SVOCs (Low) | Soil | SW-846 8270D/E | One 4-oz glass wide mouth jar | Iced to ≤6ºC, not frozen | 14 days (sampling to extraction) | 40 days (extraction to analysis) |
| SVOCs (Low) | Water | SW-846 8270D/E | Two 1-L amber glass with PTFE-lined lid | Iced to ≤6ºC, not frozen | 7 days from sampling to extraction | 40 days (extraction to analysis) |
| PAHs by SIM (Trace) | Soil | SW-846 8270D/E | One 8-oz glass wide mouth jar with PTFE-lined lid | Iced to ≤6ºC, not frozen | 14 days (sampling to extraction) | 40 days (extraction to analysis) |
| PAHs by SIM (Trace) | Water | SW-846 8270D/E | Two 1-L amber glass with PTFE-lined lid | Iced to ≤6ºC, not frozen | 7 days from sampling to extraction | 40 days (extraction to analysis) |
| OC Pesticides (Low) | Soil | SW-846 8081B | One 8-oz glass wide mouth jar with PTFE-lined lid | Iced to ≤6ºC, not frozen | 14 days (sampling to extraction) | 40 days (extraction to analysis) |
| OC Pesticides (Low) | Water | SW-846 8081B | Two 1-L amber glass with PTFE-lined lid | Iced to ≤6ºC, not frozen | 7 days from sampling to extraction | 40 days (extraction to analysis) |
| PCBs as Aroclors (Low) | Soil | SW-846 8082A | One 8-oz glass wide mouth jar with PTFE-lined lid | Iced to ≤6ºC, not frozen | 14 days (sampling to extraction) | 40 days (extraction to analysis) |
| PCBs as Aroclors (Low) | Water | SW-846 8082A | Two 1-L amber glass with PTFE- lined cap | Iced to ≤6ºC, not frozen | 7 days from sampling to extraction | 40 days (extraction to analysis) |
| Herbicides (Low) | Soil | SW-846 8151A | One 8-oz glass wide mouth jar with PTFE-lined lid | Iced to ≤6ºC, not frozen | 14 days (sampling to extraction) | 40 days (extraction to analysis) |
| Herbicides (Low) | Water | SW-846 8151A | Two 1-L amber glass with PTFE-lined lid | Iced to ≤6ºC, not frozen | 7 days from sampling to extraction | 40 days (extraction to analysis) |
| DRO and/or ORO | Soil | SW-846 8015C/D | One 4-oz glass wide mouth jar with PTFE-lined lid | Iced to ≤6ºC, not frozen | 14 days (sampling to extraction) | 40 days (extraction to analysis) |
| DRO and/or ORO | Water | SW-846 8015C/D | Two 1-L amber glass jars with PTFE-lined lid | Iced to ≤6ºC, not frozen | 7 days from sampling to extraction | 40 days (extraction to analysis) |
| ICP-AES Metals (Low) or ICP-MS Metals (Trace) | Soil | SW-846 6010C/DSW-846 6020A/B | One 4-oz glass wide mouth jar *No extra volume needed for S/D* | Iced to ≤6ºC, not frozen | None | 6 months |
| ICP-AES Metals (Low) or ICP-MS Metals (Trace) | Water | SW-846 6010C/D EPA 200.7/ 200.8 | One 500-ml HDPE bottle *Double the volume for S/D* | HNO3 to pH<2, Iced to ≤6ºC, not frozen | None | 6 months |
| Dissolved Metals by ICP-AES (Low) or ICP-MS (Trace) | Water (field filtered) | SW-846 6010C/D EPA 200.7/ 200.8 | One 500-ml HDPE bottle *Double the volume for S/D* | Sample must be filtered through 0.45-micron filter prior to preserving with HNO3 to pH<2, Iced to ≤6ºC, not frozen | None | 6 months |
| Dissolved Metals by ICP-AES (Low) or ICP-MS (Trace) | Water (not field filtered) | SW-846 6010C/D EPA 200.7/ 200.8 | One 500-ml HDPE *Double the volume for S/D* | Iced to ≤6ºC, not frozen | None | 6 months |
| Mercury (Low) | Soil | SW-846 7471B | One 4-oz glass wide mouth jar *No extra volume needed for S/D* | Iced to ≤6ºC, not frozen | None | 28 days |
| Mercury (Low) | Water | SW-846 7470A | One 250-ml HDPE bottle *Double the volume for S/D* | HNO3 to pH<2, Iced to ≤6ºC, not frozen | None | 28 days |
| Total Cyanide | Soil | SW-846 9012A/B | One 4-oz glass wide mouth jar *No extra volume needed for S/D* | Iced to ≤6ºC, not frozen | None | 14 days |
| Total Cyanide (Low) | Water | SW-846 9012A/B | One 1-L HDPE bottle *Double the volume for S/D* | NaOH pH>12, Iced to ≤6ºC, not frozen | None | 14 days |
| TCLP VOC | Soil | SW-846 1311/ 8260C/D | One 4-oz jar with PTFE-lined septum lid | Iced to ≤6ºC, not frozen | 14 days (sampling to TCLP ZHE extraction) | 14 days (TCLP extraction to analysis) |
| TCLP Organic extractables: SVOC, Pesticide, Herbicide (any or all) | Soil | SW-846 1311/ 8270D/E, 8081B, 8151A | One 8-oz. wide mouth glass jar | Iced to ≤6ºC, not frozen | 14 days (sampling to TCLP extraction) and 7 days (TCLP extraction to organic extraction for SVOCs, pesticides, or herbicides) | 40 days (organic extraction to analysis) |
| TCLP Metals including mercury | Soil | SW-846 1311/ 6010C/D and 7470A | One 8-oz. wide mouth glass jar | Iced to ≤6ºC, not frozen | Mercury: 28 days (sampling to TCLP extraction); Other metals: 180 days (sampling to TCLP extraction) | Mercury: 28 days (TCLP extraction to analysis);Other metals: 180 days (TCLP extraction to analysis) |
| Asbestos | Soil | PLM using EPA 600/R-93/116 (or equivalent) including preparation by milling similar to procedures in CARB 435 | One 1-Liter plastic bag | None | None | None |
| Asbestos | Bulk | EPA 600/R-93/116 | Per subcontractor SOP | None | None | None |
| Lead-based paint | Paint chips | SW-846 7000B | Resealable baggie or centrifuge tubes | None | None | None |

Notes:

Container requirements in this table are based on the CLP Samplers Guide and/or SW846 Chapters 3 and 4 and are considered sufficient volumes for most laboratories. Sample volumes needed by laboratories may vary depending on equipment for preparation methods used by the individual laboratories. Volumes presented in this table should be considered maximum sample amounts needed by the laboratory and include sufficient sample for re-extraction/re-digestion if needed.

Volumes for TCLP analyses in this table are adequate for soil matrices; however, waste materials with lower densities may require additional volume. Consult with the Chemist.

Technical holding times for TCLP parameters are based on EPA SW-846 holding times rather than CLP holding times. If amber containers are not available for VOCs or other organic samples, protect the sample from light. All bottleware is to be QC grade with Certificates of Analysis.VOA vials for soils are tared and require weighing in the field to the nearest 0.01 gram.

Field sampling for ACM will follow Asbestos Hazard Emergency Response Act (AHERA) sampling protocols. Bulk samples of suspected ACM and LBP will include enough volume to accurately represent these materials.

|  |  |
| --- | --- |
| AHERA | Asbestos Hazard  Emergency Response Act |
| ASTM | American Society for  Testing Materials |
| CARB | California Air Resources Board |
| DRO | Diesel-Range Organic |
| GRO | Gasoline-Range Organic |
| HCl | hydrochloric acid |
| HDPE | high-density polyethylene |
| HNO3 | nitric acid |
| ICP-AES | Inductively Coupled  Plasma-Atomic Emission Spectrometer |
| ICP-MS | Inductively Coupled  Plasma-Mass  Spectrometer |
| L | liter |
| MeOH | methanol |
| mL | milliliter |
| NA | Not Applicable |
| NaHSO4 | sodium bisulfate |
| OC | Organochlorine |
| ORO | Oil-range Organics |
| oz. | ounce |
| PAH | Polynuclear Aromatic  Hydrocarbon |
| PCB | Polychlorinated Biphenyl |
| PLM | Polarized Light  Microscopy |
| PTFE | Polytetrafluoroethylene |
| QC | quality control |
| S/D | Sample/Duplicate |
| SIM | Selected Ion Monitoring |
| SVOC | Semivolatile Organic  Compound |
| TCLP | Toxicity Characteristic  Leaching Procedure |
| VOA | Volatile Organic Analysis |
| VOC | Volatile Organic Compound |
| ZHE | Zero Headspace Extractor |

## 

## WORKSHEET #20: FIELD QC SUMMARY

***Much of the information in this table is common to all projects. However, the numbers and types of Field QC samples should be selected during the project planning based on the project’s data quality objectives (DQOs) and documented in the site-specific sampling designs. Additionally, please delete any information that is not applicable to the project. For example, if metals and VOCs in water are not analytes of interest for the project, the information for these should be deleted to streamline the table.***

| **Matrix** | **Analytical Group** | **Analytical Method** | **No. of Field Samples** | **No. of Field Duplicate Pairs** | **No. of MS/MSD** | **No. of Ambient Field Blanks** | **No.** **of Equipment Blanks[[61]](#footnote-62)** | **No. of Trip Blanks** | **No. of PE Samples** | **Total No. of Samples to Laboratory** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Soil | VOCs | SW-846 5035A+ 8260C/D | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 1 per cooler with VOC samples | TBD | TBD |
| Water | VOCs | SW-846 5030+ 8260C/D | TBD | 1 per 20 | 1 per 20 | 1 per day | 1 per day | 1 per cooler with VOC samples | TBD | TBD |
| Soil | GRO | SW-846 8015C/D | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 1 per cooler with GRO samples | 0 | TBD |
| Water | GRO | SW-846 8015C/D | TBD | 1 per 20 | 1 per 20 | 1 per day | 1 per day | 1 per cooler with GRO samples | 0 | TBD |
| Soil | DRO and ORO | SW-846 8015C/D | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | 0 | TBD |
| Water | DRO and ORO | SW-846 8015C/D | TBD | 1 per 20 | 1 per 20 | 1 per day | 1 per day | 0 | 0 | TBD |
| Soil | SVOCs | SW-846 8270D/E | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Water | SVOCs | SW-846 8270D/E | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Soil | PAHs by SIM | SW-846 8270D/E | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Water | PAHs by SIM | SW-846 8270D/E | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Soil | OC Pesticides | SW-846 8081B | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Water | OC Pesticides | SW-846 8081B | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Soil | PCBs (Aroclors) | SW-846 8082A | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Water | PCBs (Aroclors) | SW-846 8082A | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Soil | Herbicides | SW-846 8151A | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Water | Herbicides | SW-846 8151A | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Soil | Metals | SW-846 6010C/D or 6020A/B | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Water | Metals | SW-846 6010C/D, 6020A/B, EPA 200.7, EPA 200.8 | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Soil | Mercury | EPA 7471B | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Water | Mercury | EPA 7470A | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Soil | Cyanide | EPA 9012A/B | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Water | Cyanide | EPA 9012A/B | TBD | 1 per 20 | 1 per 20 | 0 | 1 per day | 0 | TBD | TBD |
| Solid | TCLP analyses | SW-846 1311+ SW-846 8260C/D+, 8270D/E+, 8081B+, 6010C/D+, 7470A | TBD | 0 | 0 | 0 | 0 | 0 | 0 | TBD |

Notes:

Analytical methods and the numbers and types of Field QC samples will be selected during the site scoping process and documented in the site-specific sampling designs. The numbers of field QC samples listed in this table may not be needed depending on the type of sampling equipment used. Equipment blanks would not be required if dedicated sampling equipment is used.

DRO and ORO can be extracted from the same 1-L sample bottle.

|  |  |
| --- | --- |
| DRO | Diesel-Range Organic |
| FSP | Field Sampling Plan |
| GRO | Gasoline-Range Organic |
| L | Liter |
| MS/MSD | Matrix Spike/ Matrix Spike Duplicate |
| OC | Organochlorine |
| ORO | Oil-Range Organic |
| PCB | Polychlorinated Biphenyl |
| PE | Performance Evaluation |
| QC | Quality Control |
| SIM | Selected Ion Monitoring |
| SVOC | Semivolatile Organic Compound |
| TBD | To Be Determined |
| TCLP | Toxicity Characteristic Leaching Procedure |
| VOC | Volatile Organic Compound |

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## WORKSHEET #21: FIELD SOPS

***Provide a brief narrative and list SOPs for field operations and activities, including but not limited to, sample collection, field screening instrument operation, field screening kits/methods, and monitoring well installation. Provide a list of organization-specific field SOPs in the table below. Include SOPs as an appendix to this QAPP.***

***Document any modification to these SOPs in site-specific plans.***

***In the event that an asbestos, lead-based paint, mold or PCB survey or sampling is required, these services may potentially be subcontracted services to complete the assessment. SOPs for such surveys/sampling should be provided by the subcontractor, maintained in the project file, and made available upon request.***

### Field Standard Operating Procedures (SOPs)

| **SOP # or reference** | **Title** | **Originating Organization** | **SOP Option or Equipment Type (if SOP provides different options)** | **Modified for Project?** |
| --- | --- | --- | --- | --- |
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## WORKSHEET #22: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION

***Common types of field monitoring equipment are listed in the table below. However, this list is neither prescriptive nor comprehensive. Organization-specific, equipment and procedures must be included.***

| **Field Equipment** | **Calibration Activity** | **Maintenance Activity** | **Testing Activity** | **Inspection Activity** | **Frequency** | **Acceptance Criteria** | **Corrective Action** | **Resp. Person** | **SOP Reference** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| pH Probe | Calibrate daily using at least two auto- calibration standard solutions | NA | NA | NA | Daily before use and when drift is identified or suspected, or readings are unstable | pH reads ± 0.2 Standards of 4.0, 7.0, or 10.0 depending on which two solutions are used. | Clean probe with deionized water and recalibrate. Do not use if unable to calibrate properly. | Field Team Leader | TBD |
| Specific Conductance probe | Calibrate daily using auto- calibration standard solutions | NA | NA | NA | Daily before use and when drift is identified or suspected, or readings are unstable | Conductivity is µS ± 3% of standard solution. | Clean probe with deionized water and recalibrate. Do not use if unable to calibrate properly. | Field Team Leader | TBD |
| Oxidation- reduction potential | Calibrate daily using auto- calibration standard solutions | NA | NA | NA | Daily before use and when drift is identified or suspected, or readings are unstable | Within Calibration Range | Clean probe with deionized water and recalibrate. Do not use if unable to calibrate properly. | Field Team Leader | TBD |
| Dissolved Oxygen, Temperature, and turbidity probes | NA for DO and temperature; Calibrate daily using auto- calibration standard solutions | NA | During calibration of instrument, check temperature against ambient. | NA | Daily before use and when drift is identified or suspected, or readings are unstable | Calibrate at saturation with acceptance criteria of ± 0.3 mg DO/L Std = 11-40 NTU, < ± 8% Std = 41-100 NTU, < ± 6.5% Std > 100 NTU, < ± 5% | Clean probe with deionized water and recalibrate. Do not use if unable to calibrate properly. | Field Team Leader | TBD |
| Multi-gas Meter | Calibrate for organic vapors using isobutylene; LEL, O2, H2S, and carbon monoxide using mixed gas | Charge battery. Allow complete discharge of battery before recharging | Self Test | NA | Daily before use and as needed during day | NA | If instrument cannot be calibrated, replaced with another unit. | Field Team Leader | TBD |
| Groundwater sampling pumps and tubing (as applicable) | NA | NA | NA | Inspect pumps, tubing and connections. | Regularly | Maintain in good working order as per manufacturer manuals | Replace items | Field Team Leader | TBD |

Notes:

|  |  |
| --- | --- |
| µS | micro-Siemens |
| DO | Dissolved Oxygen |
| H2S | Hydrogen Sulfide |
| FSP | Field Sampling Plan |
| LEL | Lower Explosive Limit |
| mg DO/L | Milligrams Dissolved Oxygen Per Liter |
| NA | Not Applicable |
| NTU | Nephelometric Turbidity Units |
| O2 | Oxygen |
| SOP | Standard Operating Procedure |
| Std | Standard |
| TBD | To be determined |

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## WORKSHEET #23: ANALYTICAL SOPS

***If a suitable laboratory is selected prior to completion of the QAPP, the laboratory’s accreditation information should be included as an attachment to this QAPP. If a suitable laboratory is selected after completion of the QAPP, the accreditation information should be included in the project file and made available upon request. Contact information for laboratory Quality Assurance Managers should be assembled, kept on file, and made available upon request.***

***Individual laboratory analytical SOPs should be made available upon request but do not need to be included in this QAPP.***

***A description of any non-standard or modified methods should be included on this worksheet.***

As part of the analytical subcontracting process, the Project Chemist will specify analytical methods to be used by subcontracted laboratories. All analytical laboratories must be accredited for the selected analytical method by a National Environmental Laboratory Accreditation Program (NELAP) accredited laboratory or a state-accredited laboratory within EPA Region 3.

If a suitable laboratory is selected prior to completion of the QAPP, the laboratory’s accreditation information will be included as an attachment to this QAPP. If a suitable laboratory is selected after completion of the QAPP, the accreditation information will be included in the project file and made available upon request. Contact information for laboratory Quality Assurance Managers will be assembled, kept on file, and made available upon request.

Individual laboratory analytical SOPs will be made available upon request but are not included in this QAPP.

## WORKSHEET #24: ANALYTICAL INSTRUMENT CALIBRATION

***Analytical instruments must be calibrated according to the method-specific criteria. If a suitable laboratory is selected prior to completion of the QAPP, then their analytical SOPs may be cited in the table below. Alternatively, the laboratory QA Manual containing their analytical instrumentation calibration procedures may be included as an attachment to this QAPP and referenced on this worksheet.***

***If a suitable laboratory is selected after completion of the QAPP, the laboratory’s QA manual must contain their analytical instrumentation calibration procedures, be kept in project files, and made available upon request.***

***Include a statement indicating the status and location of analytical instrumentation calibration procedures.***

| **Instrument** | **Calibration Procedure** | **Frequency of Calibration** | **Acceptance Criteria** | **Corrective Action (CA)** | **Person Responsible for CA** | **SOP Reference** |
| --- | --- | --- | --- | --- | --- | --- |
| GC/MS (VOCs) | SW-846 8260C/D | As specified by method | As specified by method | Instrument maintenance, standard, inspection, recalibration | Laboratory Analyst | TBD |
| GC/MS (SVOCs and PAH by SIM) | SW-846 8270D/E | As specified by method | As specified by method | Instrument maintenance, standard, inspection, recalibration | Laboratory Analyst | TBD |
| GC/ECD (OC pesticides) | SW-846 8081B | As specified by method | As specified by method | Instrument maintenance, standard, inspection, recalibration | Laboratory Analyst | TBD |
| GC/ECD (PCBs) | SW-846 8082A | As specified by method | As specified by method | Instrument maintenance, standard, inspection, recalibration | Laboratory Analyst | TBD |
| GC/ECD (Herbicides) | External Standard: SW-846 8151A | As specified by method | As specified by method | Instrument maintenance, standard, inspection, recalibration | Laboratory Analyst | TBD |
| GC/FID (GRO) | External Standard: SW-846 8015C/D | As specified by method | As specified by method | Instrument maintenance, standard, inspection, recalibration | Laboratory Analyst | TBD |
| GC/FID (DRO/ORO) | External Standard: SW-846 8015C/D | As specified by method | As specified by method | Instrument maintenance, standard, inspection, recalibration | Laboratory Analyst | TBD |
| ICP-AES (Metals) | SW-846 6010C/D  EPA 200.7 | As specified by method | As specified by method | Instrument maintenance, standard, inspection, recalibration | Laboratory Analyst | TBD |
| ICP-MS (Metals) | SW-846 6020A/B  EPA 200.8 | As specified by method | As specified by method | Instrument maintenance, standard, inspection, recalibration | Laboratory Analyst | TBD |
| Cold Vapor (Mercury) | SW-846 7470A/7471B  EPA 245.1 | As specified by method | As specified by method | Instrument maintenance, standard, inspection, recalibration | Laboratory Analyst | TBD |
| Spectrometric (Cyanide) | SW-846 9012A/B | As specified by method | As specified by method | Instrument maintenance, standard, inspection, recalibration | Laboratory Analyst | TBD |

Notes:

|  |  |
| --- | --- |
| DRO | Diesel-Range Organics |
| GC/ECD | Gas Chromatograph/Electron Capture  Detector |
| GC/FID | Gas Chromatograph/Flame Ionization  Detector |
| GC/MS | Gas Chromatograph/Mass Spectrometer |
| GRO | Gasoline-Range Organics |
| ICP-AES | Inductively Coupled Plasma-Atomic  Emission Spectrometer |
| ICP-MS | Inductively Coupled Plasma- Mass  Spectrometer |
| ORO | Oil-Range Organic |
| PAH | Polynuclear Aromatic Hydrocarbon |
| PCB | Polychlorinated Biphenyl |
| SIM | selected ion monitoring |
| SVOC | Semivolatile Organic Compound |
| TBD | To be determine |
| VOC | Volatile Organic Compound |

## 

## WORKSHEET #25: ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION

***Analytical instruments must be maintained regularly to meet method-specific calibration acceptance criteria. If a suitable laboratory is selected prior to completion of the QAPP, then the laboratory’s analytical SOPs may be cited in the table below. Alternatively, the laboratory QA Manual containing their analytical instrumentation maintenance procedures may be included as an attachment to this QAPP and referenced on this worksheet.***

***If a suitable laboratory is selected after completion of the QAPP, the laboratory’s QA manual must contain their analytical instrumentation maintenance procedures, be kept in project files, and made available upon request.***

***Include a statement indicating the status and location of analytical instrumentation maintenance procedures.***

| **Instrument / Equipment** | **Maintenance Activity** | **Testing Activity** | **Inspection Activity** | **Frequency** | **Acceptance Criteria** | **Corrective Action** | **Responsible Person** | **SOP Reference** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| GC/MS (VOCs) | Replace septa, clean injection port, clip and replace column | SW-846 8260C/D EPA 524.2,  EPA 624.1 | Leak test, column and injection port inspection, source insulator integrity | As specified by method | Per method criteria: Passing BFB tunes, ICAL, and CCVs. Passing internal standards response. | Perform maintenance, check standards, recalibrate | Laboratory Analyst | TBD |
| GC/MS (SVOCs) | Replace septa, clean injection port, clip and replace column | SW-846 8270C/D EPA 525.2,  EPA 625.1 | Leak test, column and injection port inspection, source insulator integrity | As specified by method | Per method criteria: Passing DFTPP, ICAL, and CCVs. Passing internal standards response. | Perform maintenance, check standards, recalibrate | Laboratory Analyst | TBD |
| GC/ECD (OC pesticides) | Replace septa, clean injection port, clip and replace column | Passing Calibrations:  SW-846 8081B, EPA 508.1,  EPA 608.3 | Leak test, column and injection port inspection | As specified by method | Per method criteria: Passing DDT and endrin breakdowns. Passing ICAL and CCVs. | Perform maintenance, check standards, recalibrate | Laboratory Analyst | TBD |
| GC/ECD (PCBs) | Replace septa, clean injection port, clip and replace column | Passing Calibrations:  SW-846 8082A, EPA 608.3 | Leak test, column and injection port inspection | As specified by method | Per method criteria: Passing ICAL and CCVs | Perform maintenance, check standards, recalibrate | Laboratory Analyst | TBD |
| GC/ECD (Herbicides) | Replace septa, clean injection port, clip and replace column | Passing Calibrations: SW-846 8151A, EPA 615 | Leak test, column and injection port inspection | As specified by method | Per method criteria: Passing ICAL and CCVs | Perform maintenance, check standards, recalibrate | Laboratory Analyst | TBD |
| GC/FID (GRO and DRO) | Replace septa, clean injection port, clip and replace column | Passing calibrations:  SW-846 8015C/D | Leak test, column and injection port inspection | As specified by method | Per method criteria: Passing ICAL and CCVs | Perform maintenance, check standards, recalibrate | Laboratory Analyst | TBD |
| ICP-AES (Metals) | Torch, nebulizer, spray chamber, autosampler, pump tubing | SW-846 6010C/D, EPA 200.7 | Check connections, flush lines, clean nebulizer | As specified by method | Per method criteria: Passing ICAL and CCVs | Perform maintenance, check standards, recalibrate | Laboratory Analyst | TBD |
| ICP-MS (Metals) | Torch, nebulizer, spray chamber, autosampler, pump tubing | SW-846 6010C/D, EPA 200.8 | Check connections, flush lines, clean nebulizer | As specified by method | Per method criteria: Passing tune, ICAL, and CCVs | Perform maintenance, check standards, recalibrate | Laboratory Analyst | TBD |
| CVAA (Mercury) | Pump tubing, absorption cell and lens cleaning | SW-846 7470A/7471B,  EPA 245.1,  EPA 245.2 | Check connections, flush sample lines | As specified by method | Per method criteria: Passing ICAL and CCVs | Perform maintenance, check standards, recalibrate | Laboratory Analyst | TBD |
| Automated Spectrophotometer (Cyanide) | Pump, tubing, maintenance | SW-846 9012B, EPA 335.4 | Clean or replace tubing, check connections | As specified by method | Per method criteria: Passing ICAL and CCVs | Perform maintenance, check standards, recalibrate | Laboratory Analyst | TBD |
| HRGC/HRMS (Dioxins/Furans) | Replace septa, clean injection port, clip and replace column | SW-846 8290A,  EPA 1613B | Leak test, column and injection port inspection, source insulator integrity | As specified by method | Per method criteria: Passing ICAL and CCVs | Perform maintenance, check standards, recalibrate | Laboratory Analyst | TBD |
| HRGC/HRMS (Chlorinated biphenyl congeners) | Replace septa, clean injection port, clip and replace column | EPA 1668C | Leak test, column and injection port inspection, source insulator integrity | As specified by method | Per method criteria: Passing ICAL and CCVs | Perform maintenance, check standards, recalibrate | Laboratory Analyst | TBD |

Notes:

|  |  |
| --- | --- |
| BFB | 4-Bromofluorobenzene |
| CCV | Continuing Calibration  Verification |
| CVAA | Cold Vapor Atomic Absorption |
| DDT | Dichlorodiphenyltrichloroethane |
| DFTPP | decafluorotriphenyl/phosphine |
| DRO | Diesel-Range Organics |
| EPA | U.S. Environmental Protection Agency |
| GC/ECD | Gas Chromatograph/ElectronCapture Detector |
| GC/FID | Gas Chromatograph/Flame  Ionization Detector |
| GC/MS | Gas Chromatograph/Mass  Spectrometer |
| GRO | Gasoline-Range Organics |
| HRGC/HRMS | High Resolution Gas Chromatograph/High Resolution Mass Spectrometer |
| ICA | Initial Calibration |
| ICP-AES | Inductively Coupled Plasma-Atomic Emission Spectrometer |
| ICP-MS | Inductively Coupled Plasma- Mass Spectrometer |
| OC | Organochlorine |
| PCB | Polychlorinated Biphenyl |
| SOP | Standard Operating Procedure |
| SVOC | Semivolatile Organic Compound |
| TBD | To be determined |
| VOC | Volatile Organic Compound |

## 

## WORKSHEET #26 & 27: SAMPLE HANDLING, CUSTODY, AND DISPOSAL

***Describe the requirements for sample handling and custody in the field, laboratory, and transport, taking into account the nature of the samples, the maximum allowable sample holding times before extraction or analysis, and available shipping options and schedules for projects involving physical sampling. Sample handling includes packaging, shipment from the site, and storage at the laboratory. Include examples of sample labels, custody forms, and sample custody logs.***

***The following example text summarizes thorough, defensible sample handling and custody procedures from the field to the laboratory. However, this text is neither prescriptive nor comprehensive. Organization-specific procedures must be described accurately.***

### Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to the laboratory)

To maintain a record of sample collection, transfer between personnel, shipment, and receipt by the laboratory, the field sampling team will generate a chain of custody (COC) form for each cooler containing samples for shipment. Figure 26-1 presents an example COC form. The COC may be more than one page long and list all field samples submitted for analysis in a shipping container (cooler) including field blanks (trip, equipment, and ambient blanks). The COC will be placed in a plastic zippered bag and the plastic bag will be taped to the inside lid of the container. Each time the samples are transferred, the signatures of the persons relinquishing and receiving the samples, as well as the date and time of cooler sealing/transfer and laboratory receipt, will be documented on the COC. The transfer from the field team to the shipper and from the shipper to the laboratory will be documented by the FedEx airbill records, eliminating the need for the air carrier to sign the COC. Within the laboratory, the person responsible for sample receipt must sign and date the COC form; verify that custody seals are intact on shipping containers; compare samples received against those listed on the COC form; examine all samples for possible shipping damage, leakage, and improper sampler preservation; note on the COC record that specific samples were damaged; notify sampling personnel as soon as possible so that appropriate samples may be resampled; verify that sample holding times have not been exceeded; maintain laboratory COC documentation; and place the samples in appropriate laboratory storage. The laboratory is required to include a copy of the COC and airbill as part of the laboratory’s data package. Items requiring custody procedures include field samples and data files that can include field books, logs, and laboratory reports. An item is considered in custody if it is:

* In a person’s possession
* In view of the person after being in their possession
* Sealed in a manner that it cannot be tampered with after having been in physical possession

The COC record should include, at a minimum, the following:

***Edit this list as necessary.***

* Types of analysis or analyses to be performed
* Sample identification number
* Sample information
* Type of sample (grab or composite)
* Sample station location
* Sample collection date and time
* Names and signatures of samplers
* Signatures of any individuals with control over samples
* Case number
* Laboratory contact information
* Designated QC samples
* Accurate number of containers

A sample label is affixed to each sample container. The sample label must, at a minimum, contain the sample number, project number, unique identification or station number, identification of sampler, date and time of sample collection; sample designation as grab or composite, preservative(s), and analysis/fraction.

Custody seals (see Figure 26-2) are used to determine whether any tampering has occurred during transport of samples. These signed and dated seals will be placed at the junction between the lid and the main body of the cooler by the person responsible for packing the cooler. There also may be occasions when custody seals will be affixed to bottle lids. If the coolers or jars are opened before receipt at the laboratory, the custody seals will not be intact. Samples will be placed in coolers or other containers with sufficient ice and packing material to keep sample containers from shifting and breaking during transport. A temperature indicator bottle containing tap water will be placed in the iced cooler so that the laboratory can document cooler temperature upon receipt.

The field team will make every attempt to ship samples on the same day the samples are collected, if practical. When it is not possible to ship the samples on the day of collection, the field team will store the samples in refrigerators designated for sample storage at the site or in coolers. If the samples are stored in coolers and the sample preservation requirements include refrigeration, ice will be used to keep the samples cold. The coolers or refrigerators will be secured in either a locked room or compartment or otherwise sealed to prevent tampering until the samples are transferred to an overnight carrier or courier.

Unless previous screening results, site knowledge, or other information indicate the samples are hazardous, all samples collected and shipped for analysis will be treated as environmental samples. Samples, whether classified as hazardous or as environmental samples, will be shipped in compliance with applicable regulations. The United States Department of Transportation (DOT) and the International Air Transport Association (IATA) establish specific regulations governing the packaging of hazardous and environmental samples for shipment. These regulations include specifications for packing materials, shipping containers, and shipping labels. Based on the best available knowledge of the samples being collected, all samples will be shipped in accordance with these regulations.

### Sample Identification Procedures

Samples collected at the site must be uniquely labeled. All samples will be identified with a label attached directly to the container (see Figure 26-3). Sample label information will be entered into Scribe and printed onto labels which can be adhered to sample containers. Tetra Tech will provide the following information on sample labels and sample tags:

Sample bottle labels should include the following information:

***Edit this list as necessary.***

1. Sample number.
2. Sample identifier (assigned by samplers).
3. Location No./Station location No. (assigned by sampler).
4. Date sample was collected (MM/DD/YYYY).
5. Time sample was collected (in military time) [00:000].
6. Preservative(s), if any (specify “None” if sample is not preserved).
7. Type of sample (grab or composite).
8. Analysis/fraction.

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

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

* Upon receipt, sign, date, and document the time of sample receipt on the airbills or other shipping manifests received from the couriers.
* Sign the COC, assuming custody of the samples. If a COC is not received with a set of samples, the laboratory will immediately notify the Project Chemist, Field Team Leader, and/or Project Manager.
* Inspect the sample cooler for integrity and then document the following information:
  + - Air carrier or courier and whether the samples were shipped, or hand delivered (copies of the airbills are maintained).
    - Confirmation of presence of intact custody seals.
    - Sample temperature (whether ambient or chilled) and actual temperature of the temperature indicator bottle.
    - Presence of leaking or broken containers and indication of chemical preservation.
* Verify that the holding time is not exceeded. If a sample has exceeded holding time, the laboratory will notify the Project Chemist, Field Team Leader, and/or Project Manager.
* Match the sample container information (e.g., sample tag/label) with the COC, and any other pertinent sample information. The sample custodian then verifies sample identity to ensure that all information is correct. Any inconsistencies are resolved with the Project Chemist, Field Team Leader, and/or Project Manager, and corrective action measures are resolved and documented before sample analysis proceeds.

Samples submitted to laboratories will be stored at ≤6ºC for a minimum of 60 days following the completion of analyses and/or issue of final reports. Laboratories are also responsible for the proper management and disposal of all sample residuals and extracts, following all applicable federal, state, and local laws; rules; and regulations.

Figure 26-1. Example Chain-of-Custody Form

***Include an example chain of custody form here.***

Figure 26-2. Custody Seal

***Include an example custody seal here.***

Figure 26-3. Sample Label

***Include an example sample label here.***

## WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION

***Delete tables for analytical methods that will not be utilized for the project. Similarly, information should be added for methods that are used but not included in the following tables, modified methods, or non-standard methods.***

Samples may be analyzed under a variety of analytical methods. Method selection and MPCs will be based on site-specific DQOs. The MPC listings in the worksheets in this section are based on the current analytical methods. Laboratory analyses will be expected to meet these minimum MPCs.

If site-specific DQOs cannot be met using the MPC listed in these worksheets, more stringent MPC criteria will be developed for the site by the Project Chemist as part of the analytical technical specifications and included in the site-specific sampling plan and analytical procurement.

## WORKSHEET #28.1: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION – VOCS BY GC/MS

| **QC Sample** | **Number/ Frequency** | **Method/SOP Acceptance Criteria** | **Corrective Action (CA)** | **Title/position of person Responsible for Corrective Action** | **Project-Specific MPC** |
| --- | --- | --- | --- | --- | --- |
| Method Blank (MB) | 1 per 12-hour period | Method criteria same as Project-Specific MPC Lab SOPs vary by method # | Investigate the source of contamination and eliminate the problem before proceeding with further analysis. (Corrective actions are required only if the samples contain the same contaminant at concentrations exceeding the MPC levels.)  CA includes:   * Reanalyze the samples if sufficient sample volume remains. * Flag (qualify) the sample result. * Document the problem in the case narrative. | Analyst | SW-846 8260C/D and TO-15: analyte concentrations < RL  EPA 524.2 and EPA 624.1:  analyte concentrations < RL |
| Trip Blank | 1 per cooler containing VOC samples | No criteria specified in method or SOPs | Investigate sources of trip blank contamination after method blank actions are applied and considering field blank contamination.  CA includes:   * Review potential laboratory or field sources of contaminants (including type of water used to make the trip blank). * Once identified, QAM or Chemist should share findings with project management and the field team. * Discuss trip blank contamination in EPA deliverables and any impacts on data quality. | Project Manager, Field Samplers, QAM, and Chemist | All analyte concentrations < RL |
| Equipment and Ambient Field Blanks | 1 per day | No criteria specified in method or SOPs | Investigate sources of field blank contamination after method blank actions are applied and considering trip blank contamination.  CA includes:   * Review potential laboratory or field sources of contaminants (including type of water used to make the field blank). * Once source is identified, QAM or Chemist should share findings with project management and the field team. * Discuss trip blank contamination in EPA deliverables and any impacts on data quality. | Project Manager, Field Samplers, QAM, and Chemist | All analyte concentrations < RL |
| TCLP/SPLP LEB | 1 per TCLP extraction batch | Analysis of LEB required but no method acceptance criteria | None; report results in laboratory data package | Analyst | SW-846 8260C/D: Analysis of LEB required but no MPC |
| Laboratory Control Sample (LCS) | 1 per analysis or methanol extraction batch | laboratory must develop statistically- derived laboratory limits. | Investigate reason for poor LCS recovery. Eliminate problem before proceeding with further analysis.  CA includes:   * If low spike recovery, reanalyze samples under compliant LCS, if sufficient sample volumes are available. * For any low or high LCS outliers, flag (qualify) any analytes in samples from the affected batch. * Document the problem in the case narrative. | Analyst and Prep Analyst | Other methods: %R within statistically-derived laboratory limits |
| Field Duplicate | 1 per 20 field samples of the same matrix | No method or SOP criteria specified | If MPC is not met for the field duplicate results >4x RL, a careful examination of the sampling techniques, sample matrix, and analytical method and other analytical QC criteria will be conducted to identify the root cause of the high RPD and the usability of the data. | Field Samplers and Chemist | RPD ≤30% (water and air) RPD ≤50% (soil) |
| Surrogates (DMCs) | Each field and QC sample | Statistically-derived laboratory control limits | Investigate reason for poor surrogate recovery.  CA includes:   * Reanalyze sample to confirm the problem is with the sample matrix and not the analysis. Report both sets of results if the reanalysis confirms the initial analysis. * Otherwise, report only the compliant analysis. Document surrogate outliers on the CLP Form 2 equivalent and in the case narrative. | Analyst | %R within statistically-derived laboratory control limits |
| Internal Standards (IS) | Each field and QC sample | IS Area in the sample within -50% to +100% of the IS area in the opening CCV For TO-15: within ±40 percent of the mean area response of the IS in the most recent valid calibration. | Investigate reason for poor IS performance.  If failure is due to instrument performance, the problem must be identified, corrected, and the sample must be reanalyzed.  CA includes:   * Reanalyze sample and if upon reanalysis the IS area in the sample is still not within limits, report both the initial and reanalysis in the data package to document matrix interference. * Document surrogate outliers on Form 8 and in the case narrative | Analyst | IS area in the sample within -50% to +100% of the IS area in the opening CCV. For TO-15: within ±40 percent of the mean area response of the IS in the most recent valid calibration. |
| Cooler Temperature Indicator | One per cooler | ≤6°C (not frozen) | Laboratory to notify Project Chemist and confirm whether to proceed with analysis. Resampling may be required. | Laboratory Sample Custodian/ Project Chemist | ≤6°C (not frozen) |

Notes:

Laboratory SOPs are retained on file..

|  |  |
| --- | --- |
| %R | percent recovery |
| CCV | Continuing Calibration Verification |
| CLP | Contract Laboratory Program |
| DMC | Deuterated Monitoring Compound |
| GC/MS | Gas Chromatography/Mass Spectrometry |
| LEB | Leachate Extraction Blank |
| MCL | Maximum Contaminant Level |
| MPC | Measurement Performance Criteria |
| QAM | Quality Assurance Manager |
| QC | Quality Control |
| RL | Reporting Limit |
| RPD | relative percent difference |
| SOP | Standard Operating Procedure |
| SPLC | Synthetic Precipitation Leaching Procedure |
| TCLP | Toxicity Characteristic Leaching Procedure |
| VOC | Volatile Organic Compound |

## WORKSHEET #28.2: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION – SVOCS INCLUDING PAHS BY GC/MS

| **QC Sample** | **Number/Frequency** | **Method/SOP Acceptance Criteria** | **Corrective Action (CA)** | **Title/position of person Responsible for Corrective Action** | **Project-Specific MPC** |
| --- | --- | --- | --- | --- | --- |
| Method Blank (MB) | 1 per extraction batch | Method criteria same as Project-Specific MPC  Lab SOPs vary by method # | Investigate the source of contamination and eliminate the problem before proceeding with further analysis. (Corrective actions are required only if the samples contain the same contaminant at concentrations exceeding the MPC levels.) CA includes:   * Re-extract and reanalyze the samples if sufficient sample volume remains. * Flag (qualify) the sample result. * Document the problem in the case narrative. | Analyst/Prep Analyst | SW-846 8270D/E:  analyte concentrations <RL  EPA 525.2 and EPA 625.1: analyte concentrations <RL |
| Equipment blanks and Lot Blanks | 1 per day per type of sampling equipment or 1 per lot of wipes | No criteria specified in method or SOPs | Investigate sources of equipment blank or lot blank contamination after method blank actions are applied and considering other sources of blank contamination.  CA includes:   * Review potential laboratory or field sources of contaminants (including type of water or solvents used to make the field blank). * Once source is identified, QAM or Chemist should share findings with project management and the field team. * Discuss equipment blank or lot blank contamination in EPA deliverables and any impacts on data quality. | Project Manager, Field Samplers, QAM, and Chemist | All analyte concentrations < RL |
| TCLP/SPLP LEB | 1 per TCLP extraction batch | Analysis of LEB required but no method acceptance criteria | None; report results in laboratory data package | Analyst | SW-846 8270D/E: Analysis of LEB required but no MPC |
| Laboratory Control Sample (LCS) | 1 per analysis or extraction batch | None listed; laboratory must develop statistically-derived laboratory limits. | Investigate reason for poor LCS recovery. Eliminate problem before proceeding with further analysis.  CA includes:   * If low spike recovery, re-extract and reanalyze samples under compliant LCS, if sufficient sample volumes are available. * For any low or high LCS outliers, flag (qualify) any analytes in samples from the affected batch. Document the problem in the case narrative. | Analyst and Prep Analyst | %R within statistically-derived laboratory limits |
| Field Duplicate | 1 per 20 field samples of the same matrix | No method or SOP criteria specified | If MPC is not met for the field duplicate results >4x RL, a careful examination of the sampling techniques, sample matrix, and analytical method and other analytical QC criteria will be conducted to identify the root cause of the high RPD and the usability of the data. | Field Samplers and Chemist | RPD ≤30% (water)  RPD ≤50% (soil) |
| Surrogates (DMCs) | Each field and QC sample | Statistically-derived laboratory control limits | Investigate reason for poor surrogate recovery.  CA includes:   * Re-extract the sample to confirm the problem is with the sample matrix and not the extraction. Report both sets of results if the re-extraction confirms the initial analysis. Otherwise, report only the compliant analysis. * Document surrogate outliers on Form 2 and in the case narrative. | Analyst | %R within statistically-derived laboratory control limits |
| Internal Standards (IS) | Each field and QC sample | IS Area in the sample within -50% to +100% of the IS area in the opening CCV | Investigate reason for poor IS performance.  If failure is due to instrument performance, the problem must be identified, corrected, and the sample must be reanalyzed.   * CA includes: * Reanalyze sample and if upon reanalysis the IS area in the sample is still not within limits, report both the initial and reanalysis in the data package to document matrix interference. * Document surrogate outliers on Form 8 and in the case narrative. | Analyst | IS area in the sample within - 50% to +100% of the IS area in the opening CCV |
| Cooler Temperature Indicator | One per cooler | ≤6°C (not frozen) | Laboratory to notify Project Chemist and confirm whether to proceed with analysis. Resampling may be required. | Laboratory Sample Custodian/ Project Chemist | ≤6°C (not frozen) |

Notes:

Laboratory SOPs are retained on file..

|  |  |
| --- | --- |
| %R | percent recovery |
| CCV | Continuing Calibration Verification |
| DMC | Deuterated Monitoring Compound |
| GC/MS | Gas Chromatography/Mass  Spectrometry |
| LEB | Leachate Extraction Blank |
| MCL | Maximum Contaminant Level |
| MPC | Measurement Performance Criteria |
| PAH | Polycyclic Aromatic Hydrocarbons |
| QAM | Quality Assurance Manager |
| QC | Quality Control |
| RL | Reporting Limit |
| RPD | relative percent difference |
| SOP | Standard Operating Procedure |
| SPLP | Synthetic Precipitation Leaching  Procedure |
| SVOC | Semivolatile Organic Compound |
| TCLP | Toxicity Characteristic Leaching  Procedure |
| VOC | Volatile Organic Compound |

## WORKSHEET #28.3: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION – OC PESTICIDES AND HERBICIDES BY GC/ECDQ

| **QC Sample** | **Number/ Frequency** | **Method/SOP Acceptance Criteria** | **Corrective Action (CA)** | **Title/position of person Responsible for Corrective Action** | **Project-Specific MPC** |
| --- | --- | --- | --- | --- | --- |
| Method Blank (MB) | 1 per extraction batch | Method criteria same as Project-Specific MPC  */ SOPs vary by laboratory*# | Investigate the source of contamination and eliminate the problem before proceeding with further analysis. (Corrective actions are required only if the samples contain the same contaminant at concentrations exceeding the MPC levels.) CA includes:   * Re-extract and reanalyze the samples if sufficient sample volume remains. * Flag (qualify) the sample result. * Document the problem in the case narrative. | Analyst/Prep Analyst | SW-846 8081B and SW-846 8151A: analyte concentrations <RL |
| Equipment blanks and Lot Blanks | 1 per day per type of sampling equipment or 1 per lot of wipes | No criteria specified in method or SOPs | Investigate sources of equipment blank or lot blank contamination after method blank actions are applied and considering other sources of blank contamination.  CA includes:   * Review potential laboratory or field sources of contaminants (including type of water or solvents used to make the field blank). * Once source is identified, QAM or Chemist should share findings with project management and the field team. * Discuss equipment blank or lot blank contamination in EPA deliverables and any impacts on data quality. | Project Manager, Field Samplers, QAM, and Chemist | All analyte concentrations < RL |
| TCLP/SPLP LEB | 1 per TCLP extraction batch | Analysis of LEB required but no method acceptance criteria | None; report results in laboratory data package | Analyst | SW-846 8260C/D: Analysis of LEB required but no MPC |
| Laboratory Control Sample (LCS) | 1 per extraction batch | SW-846 8081A (OC pesticides) and SW-846 8151A (herbicides):  None listed; laboratory must develop statistically-derived laboratory limits.  EPA 508.1: 70-130%R  */ SOPs vary by laboratory #* | Investigate reason for poor LCS recovery. Eliminate problem before proceeding with further analysis.  CA includes:   * If low spike recovery, reanalyze samples under compliant LCS, if sufficient sample volumes are available. * For any low or high LCS outliers, flag (qualify) any analytes in samples from the affected batch. Document the problem in the case narrative. | Analyst and Prep Analyst | SW-846 8151A (herbicides):  Refer to Worksheet 15. 6 |
| Field Duplicate | 1 per 20 field samples of the same matrix | No method or SOP criteria specified | If MPC is not met for the field duplicate results >4x RL, a careful examination of the sampling techniques, sample matrix, and analytical method and other analytical QC criteria will be conducted to identify the root cause of the high RPD and the usability of the data. | Field Samplers and Chemist | RPD ≤30% (water)  RPD ≤50% (soil) |
| Matrix Spike (MS) | 1 per 20 samples of the same matrix, or one per extraction batch | SW-846 8081A (OC pesticides) and SW-846 8151A (herbicides):  None listed; laboratory must develop statistically-derived laboratory limits.  EPA 508.1: 70-130%R  / *SOPs vary by laboratory*# | *The MPC only applies when the sample concentration is < 4x the spike added concentration.* No Laboratory CAs required. (Data validator will qualify data based on %R outliers.) | Analyst/Prep Analyst | SW-846 8151A (herbicides):  within statistically-derived laboratory limits *NOTE: The MPC only applies when the sample concentration is < 4x the spike added concentration.* |
| Matrix Spike Duplicate (MSD) | 1 per 20 samples of the same matrix, or one per extraction batch | Spike %Rs - same as for MS above  Other methods:  None listed; laboratory must develop statistically-derived laboratory limits.  */ SOPs vary by laboratory #* | No required Laboratory CAs. Data validator will qualify data based on RPD exceedances. | Analyst/Prep Analyst | Spike %Rs - same as for MS above  RPDs within statistically-derived laboratory limits |
| Surrogates | Each field and QC sample | None listed; laboratory must develop statistically-derived laboratory limits.  */ SOPs vary by laboratory*# | Investigate reason for poor surrogate recovery. CA includes:  Reanalyze and/or re-extract sample to confirm the problem is with the sample matrix and not the extraction. Report both sets of results if the re- extraction confirms the initial analysis.  Otherwise, report only the compliant analysis. Document surrogate outliers on Form 2 and in the case narrative. | Analyst | %R within statistically-derived laboratory control limits |
| Dual column confirmation | Performed if analytes are detected | Other methods: 40% RPD  */ SOPs vary by laboratory*# | Report sample concentrations and RPDs on Form 10 for each reported analyte. No CA requirement. | Analyst | RPD <40% |
| Cooler Temperature Indicator | One per cooler | ≤6°C (not frozen) | Laboratory to notify Project Chemist and confirm whether to proceed with analysis. Resampling may be required. | Laboratory Sample Custodian/ Project Chemist | ≤6°C (not frozen) |

Notes:

Laboratory SOPs are retained on file..

|  |  |
| --- | --- |
| %R | percent recovery |
| GC/ECD | Gas Chromatography/ Electron Capture Detector |
| LEB | Leachate Extraction Blank |
| MCL | Maximum Contaminant Level |
| MPC | Measurement Performance Criteria |
| MS | Matrix Spike |
| OC | Organochlorine |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| QAM | Quality Assurance Manager |
| QC | Quality Control |
| SOP | Standard Operating Procedure |
| SPLC | Synthetic Precipitation Leaching Procedure |
| TCLP | Toxicity Characteristic Leaching Procedure |

## WORKSHEET #28.4: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION – PCBS AS AROCLORS BY GC/ECD

| **QC Sample** | **Number/ Frequency** | **Method/SOP Acceptance Criteria** | **Corrective Action (CA)** | **Title/position of person Responsible for Corrective Action** | **Project-Specific MPC** |
| --- | --- | --- | --- | --- | --- |
| Method Blank (MB) | 1 per extraction batch | Method criteria same as Project-Specific MPC  */ SOPs vary by laboratory #* | Investigate the source of contamination and eliminate the problem before proceeding with further analysis. (Corrective actions are required only if the samples contain the same contaminant at concentrations exceeding the MPC levels.) CA includes:   * Reanalyze the samples if sufficient sample volume remains. * Flag (qualify) the sample result. Document the problem in the case narrative. | Analyst/Prep Analyst | SW-846 8082A:  analyte concentrations <RL  EPA 608.3:  analyte concentrations <RL |
| Equipment blanks and Lot Blanks | 1 per day per type of sampling equipment or 1 per lot of wipes | No criteria specified in method or SOPs | Investigate sources of equipment blank or lot blank contamination after method blank actions are applied and considering other sources of blank contamination.  CA includes:   * Review potential laboratory or field sources of contaminants (including type of water or solvents used to make the field blank). * Once source is identified, QAM or Chemist should share findings with project management and the field team. * Discuss equipment blank or lot blank contamination in EPA deliverables and any impacts on data quality. | Project Manager, Field Samplers, QAM, and Chemist | All analyte concentrations < RL |
| Laboratory Control Sample (LCS) | 1 per extraction batch | None listed.  */ SOPs vary by laboratory #* | Investigate reason for poor LCS recovery. Eliminate problem before proceeding with further analysis.  CA includes:   * If low spike recovery, reanalyze samples under compliant LCS, if sufficient sample volumes are available. * For any low or high LCS outliers, flag (qualify) any analytes in samples from the affected batch. * Document the problem in the case narrative. | Analyst and Prep Analyst | %R within statistically derived laboratory limits |
| Field Duplicate | 1 per 20 field samples of the same matrix | No method or SOP criteria specified | If MPC is not met for the field duplicate results >4x RL, a careful examination of the sampling techniques, sample matrix, and analytical method and other analytical QC criteria will be conducted to identify the root cause of the high RPD and the usability of the data. | Field Samplers and Chemist | RPD ≤30% (water)  RPD ≤50% (soil) |
| Matrix Spike (MS) | 1 per 20 samples of the same matrix, or one per extraction batch | SW-846 8082A: None listed; laboratory must develop statistically derived laboratory limits. EPA 608.3: none listed */ SOPs vary by laboratory #* | The MPC only applies when the sample concentration is <4x the spike added concentration.  No Laboratory CAs required. (Data validator will qualify data based on %R outliers.) | Analyst/Prep Analyst | %R within statistically derived laboratory limits |
| Matrix Spike Duplicate (MSD) | 1 per 20 samples of the same matrix, or one per extraction batch | Spike %Rs - same as for MS above None listed; laboratory must develop statistically- derived laboratory limits. */ SOPs vary by laboratory #* | No required Laboratory CAs. Data validator will qualify data based on RPD exceedances. | Analyst/Prep Analyst | Spike %Rs - same as for MS above  RPDs within statistically derived laboratory limits |
| Surrogates | Each field and QC sample | Statistically derived laboratory control limits | Investigate reason for poor surrogate recovery.  CA includes:   * Reanalyze and/or re-extract sample to confirm the problem is with the sample matrix and not the extraction. Report both sets of results if the re-extraction confirms the initial analysis. Otherwise, report only the compliant analysis. * Document surrogate outliers on the CLP Form 2 and in the case narrative. | Analyst | %R within statistically derived laboratory control limits |
| Dual column confirmation | Performed if analytes are detected | 40% RPD / *SOPs vary by laboratory #* | Report sample concentrations and RPDs on Form 10 for each reported analyte. No CA requirement. | Analyst | RPD <40% |
| Cooler Temperature Indicator | One per cooler | ≤6°C (not frozen) | Laboratory to notify Project Chemist and c onfirm whether to proceed with analysis. Resampling may be required. | Laboratory Sample Custodian/ Project Chemist | ≤6°C (not frozen) |

Notes:

Laboratory SOPs are retained on file.

|  |  |
| --- | --- |
| %R | percent recovery |
| CRQL | Contract Required Quantitation Limit |
| CLP | Contract Laboratory Program |
| GC/ECD | Gas Chromatography/ Electron Capture Detector |
| MPC | Measurement Performance Criteria |
| MS | Matrix Spike |
| PCB | Polychlorinated Biphenyl |
| QAM | Quality Assurance Manager |
| QC | Quality Control |

## WORKSHEET #28.5: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION – GRO, DRO, AND ORO BY GC/FID

| **QC Sample** | **Number/ Frequency** | **Method/SOP Acceptance Criteria** | **Corrective Action (CA)** | **Title/position of person Responsible for Corrective Action** | **Project-Specific MPC** |
| --- | --- | --- | --- | --- | --- |
| Method Blank (MB | 1 per extraction batch | Method criteria same as Project-Specific MPC */ SOPs vary by laboratory* | Investigate the source of contamination and eliminate the problem before proceeding with further analysis. (Corrective actions are required only if the samples contain the same contaminant at concentrations exceeding the MPC levels.)  CA includes:   * Reanalyze the samples if sufficient sample volume remains. * Flag (qualify) the sample result. * Document the problem in the case narrative. | Analyst | SW-846 8015A:  analyte concentrations < RL |
| Trip Blank | 1 per cooler containing GRO sample | No criteria specified in method or SOP. | Investigate sources of trip blank contamination after method blank actions are applied and considering field blank contamination.  CA includes:   * Review potential laboratory or field sources of contaminants (including type of water used to make the trip blank). * Once identified, QAM or Chemist should share findings with project management and the field team. * Discuss trip blank contamination in EPA deliverables and any impacts on data quality. | Project Manager, Field Samplers, QAM, and Chemist | Analyte concentrations <RL |
| Equipment blank (or Ambient Field Blanks) | 1 per day per type of non-dedicated sampling equipment | No criteria specified in method or SOPs | Investigate sources of field blank contamination after method blank actions are applied and considering trip blank contamination.  CA includes:   * Review potential laboratory or field sources of contaminants (including type of water used to make the field blank). * Once source is identified, QAM or Chemist should share findings with project management and the field team. * Discuss blank contamination in EPA deliverables and any impacts on data quality. | Project Manager, Field Samplers, QAM, and Chemist | Analyte concentrations <RL |
| Laboratory Control Sample (LCS) | 1 per extraction batch | None listed; laboratory must develop statistically- derived laboratory limits. */ SOPs vary by laboratory* # | Investigate reason for poor LCS recovery. Eliminate problem before proceeding with further analysis.  CA includes:   * If low spike recovery, reanalyze samples under compliant LCS, if sufficient sample volumes are available. * For any low or high LCS outliers, flag (qualify) sample concentrations from the affected batch. * Document the problem in the case narrative. | Analyst and Prep Analyst | %R within statistically derived laboratory limits |
| Field Duplicate | 1 per 20 field samples of the same matrix | No method or SOP criteria specified | If MPC is not met for the field duplicate results >4x RL, a careful examination of the sampling techniques, sample matrix, and analytical method and other analytical QC criteria will be conducted to identify the root cause of the high RPD and the usability of the data. | Field Samplers and Chemist | RPD ≤30% (water)  RPD ≤50% (soil) |
| Matrix Spike (MS) | 1 per 20 samples of the same matrix, or one per extraction batch | SW-846 8015B: None listed; laboratory must develop statistically derived laboratory limits. */ SOPs vary by laboratory* # | *The MPC only applies when the sample concentration is <4x the spike added concentration.* No Laboratory CAs required. (Data validator will qualify data based on %R outliers.) | Analyst/Prep Analyst | SW-846 8015C/D:  within statistically- derived laboratory limits |
| Matrix Spike Duplicate (MSD) | 1 per 20 samples of the same matrix, or one per extraction batch | Spike %Rs - same as for MS above SW-846 8015C/D: None listed; laboratory must develop statistically derived laboratory limits. */ SOPs vary by laboratory* # | No required Laboratory CAs. Data validator will qualify data based on RPD exceedances. | Analyst/Prep Analyst | Spike %Rs - same as for MS above  RPDs within statistically derived laboratory limits |
| Surrogates | Each field and QC sample | %R within statistically derived laboratory control limits | Investigate reason for poor surrogate recovery.  CA includes:   * Reanalyze and/or re-extract sample to confirm the problem is with the sample matrix and not the extraction. Report both sets of results if the re-extraction confirms the initial analysis. Otherwise, report only the compliant analysis. * Document surrogate outliers on Form 2 and in the case narrative. | Analyst | %R within statistically-derived laboratory control limits |
| Cooler Temperature Indicator | One per cooler | ≤6°C (not frozen) | Laboratory to notify Project Chemist and confirm whether to proceed with analysis. Resampling may be required. | Laboratory Sample  Custodian/ Project Chemist | ≤6°C (not frozen) |

Notes:

Laboratory SOPs are retained on file.

|  |  |
| --- | --- |
| %R | percent recovery |
| DRO | Diesel Range Organic |
| GC/FID | Gas Chromatography/Flame Ionization Detector |
| GRO | Gasoline Range Organic |
| MCL | Maximum Contaminant Level |
| MPC | Measurement Performance Criteria |
| MS | Matrix Spike |
| ORO | Oil Range Organic |
| QAM | Quality Assurance Manager |
| QC | Quality Control |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| SOP | Standard Operating Procedure |
| VOC | Volatile Organic Compound |

## WORKSHEET #28.6: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION – INORGANICS (METALS, MERCURY, AND CYANIDE)

| **QC Sample** | **Number/ Frequency** | **Method/SOP Acceptance Criteria** | **Corrective Action (CA)** | **Title/position of person Responsible for Corrective Action** | **Project-Specific MPC** |
| --- | --- | --- | --- | --- | --- |
| Method Blank (MB) | 1 per digestion batch | Method criteria same as Project-Specific MPC  */ SOPs vary by laboratory #* | Investigate the source of contamination and eliminate the problem before proceeding with further analysis. (Corrective actions are required only if the samples contain the same contaminant at concentrations exceeding the MPC levels.) CA includes:   * Reanalyze the samples if sufficient sample volume remains. * Flag (qualify) the sample result. * Document the problem in the case narrative. | Analyst | Blank analyte concentrations < RL |
| TCLP/SPLP LEB | 1 per TCLP or SPLP extraction batch | Analysis of LEB required but no method acceptance criteria | None; report results in laboratory data package | Analyst | SW-846 6010C/D, SW-846 7470A: Analysis of LEB required but no MPC |
| Equipment Blank | 1 per day per type of non-dedicated sampling equipment | No criteria specified in method or SOPs | Investigate sources of field blank contamination after method blank actions are applied and considering trip blank contamination. CA includes:   * Review potential laboratory or field sources of contaminants (including type of water used to make the field blank). * Once source is identified, QAM or Chemist should share findings with project management and the field team. * Discuss blank contamination in EPA deliverables and any impacts on data quality. | Project Manager, Field Samplers, QAM, and Chemist | Analyte concentrations <RL |
| Laboratory Control Sample (LCS) | 1 per digestion batch | Laboratory must develop statistically derived laboratory limits. */ SOPs vary by laboratory* # | Investigate reason for poor LCS recovery. Eliminate problem before proceeding with further analysis. CA includes:   * If low spike recovery, reanalyze samples under compliant LCS, if sufficient sample volumes are available. * For any low or high LCS outliers, flag (qualify) sample concentrations from the affected batch. Document the problem in the case narrative. | Analyst and Prep Analyst | %R within statistically derived laboratory limits |
| Field Duplicate | 1 per 20 field samples of the same matrix | No method or SOP criteria specified | If MPC is not met for the field duplicate results >4x RL, a careful examination of the sampling techniques, sample matrix, and analytical method and other analytical QC criteria will be conducted to identify the root cause of the high RPD and the usability of the data. | Field Samplers and Chemist | RPD ≤30% (water)  RPD ≤50% (soil) |
| Matrix Spike (MS) and post- digestion spike (PDS) | 1 per 20 samples of the same matrix, or one per extraction batch | None listed; laboratory must develop statistically derived laboratory limits. */ SOPs vary by laboratory #* | Laboratory CA required if %Rs outside of QC limits:  Perform a post-digestion spike (PDS) and flag sample results in the digestion batch. (Data validator will qualify sample data based on spike recovery outliers for the MS and PDS.) | Analyst/Prep Analyst | % R within statistically derived laboratory limits |
| Laboratory Duplicate (D) | 1 per 20 samples or one for each extraction batch | None listed; laboratory must develop statistically derived laboratory limits. */ SOPs vary by laboratory* # | Laboratory CA is to flag sample results for analytes for which the MPC are not met. | Analyst/Prep Analyst | RPD within statistically derived laboratory limits |
| Cooler Temperature Indicator | One per cooler | ≤6°C (not frozen) | Laboratory to notify Project Chemist and confirm whether to proceed with analysis. Resampling may be required. | Laboratory Sample Custodian/ Project Chemist | ≤6°C (not frozen) |

Notes:

Acceptance criteria for LCSs and MSs are included under the appropriate method in Section 15.

Laboratory SOPs are retained on file..

|  |  |
| --- | --- |
| %R | percent recovery |
| LEB | Leachate Extraction Blank |
| MPC | Measurement Performance Criteria |
| QAM | Quality Assurance Manager |
| QC | Quality Control |
| RL | Reporting Limit |
| RPD | relative percent difference |
| SOP | Standard Operating Procedure |
| SPLC | Synthetic Precipitation Leaching Procedure |
| TCLP | Toxicity Characteristic Leaching Procedure |

## WORKSHEET #28.7: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION – DIOXINS/FURANS HRGC/HRMS

| **QC Sample** | **Number/Frequency** | **Method/SOP Acceptance Criteria** | **Corrective Action (CA)** | **Title/position of person Responsible for Corrective Action** | **Project-Specific MPC** |
| --- | --- | --- | --- | --- | --- |
| Method Blank (MB) | 1 per extraction batch | Method criteria same as Project-Specific MPC  Lab SOPs vary by method # | Investigate the source of contamination and eliminate the problem before proceeding with further analysis. (Corrective actions are required only if the samples contain the same contaminant at concentrations exceeding the MPC levels.) CA includes:   * Re-extract and reanalyze the samples if sufficient sample volume remains. * Flag (qualify) the sample result. * Document the problem in the case narrative. | Analyst/Prep Analyst | Analyte concentrations <1/2 RL except for OCDD and OCDF which are allowed concentrations of <3x RL |
| Equipment blanks | 1 per day per type of non-dedicated sampling equipment | No criteria specified in method or SOPs | Investigate sources of equipment blank contamination after method blank actions are applied and considering other sources of blank contamination. CA includes:   * Review potential laboratory or field sources of contaminants (including type of water or solvents used to make the field blank). * Once source is identified, QAM or Chemist should share findings with project management and the field team. * Discuss equipment blank contamination in EPA deliverables and any impacts on data quality. | Project Manager, Field Samplers, QAM, and Chemist | All analyte concentrations < RL |
| Laboratory Control Sample (LCS) | 1 per extraction batch | Method criteria same as Project-Specific MPC | Investigate reason for poor LCS recovery. Eliminate problem before proceeding with further analysis. CA includes:   * If low spike recovery, re-extract and reanalyze samples under compliant LCS, if sufficient sample volumes are available. * For any low or high LCS outliers, flag (qualify) any analytes in samples from the affected batch. Document the problem in the case narrative. | Analyst and Prep Analyst | %R must meet criteria in HRSM02.1 Exhibit D, Table 5 |
| Laboratory Control Sample Duplicate (LCSD) | 1 per extraction batch | Method criteria same as Project-Specific MPC | Re-extraction or reanalysis not required for RPD outlier between the LCS and LCSD. CA includes:   * For any high RPDs, flag (qualify) the analyte in samples from the affected batch. * Document the problem in the case narrative. | Analyst and Prep Analyst | 30%RPD |
| Field Duplicate | 1 per 20 field samples of the same matrix | No method or SOP criteria specified | If MPC is not met for the field duplicate results >4x RL, a careful examination of the sampling techniques, sample matrix, and analytical method and other analytical QC criteria will be conducted to identify the root cause of the high RPD and the usability of the data. | Field Samplers and Chemist | RPD ≤30% (water)  RPD ≤50% (soil) |
| Labeled compounds | Each field and QC sample | Limits specified in the method HRSM02.1 | Investigate reason for poor recovery. CA includes:   * Re-extract the sample to confirm the problem is with the sample matrix and not the extraction. Report both sets of results if the re-extraction confirms the initial analysis. Otherwise, report only the compliant analysis. * Document surrogate outliers on the Forms and in the case narrative. | Analyst | Within limits specified in the method HRSM02.1 |
| Cooler Temperature Indicator | One per cooler | ≤6°C (not frozen) | Laboratory to notify Project Chemist and confirm whether to proceed with analysis. Resampling may be required. | Laboratory Sample Custodian/ Project Chemist | ≤6°C (not frozen) |

Notes:

Laboratory SOPs are retained on file.

|  |  |
| --- | --- |
| %R | percent recovery |
| HRGC | High Resolution Gas Chromatography |
| HRMS | High Resolution Mass Spectrometry |
| LCS | Laboratory Control Sample |
| MPC | Measurement Performance Criteria |
| OCDD | Octachlorinated dibenzo-p-dioxin |
| OCDF | Octachlorinated dibenzofuran |
| QAM | Quality Assurance Manager |
| QC | Quality Assurance |
| RL | Reporting Limit |
| RPD | relative percent difference |
| SOP | Standard Operating Procedure |

## WORKSHEET #28.8: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION – CHLORINATED BIPHENYL CONGENERS BY HRGC/HRMS

| **QC Sample** | **Number/Frequency** | **Method/SOP Acceptance Criteria** | **Corrective Action (CA)** | **Title/position of person Responsible for Corrective Action** | **Project-Specific MPC** |
| --- | --- | --- | --- | --- | --- |
| Method Blank (MB) | 1 per extraction batch | Method criteria same as Project-Specific MPC  Lab SOPs vary by method # | Investigate the source of contamination and eliminate the problem before proceeding with further analysis. (Corrective actions are required only if the samples contain the same contaminant at concentrations exceeding the MPC levels.)  CA includes:   * Re-extract and reanalyze the samples if sufficient sample volume remains. * Flag (qualify) the sample result. * Document the problem in the case narrative. | Analyst/Prep Analyst | HRSM02.1:  concentrations for the 12 WHO toxic CBC congeners <1/2 RL |
| Equipment blanks | 1 per day per type of non-dedicated sampling equipment | No criteria specified in method or SOPs | Investigate sources of equipment blank contamination after method blank actions are applied and considering other sources of blank contamination.  CA includes:   * Review potential laboratory or field sources of contaminants (including type of water or solvents used to make the equipment blank). * Once source is identified, QAM or Chemist should share findings with project management and the field team. * Discuss equipment blank contamination in EPA deliverables and any impacts on data quality. | Project Manager, Field Samplers, QAM, and Chemist | All analyte concentrations < RL |
| Laboratory Control Sample (LCS) | 1 per extraction batch | Method criteria same as Project-Specific MPC | Investigate reason for poor LCS recovery. Eliminate problem before proceeding with further analysis. CA includes:   * If low spike recovery, re-extract and reanalyze samples under compliant LCS, if sufficient sample volumes are available. * For any low or high LCS outliers, flag (qualify) any analytes in samples from the affected batch. Document the problem in the case narrative. | Analyst and Prep Analyst | %R must meet criteria in HRSM02.1Table 5 |
| Laboratory Control Sample Duplicate (LCSD) | 1 per extraction batch | Method criteria same as Project-Specific MPC | Re-extraction or reanalysis not required for RPD outlier between the LCS and LCSD.  CA includes:   * For any high RPDs, flag (qualify) the analyte in samples from the affected batch. * Document the problem in the case narrative. | Analyst and Prep Analyst | 30% RPD |
| Field Duplicate | 1 per 20 field samples of the same matrix | No method or SOP criteria specified | If MPC is not met for the field duplicate results >4x RL, a careful examination of the sampling techniques, sample matrix, and analytical method and other analytical QC criteria will be conducted to identify the root cause of the high RPD and the usability of the data. | Field Samplers and Chemist | RPD ≤30% (water) RPD ≤50% (soil) |
| Labeled congeners | Each field and QC sample | Limits specified in the method HRSM02.1 | Investigate reason for poor recovery. CA includes:   * Re-extract the sample to confirm the problem is with the sample matrix and not the extraction. Report both sets of results if the re-extraction confirms the initial analysis. Otherwise, report only the compliant analysis. * Document surrogate outliers on the Forms and in the case narrative. | Analyst | Within limits specified in the method HRSM02.1 |
| Cooler Temperature Indicator | One per cooler | ≤6°C (not frozen) | Laboratory to notify Project Chemist and confirm whether to proceed with analysis. Resampling may be required. | Laboratory Sample Custodian/ Project Chemist | ≤6°C (not frozen) |

Notes:

Laboratory SOPs are retained on file.

|  |  |
| --- | --- |
| %R | percent recovery |
| CBC | Chlorinated Biphenyl Congener |
| HRGC | High Resolution Gas Chromatography |
| HRMS | High Resolution Mass Spectrometry |
| MPC | Measurement Performance Criteria |
| QAM | Quality Assurance Manager |
| QC | Quality Control |
| RL | Reporting Limit |
| RPD | Relative percent difference |
| SOP | Standard Operating Procedure |
| WHO | World Health Organization |

## WORKSHEET #29: PROJECT DOCUMENTS AND RECORDS

***Itemize the information and records which must be included in the data report package and specify the reporting format for hard copy and any electronic forms. Records can include raw data, data from other sources such as data bases or literature, field logs, sample preparation and analysis logs, instrument printouts, model input and output files, and results of calibration and QC checks.***

***Identify any other records and documents applicable to the project that will be produced, such as audit reports, interim progress reports, and final reports. Specify the level of detail of the field sampling, laboratory analysis, literature or data base data collection, or modeling documents or records needed to provide a complete description of any difficulties encountered.***

***Specify or reference all applicable requirements for the final disposition of records and documents, including location and length of retention period.***

***The following examples are neither prescriptive nor comprehensive. The information must be edited as necessary to accurately reflect the organization-specific project records that will be maintained and the policies and procedures that will be followed.***

Sample Collection and Field Records

| **Record** | **Generation** | **Verification** | **Storage Location/Archival** |
| --- | --- | --- | --- |
| Field Notebook: daily observations and notes, personnel on site, tailgate meetings, communications with EPA or state agency representatives, unusual incidents, recording of sample collection dates and times including parameters, preservation, and sketch of sampling locations and/or GPS coordinates, etc. | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Site Maps | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Soil boring/coring logs: soil lithology, sample depth, groundwater depth, and other observations. | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Water Quality Readings: pH, temperature, dissolved oxygen (DO), turbidity, and oxidation-reduction potential (ORP). | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Monitoring Instrument Readings including calibration records (PID, FID, CGI/O2, radiation detectors, etc.) | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Data usability assessments | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Field Screening Reports | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Data analyses | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Instrument maintenance records | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Field surveys | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| COC | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Sample Tags | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Custody seals | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Airbill | [Responsible Personnel] | [Responsible Personnel] | [Location] |

Notes:

|  |  |
| --- | --- |
| CGI/O2 | Combustible Gas Indicator/ Oxygen |
| COC | Chain-of-Custody |
| FID | Flame Ionization Detector |
| GIS | Geographical Information System |
| GPS | Global Positioning System |
| PID | Photoionization Detector |
| XRF | X-Ray Fluorescence |

**Project Assessments**

|  |  |  |  |
| --- | --- | --- | --- |
| **Record** | **Generation** | **Verification** | **Storage Location/Archival** |
| Field Audit Checklists (for field operations, logbooks, etc.) | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Data validation reports | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Trip reports | [Responsible Personnel] | [Responsible Personnel] | [Location] |
| Progress Reports | [Responsible Personnel] | [Responsible Personnel] | [Location] |

Laboratory Records\*

|  |  |  |  |
| --- | --- | --- | --- |
| **Record** | **Generation** | **Verification** | **Storage Location/Archival** |
| Laboratory data packages | [Responsible Personnel] | [Responsible Personnel] | [Location] |

Notes:

|  |  |
| --- | --- |
| POC | Point of Contact |
| QAM | Quality Assurance Manager |

\* Laboratory records include the following:

***Edit this list as necessary***

|  |
| --- |
| Sample Receipt/Condition Reports |
| Field Chain-of-Custody (COCs) |
| Internal Chains-of-Custody (COCs) |
| Laboratory Information Management System (LIMS) login information |
| Extraction bench sheets |
| Instrument run logs |
| Standards preparation records and traceability records (including certificates) |
| Instrument Calibration and Maintenance records |
| Non-Conformance Records |
| Communication records (emails, phone logs) |
| Quality Control (QC) sample reports |
| Laboratory data qualifiers |
| Electronic Data Deliverables |
| Case narrative |
| Sample Cross-reference table |
| Quality Assurance/Quality Control (QA/QC) forms |
| Method Detection Limit/Reporting Limit (MDL/RL) studies |
| Laboratory Accreditations/Certifications |
| Quality Assurance Manual |
| Analytical Standard Operating Procedures (SOPs) |
| Sample Disposal Records |
| Control Charts |

## WORKSHEET #31, 32 & 33: ASSESSMENTS, CORRECTIVE ACTION & QA MANAGEMENT REPORTS

***The following examples are neither prescriptive nor comprehensive. The information must be edited as necessary to accurately reflect the organization-specific assessments that will be conducted, the responsible personnel, timelines, and the policies and procedures that will be followed.***

### Assessments

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Assessment Type** | **Responsible Party & Organization** | **Number/Fre****quency/ Estimated dates** | **Assessment Deliverable** | **Deliverable Due Date** |
| Review of QAPP with Field Staff | [Responsible Party] | [Number/Frequency/ Estimated dates] | [Deliverable] | [Due Date] |
| QC of Daily Field Reporting and Field Forms/logbooks and review against FSP requirements | [Responsible Party] | [Number/Frequency/ Estimated dates] | [Deliverable] | [Due Date] |
| Daily Tailgate Safety Meeting | [Responsible Party] | [Number/Frequency/ Estimated dates] | [Deliverable] | [Due Date] |
| Field TSA Audits | [Responsible Party] | [Number/Frequency/ Estimated dates] | [Deliverable] | [Due Date] |
| Logbook Audit | [Responsible Party] | [Number/Frequency/ Estimated dates] | [Deliverable] | [Due Date] |
| Laboratory Report Deliverables – verification of data package completeness, analytical compliance, and data correctness (also see Worksheet #34) | [Responsible Party] | [Number/Frequency/ Estimated dates] | [Deliverable] | [Due Date] |
| Data validation review for all project data - Assess problems with samples or analysis, laboratory performance, sampling issues resulting in rejected or qualified data, field blank contamination. (also see Worksheet #35/36) | [Responsible Party] | [Number/Frequency/ Estimated dates] | [Deliverable] | [Due Date] |
| Data Validation (also see Worksheet #35/36) | [Responsible Party] | [Number/Frequency/ Estimated dates] | [Deliverable] | [Due Date] |
| Management reviews | [Responsible Party] | [Number/Frequency/ Estimated dates] | [Deliverable] | [Due Date] |

### Assessment Response and Corrective Action

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Assessment Type** | **Responsibility for Responding to Assessment Findings** | **Assessment Response Documentation** | **Timeframe for Response** | **Responsibility for Implementing Corrective Action** | **Responsible for Monitoring Corrective Action Implementation** |
| Field Sampling TSA | [Responsible Party] | [Assessment Response Documentation] | [Timeframe for Response] | [Responsible Party] | [Responsible Party] |
| Logbook audit | [Responsible Party] | [Assessment Response Documentation] | [Timeframe for Response] | [Responsible Party] | [Responsible Party] |
| Data Validation | [Responsible Party] | [Assessment Response Documentation] | [Timeframe for Response] | [Responsible Party] | [Responsible Party] |
| Management reviews | [Responsible Party] | [Assessment Response Documentation] | [Timeframe for Response] | [Responsible Party] | [Responsible Party] |

### QA Management Reports

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Type of Report** | **Frequency (daily, weekly, monthly, quarterly, annually, etc.)** | **Projected Delivery** | **Person(s) Responsible for Report Preparation (Name, Title, Organization)** | **Report Recipient(s) (Title and Organization)** |
| Monthly progress report | Monthly | Monthly | [Responsible Party] | [Report Recipients] |
| Annual quality report | Annual | [Within \_\_\_\_\_\_\_\_\_\_\_\_\_] | [Responsible Party] | [Report Recipients] |

Notes:

|  |  |
| --- | --- |
| EPA | U.S. Environmental Protection Agency |
| FSP | Field Sampling Plan |
| FTL | Field Team Leader |
| PM | Program Manager |
| QA | Quality Assurance |
| QAM | Quality Assurance Manager |
| QAPP | Quality Assurance Project Plan |
| TSA | Technical Systems Audit |

## WORKSHEET #34: DATA VERIFICATION AND VALIDATION INPUTS

Project inputs include programmatic and site-specific planning documents, field records, and laboratory records. Verification is a check that all specified activities involved in collecting and analyzing samples have been completed and documented, and all necessary records (objective evidence) are available to proceed to data validation.

Validation is the evaluation of conformance to stated requirements, including those included in the methods, SOPs, and the QAPP. Examples of records subject to verification and validation are listed below. The actual inputs required should be based on the graded approach, as defined during project planning.

***The following examples are neither prescriptive nor comprehensive. The information must be edited as necessary to accurately reflect the organization-specific data verification and data validation activities that will be conducted, the responsible personnel, and the policies and procedures that will be followed.***

***EPA Region 3 uses the graded approach to evaluate QAPPs. Depending on the project’s scope and objectives, some of the data verification and validation inputs listed below may not be applicable to every project. Please delete or add items to accurately reflect the organization-specific procedures that are followed.***

### Program Planning Documents / Records

| **Item** | **Description** | **Description** | **Verification check (completeness) by (person responsible)** | **Validation check (conformance to specifications) by (person responsible)** |
| --- | --- | --- | --- | --- |
| 1 | Approved QAPP | QAPP  *A copy of the reviewed and approved version of the QAPP will be distributed to the laboratories and be available for review by all personnel involved in this project. The Laboratory QA Manager is responsible for review of the QAPP with laboratory staff. The Project Manager will be responsible for ensuring that all staff have reviewed the final QAPP.* | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 4 | Field SOPs | Sample collection and field operations SOPs | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 5 | Health & Safety | Project health and safety plan | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 6 | Laboratory SOPs and QAM | Tier IV Laboratory QAMs and SOPs for each method/subcontracted analysis. | Yes or N/A [Responsible Personnel] | Yes or N/A Personnel] |
| 7 | Field Staff Training | Training records of any required project-specific training | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 8 | Site-specific Worksheets & Plans | The site-specific CSMs, DQOs, and sampling plans will be prepared by the Project Manager and reviewed by the Project Chemist and the Quality Assurance Manager prior to submitting to EPA for approval. All on-site and sampling personnel will be provided a copy of the site-specific plans by the Project Manager and must review the plans prior to mobilizing to the site. | Yes or N/A [Responsible Personnel] | Yes or N/A  [Responsible Personnel] |
| 10 | Laboratory Accreditation | All laboratories providing analytical services for this project will have the required laboratory accreditations as specified in this document. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |

### Field Records

| **Item** | **Description** | **Description** | **Verification check (completeness) by (person responsible)** | **Validation check (conformance to specifications) by (person responsible)** |
| --- | --- | --- | --- | --- |
| 11 | Field Logbooks | Site-specific logbooks will be assigned for long-term site investigations. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 12 | Equipment calibration Records | Equipment calibrations are recorded in site logbooks. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 13 | COC Forms | A review of the COC forms for completeness and accuracy will be conducted. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 14 | Sample Location Verification and Site maps and sampling diagrams | The Project Manager and Field Team Leader will verify/confirm that field staff have collected the samples from the proper locations and depths described in the site-specific sampling plans. Site maps and sampling diagrams based on the site sketches recorded in the site logbook. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 15 | Drilling / boring logs | Drilling and boring logs for final deliverables are prepared by field staff or technical staff from the field copies of boring logs. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 16 | Site surveys | Surveyor reports are prepared as a final deliverable by the subcontractor. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 17 | Geophysical surveys | Geophysical survey reports are received from the subcontracted firm | Yes or N/A [Responsible Personnel] | Yes or N/A  [Responsible Personnel] |
| 18 | Correspondence | Letters, reports, emails, etc. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 19 | Field Corrective Action Reports | Corrective Action reports may be prepared as the result of a field audit or unusual site event during site activities. | Yes or N/A Responsible Personnel] | Yes or N/A [Responsible Personnel] |

### Analytical Data Package

| **Item** | **Description** | **Description** | **Verification check (completeness) by (person responsible)** | **Validation check (conformance to specifications) by (person responsible)** |
| --- | --- | --- | --- | --- |
| 20 | Cover page | Identifies laboratory and provides project information | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 21 | Case Narrative and sample cross reference | Case Narrative with sample ID cross reference table | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 22 | Internal COC | Internal COCs document sample transfers between laboratory departments | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 23 | Sample Receipt Records | Sample receipt records may include signed copies of COCs and sample login documents. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 24 | Sample Chronology | Dates of sample receipt, preparation and analysis are included within the data package on various QC forms. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 25 | Communication Records | Emails and Telephone logs with specific direction for sample analyses | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 26 | RLs and MDLs | Sample results, elevated due to sample dilution or sample volume limitations, will be reviewed against the site PALs. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 27 | Standards Traceability | Standards preparation logs and standards certificates | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 28 | Instrument Calibration records | ICAL and CCVs standards results | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 29 | Definition of Lab qualifiers | Laboratory qualifiers definitions | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 30 | Result Report Forms | CLP-like Form Is for each field sample analyzed | Yes or N/A Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 31 | QC Summary Forms | QC Summary forms present for surrogates, internal standards, LCS/LCSD, MS/MSD, S/D, tune, run log, ICSA/ICSAB | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 32 | Corrective Action Reports | CA Reports are typically written after receipt and review of the analytical data package and only when a deficiency has been identified in analytical procedures related to the data package. The CA report should be included with the data package in the file. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 33 | Raw data | Instrument raw data may include chromatograms, quantitation reports, spectra, strip charts, GPC records, bench sheets, sample preparation and analysis log pages. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |
| 34 | Electronic Data Deliverables (EDD) | Laboratory-provided EDDs as specified for the site-specific analytical procurement. | Yes or N/A [Responsible Personnel] | Yes or N/A [Responsible Personnel] |

### Data Validation Reports

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item | Description | Description | Verification check (completeness) by (person responsible) | Validation check (conformance to specifications) by (person responsible) |
| 35 | Data Validation Deliverables | Laboratory data packages are validated by [a third-party data validator or subcontractor], and deliverables include pdf versions of the validation report, a Sample Summary Report with validation qualifiers applied based on the data validation, and an Excel EDD containing the data validation qualifiers. | Yes or N/A  [Responsible Personnel] | Yes or N/A  [Responsible Personnel] |

Notes:

|  |  |
| --- | --- |
| CA | Corrective Action |
| CCV | Continuing Calibration Verification |
| CLP | Contract Laboratory Program |
| COC | Chain-of-Custody |
| DAS | Delivery of Analytical Services |
| EDD | Electronic Data Deliverable |
| GIS | Geographic Information System |
| GPC | Gel Permeation Chromatography |
| HAZ-WOPER | Hazardous Waste Operations /Emergency Response |
| ICAL | Initial Calibration |
| ICSA | Interference Check Solution A |
| ICSAB | Interference Check Solution AB |
| LCS | Laboratory Control Sample |
| LCSD | Laboratory Control Sample Duplicate |
| MDL | Method Detection Limit |
| MS | Matrix Sample |
| MSD | Matrix Sample Duplicate |
| PAL | Project Action Levels |
| PE | Performance Evaluation |
| PM | Program Manger |
| POC | Point of Contact |
| QA | Quality Assurance |
| QAM | Quality Assurance Manual |
| QAM | Quality Assurance Manager |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| QMP | Quality Management Plan |
| RL | Reporting Limit |
| S/D | Sample/Duplicate |
| SOP | Standard Operating Procedure |
| SWP | Safe Work Practice |
| XRF | X-Ray Fluorescence |

## WORKSHEET #35: DATA VERIFICATION PROCEDURES

This worksheet documents procedures used to verify project data and applies to both field and laboratory records. Data verification is a completeness check to confirm that all required activities were conducted, all specified records are present, and the contents of the records are complete. Verification is often performed at more than one step by more than one person.

***The following examples are neither prescriptive nor comprehensive. The information should be edited as necessary to accurately reflect the organization-specific data verification activities that will be conducted, the responsible personnel, and the policies and procedures that will be followed.***

***EPA Region 3 uses the graded approach to evaluate QAPPs. Depending on the project’s scope and objectives, some of the data verification procedures listed below may not be applicable to every project. Please delete or add items to accurately reflect the organization-specific procedures that are followed.***

| **Records Reviewed** | **Required Documents** | **Process Description** | **Responsible Person (Organization)** |
| --- | --- | --- | --- |
| Field or Personal Logbook | QAPP, Field Documentation SOP | Verify that:   * Daily entries are completed for each day of field activities. * All planned samples including field QC samples were collected. * All sample locations are documented in the logbook. * Meteorological data were included for each day of field activities. * Any changes/exceptions from the site-specific plans are documented. * Field instruments were calibrated, and field monitoring was performed, and results are documented. | [Responsible Person (Organization)] |
| COCs Sample tag/bottle labels | Sample Handling and Custody SOP, CLP Sampler’s Guide, EPA R3-specific requirements | Verify that all data elements for the COCs and sample tags listed on the COC checklist are present and correct. Verify consistency with the field logbook and that appropriate sample volumes have been collected. Verify that all required signatures and dates are present, including those of reviewers. Check for transcription errors. | [Responsible Person (Organization)] |
| Analytical Data Packages | QAPP, COC | Verify that:   * All applicable data elements in Worksheet 34 data elements are included in the data package. * All field sample results are reported and laboratory results are complete. * Sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported. * Project Quantitation Limits are less than or equal to the project action limits as specified in the site-specific DQOs and sampling plans. * Verify that necessary signatures and dates are present. | [Responsible Person (Organization)] |
| Data Validation Deliverables | QAPP, COC | Verify that the report consists of the following for all field samples submitted to the laboratory:   * Data validation report (PDF) * Sample Summary Report with data validation qualifiers * Excel EDD file with data validation qualifiers | [Responsible Person (Organization)] |
| Audit reports, Corrective Action reports | QAPP | Verify that all planned audits were conducted. Examine audit reports. For any deficiencies noted, verify that corrective action was implemented according to the plan. | [Responsible Person (Organization)] |

Notes:

|  |  |
| --- | --- |
| CLP | Contract Laboratory Program |
| COC | Chain-of-Custody |
| EDD | Electronic Data Deliverable |
| EPA | U.S. Environmental Protection Agency |
| FSP | Field Sampling Plan |
| PDF | Portable Data Format |
| QC | Quality Control |
| QAM | Quality Assurance Manager |
| QAPP | Quality Assurance Project Plan |
| SOP | Standard Operating Procedure |

## WORKSHEET #36: DATA VALIDATION PROCEDURES

***The following information is neither prescriptive nor comprehensive. The information must be edited as necessary to accurately reflect the project-specific and organization-specific data validation activities that will be conducted and the policies and procedures that will be followed. If data validation procedures are contained in an SOP or other document, the procedures should be referenced on this worksheet and included as an attachment to the QAPP.***

***EPA Region 3 uses the graded approach to evaluate QAPPs. Depending on the project’s scope and objectives, some of the data validation procedures listed below may not be applicable to every project. Please delete or add items to accurately reflect the project-specific procedures that are followed.***

This worksheet documents procedures that will be used to validate project data. Data validation is an analyte and sample-specific process for evaluating compliance with contract requirements, methods/SOPs, and MPC. The scope of data validation needs to be defined during project planning because it affects the type and level of documentation required for both field and laboratory activities. The data validation levels described below use terminology contained in *Guidance for Labeling Externally Validated Laboratory Data for Superfund Use*, EPA 540-R-08-005, which was developed to promote the use of consistent terminology by external data reviewer to describe the scope and content of data review activities. Of particular importance, third party data validation should NOT include the rejection of data (noted by the designation of the “R” data qualifier). Data validation should note when performance criteria are not met but the final rejection of any data and their use is a decision reserved specifically for the project team.

Analytical data packages will undergo data validation at a level commensurate with the project’s needs, which will be determined during the project planning phase and specified in the site-specific plans and data quality objectives. Data validation levels may include the following:

* Stage 1 Validation is a verification and validation based only on completeness and compliance of sample receipt condition checks.
* Stage 2A Validation is a verification and validation based on completeness and compliance checks of sample receipt conditions and only sample-related QC results.
* Stage 2B is verification and validation based on completeness and compliance checks of sample receipt conditions and both sample-related and instrument-related QC results.
* Stage 3 Validation is a verification and validation based on completeness and compliance checks of sample receipt conditions, both sample-related and instrument-related QC results, and recalculation checks.
* Stage 4 Validation is a verification and validation based on completeness and compliance checks of sample receipt conditions, both sample-related and instrument-related QC results, recalculation checks, and the review of actual instrument outputs.

The recommended minimum baseline checks conducted for each stage of analytical data verification and validation are described in more detail in *Guidance for Labeling Externally Validated Laboratory Data for Superfund Use*, EPA 540-R-08-005

Using higher stages of analytical verification and validation does not typically result in higher data quality. However, the quality of the analytical data becomes more transparent as more stages of verification and validation are conducted. As a result, the usability of the analytical data for its intended use becomes more apparent.

The validation “stages” referenced above specify which data elements are reviewed, which allows a staged approach to data validation. EPA Region 3 currently uses the following guidance documents for data validation:

* **Organic Data for CLP SOW SFAM01.1:** *National Functional Guidelines for Organic Superfund Methods Data Review.* EPA 540-R-20-005 (EPA, November 2020)
* **Inorganic Data for CLP SOW SFAM01.1:** *National Functional Guidelines for Inorganic Superfund Methods Data Review.* EPA 540-R-20-006 (EPA, November 2020)
* **Dioxin/Furan and PCB Congener Data for CLP SOW HRSM02**.1: *National Functional Guidelines for High Resolution Superfund Methods Data Review.* EPA 542-R-20-007 (EPA, November 2020)

For sites entering State-specific cleanup programs, State-produced guidance should be consulted to identify potential State-required data validation requirements.

## WORKSHEET #37: DATA USABILITY ASSESSMENT

Data usability assessments will be performed in general accordance with EPA guidance QA/G-9R, *Data Quality Assessment, A Reviewer's Guide* (EPA/240/B-06/002) (EPA February 2006) and *Guidance for Data Usability in Risk Assessment* [Publication No. 9285.7-05FS (EPA, September 1992)], as appropriate. This worksheet documents procedures that will be used to perform the data usability assessment (DUA). The DUA is performed at the conclusion of data collection activities using the outputs from data verification and data validation (i.e., data of known and documented quality). It is the data interpretation phase, which involves a qualitative and quantitative evaluation of environmental data to determine if the site data are of the right type, quality, and quantity to support the decisions that need to be made. It involves a retrospective evaluation of the systematic planning process and participation by key members of the project team. The DUA evaluates whether underlying assumptions used during systematic planning are supported, sources of uncertainty have been accounted for and are acceptable, data are representative of the population of interest, and the results can be used as intended, with the acceptable level of confidence.

Project personnel who may be involved with the DUA include the [Project Manager, Field Team Leader, QA Manager, Project Chemist]. An overview of steps included in the DUA is as follows:

* **Step 1: Review the project’s objectives and sampling design**: This includes reviewing the DQOs and MPC to make sure they are still applicable. The sampling design should be consistent with stated DQOs.
* **Step 2: Review the data verification and data validation reports**: Graphs, maps, and tables can be prepared to summarize the data. Deviations from activities planned in the site-specific plans should be considered including samples not collected (potential data gaps), holding time exceedances, damaged samples, impact of non-compliant PE sample results, and SOP deviations. The implications of unacceptable QC sample results should be assessed.
* **Step 3**: **Verify the assumptions of the selected statistical method**: Verify whether underlying assumptions for the selected statistical methods are valid. Common assumptions include the distributional form of the data, independence of the data, dispersion characteristics, homogeneity, etc. Depending on the robustness of the statistical method, minor deviations from assumptions usually are not critical to statistical analysis and data interpretation. If serious deviations from assumptions are discovered, then another statistical method may need to be selected.
* **Step 4**: **Implement the statistical method**: Implement the statistical procedures, if specified in site-specific plans, for analyzing the data and review underlying assumptions. For decision project that involve hypothesis testing (e.g., “concentrations of lead in groundwater are below the action level”) consider the consequences for selecting the incorrect alternative; for estimation projects (e.g., establishing a boundary for surface soil contamination), consider the tolerance for uncertainty in measurements.
* **Step 5**: **Document data usability and draw conclusions**: Determine whether the data can be used as intended, considering any deviations and corrective actions. Discuss whether DQOs were achieved based on comparison with the site data quality indicators (DQI). Assess the performance of the sampling design and identify limitations on data use. Update the conceptual site model and document conclusions. Prepare a DUA report or include the data usability summary in the final site report. The DUA can be in the form of text and/or a table.

DQIs and DUAs are described in more detail below.

DQIs are commonly referred to as “PARCCS parameters” and include measurements of precision, accuracy, representativeness, comparability, completeness, and sensitivity. The MPCs in this QAPP establish minimum limits for some of these PARCC parameters. The DUA will reconcile site-specific DQOs with the results of the data collection, including validated analytical results. DQIs aid in the evaluation process and are described in the following subsections.

### Precision

Precision is a measure of the reproducibility of sample results. Two of the most used estimates of precision are the RPD for cases in which only two measurements are available, and the percent relative standard deviation (%RSD) when three or more measurements are available. This is especially useful in normalizing environmental measurements to determine acceptability ranges for precision because it effectively corrects for the wide variability in sample analyte concentrations.

RPD: Precision is frequently represented as the RPD between concentrations of an analyte in laboratory duplicates, field duplicates, MSDs, and LCSDs. RPD is mathematically expressed by the formula:

where:

C1 = First measurement value  
C2 = Second measurement value

**RSD:** Precision, when represented as the %RSD between more than two replicate measurements, is calculated by dividing the standard deviation of the measurements by the mean value for the measurements () then multiplying by 100. For example, the precision between calibration standard Relative Response Factors (RRFs) is evaluated using the %RSD between a minimum of five replicates. %RSD is mathematically expressed by the formula:

The mathematical formula for SD is:

where:

*xi* = each individual value used to calculate the mean  
 = the mean of *n* values  
*n* = the total number of values

### Accuracy/Bias

Accuracy is a measure of how close a measured result is to the true value. Accuracy control limits are established by the analysis of laboratory control samples (LCS) from analyte-free water and solid matrices. The LCS is subjected to all sample preparation and analytical steps. The percent recovery (%R) of each analyte is entered into a database and, when a large enough data set is acquired, statistical control limits are established for each analyte. These statistical control limits are often updated on an annual or semiannual basis, depending on the method. LCS recoveries are used for batch control; if a low LCS recovery is encountered, the corrective action might be to reanalyze or re-extract/reanalyze the field samples in that batch.

The percent recovery (% R) for spiked field sample analysis (e.g., matrix spike) provides a tool for evaluating how well the method worked for the respective matrix. The %R is used to assess a reported result for analytical accuracy and high or low bias. For MS or MSD recoveries outside control limits, batch reanalyses are not usually required unless specified in the analytical method. LCS, LCSD, MS, or MSD outliers will be noted in the case narrative accompanying the sample results.

Percent recovery (%R) is mathematically expressed by the formula:

where:

SR = Spiked sample result   
SR = Sample result  
SA = Spike added

Accuracy and bias for organic calibrations is evaluated using the percent difference (%D), which measures the degree of agreement between the RRF or calibration factor (CF) for the continuing calibration verification (CCV) standard against the initial calibration (ICAL) curve average RRF or average CF. The percent difference (%D) of a CCV from the reference value (ICAL) and is used by the laboratory to document the acceptability of the continuing calibration.

The %D is calculated by expressing, as a percentage, the difference between the original value and new value relative to the original value. Unlike RPD and RSD, %D may be positive or negative. This method for precision measurement can be expressed by the formula:

where:

RRFc = RRF or CF from current CCV   
Mean RRFi = Sample result

### Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. Sitewide completeness goals account for all aspects of sample handling, from collection through data reporting. The level of completeness can be affected by loss or breakage of samples during transport and analysis, as well as external problems that prohibit collection of the sample. Validation qualifiers will be used to assess analytical completeness. When evaluating analytical completeness, usable results include non-qualified and estimated (J-qualified) data; data qualified as rejected (R) are unusable. The general formula used to determine percent completeness is as follows:

where:

A = Number of usable data points  
B = Total number of data points collected

The formula for sampling completeness is:

The formula for analytical completeness is:

The following table lists the completeness goals for the project. If the completeness goal is not met because of controllable circumstances, then the samples will be recollected and reanalyzed, as necessary, to meet the completeness objective. If the completeness goal is not met due to uncontrollable circumstances such as inaccessible sample points, matrix interferences, etc., then the deficiency will be evaluated, and resampling may not be required.

### Project Completeness Goals

|  |  |  |
| --- | --- | --- |
| **Task** | **Subtask** | **Completeness Goal** |
| Sampling | Sample Collection | [XYZ]% |
| Field Measurements | Conductivity | [XYZ]% of applicable collected samples |
| pH/Turbidity/Dissolved Oxygen/  Oxidation-Reduction Potential/Volatile Organic  Compounds | [XYZ]% of applicable collected samples |
| Analytical Measurements | All Laboratory Analyses | [XYZ]% of analytes |
| [XYZ]% of each target analyte |

### Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions and depends on sampling and analytical variability and the variability of environmental media at the site. Data representativeness is accomplished by properly designing the sampling plan and conceptual site model, implementing the approved site-specific sampling plans, following SOPs for sample collection, and by using analytical methods that are appropriate for the intended data uses.

### Comparability

Comparability is the degree to which the quality characteristics of one data set compare to another. Comparability of data sets generated for this project will be obtained through the implementation of standard sampling and analysis procedures, by the use of traceable reference materials for laboratory standards, and by expressing the results in comparable concentration units, and for soil samples, comparing dry weight adjusted results.

### Sensitivity

Sensitivity is the ability of the method or analytical instrument to detect target analytes at the concentration of interest. For acceptable sensitivity, quantitative measurement performance criteria need to be determined during the project planning stage to ensure that the quantitation limits can be routinely achieved for each matrix, analytical parameter, and concentration level. The concentration of the lowest calibration standard establishes the lower limits of the analytical instrument calibration range and RLs are based on this concentration level. To provide adequate analytical sensitivity, EPA recommends that the sample RL be 3 to 10 times less than the PAL established for the site.

### Assessment of Data Usability

The DUA goes beyond validation in that it evaluates the achievement of the DQOs based on a review of the validated analytical data and site DQIs as established in the QAPP or modified by the site-specific plans. The DUA will note any changes to the DQOs necessitated by the data not meeting usability criteria.

### Sampling and Analysis Activities Evaluation

The first step of the DUA will include a review of the sampling and analysis activities in comparison to the activities proposed in the site-specific plans. Data limitations [i.e., results that are qualified as estimated (J/UJ) or rejected (R)] will be documented in the DUA.

### Achievement of DQIs

The second step of DUA assesses the achievement of site-specific DQIs. Validated sample results will be compared to these DQIs and is a critical component of the DUA process. Deviations from planned performance will be documented and evaluated to determine whether corrective action is necessary. Potential corrective actions will range from resampling and/or sample reanalysis, to qualification or exclusion of the data for use. (If corrective action is not possible, the DUA will note any data limitations with regard to achieving the DQOs.)

As part of this step of the DUA assessment, the investigation team will need to make decisions on the use of qualified data for individual sample results and locations. Data usability decisions will be made based on this assessment for the intended purpose. The DUA will describe the uncertainty (e.g., bias, imprecision) of the qualified results. Cumulative QC exceedances may require technical judgment to determine the overall effect on the usability of the data. Decisions about usability of qualified data for use in risk assessment will be based on the referenced EPA documents, which allows for the use of estimated values.

### Achievement of DQOs

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

* Are the data adequate to determine the extent to which hazardous substances have migrated or to what extent they are expected to migrate from potential hazardous substance source areas?
* Do the data collected adequately characterize the nature and extent of potential hazardous substance source areas at the site?
* Are the data statistically adequate to allow evaluation on a per chemical and per media basis?
* Do the data collected allow assessment of hydrogeologic factors, which may influence contaminant migration/distribution?
* Is the sample set sufficient to develop site-specific removal and disposal treatment methodologies?
* Have sufficient data been collected to evaluate how factors, including physical characteristics of the site and climate and water table fluctuations, affect contaminant fate and transport?
* Have sufficient data been collected to determine the toxicity, environmental fate, and other significant characteristics of each hazardous substance present?
* Has an adequate amount of information been gathered to determine groundwater characteristics and current and potential groundwater uses for locations close to the site?
* Is the data set sufficient to evaluate the potential extent and risk of future releases of hazardous substances, which may remain as residual contamination at the source facility?

The project team will need to formulate solutions if data gaps are found as a result of problems, biases, or trends in the analytical data, or if conditions exist that were not anticipated in the development of the DQOs. It is particularly important that each data usability evaluation specifically assess and document any limitations on the use of the data that may result from a failure to achieve the site DQOs.

## Figures

## Appendices

1. Training provider and date of training will vary from person to person because of individual scheduling of training. [↑](#footnote-ref-2)
2. Training records and/or certificates are available upon request. [↑](#footnote-ref-3)
3. Corrective Actions and Distribution of QAPP and QAPP Updates must be included. [↑](#footnote-ref-4)
4. Various versions of the listed method are indicated by the A, B, C, D and E suffixes. [↑](#footnote-ref-5)
5. Ambient field blanks will be collected for aqueous VOC and GRO regardless of whether an Equipment Blank is collected. Equipment blanks are not required if the sample is collected with dedicated sampling equipment. [↑](#footnote-ref-6)
6. Laboratory RLs and MDLs will be reviewed prior to award of an analytical services subcontract to a laboratory. Laboratory RLs and MDLs will be compared with RSLs or other appropriate action levels in the DQOs and sampling design prepared for each site [↑](#footnote-ref-7)
7. Blank media which have not been opened and exposed to the sampling environment will be provided as lot blanks. [↑](#footnote-ref-8)
8. Laboratory RLs and MDLs will be reviewed prior to award of an analytical services subcontract to a laboratory. Laboratory RLs and MDLs will be compared with RSLs or other appropriate action levels in the DQOs and sampling design prepared for each site. [↑](#footnote-ref-9)
9. Blank media which have not been opened and exposed to the sampling environment will be provided as lot blanks. [↑](#footnote-ref-10)
10. Laboratory RLs and MDLs will be reviewed prior to award of an analytical services subcontract to a laboratory. Laboratory RLs and MDLs will be compared with RSLs or other appropriate action levels in the DQOs and sampling design prepared for each site. [↑](#footnote-ref-11)
11. Blank media which have not been opened and exposed to the sampling environment will be provided as lot blanks. [↑](#footnote-ref-12)
12. Laboratory RLs and MDLs will be reviewed prior to award of an analytical services subcontract to a laboratory. Laboratory RLs and MDLs will be compared with RSLs or other appropriate action levels in the DQOs and sampling design prepared for each site. [↑](#footnote-ref-13)
13. Laboratory RLs and MDLs will be reviewed prior to award of an analytical services subcontract to a laboratory. Laboratory RLs and MDLs will be compared with RSLs or other appropriate action levels in the DQOs and sampling design prepared for each site. [↑](#footnote-ref-14)
14. Ambient field blanks for GRO will be collected for aqueous samples regardless of whether an Equipment Blank is collected. Equipment blanks are not required if the sample is collected with dedicated sampling equipment. [↑](#footnote-ref-15)
15. Laboratory RLs and MDLs will be reviewed prior to award of an analytical services subcontract to a laboratory. Laboratory RLs and MDLs will be compared with RSLs or other appropriate action levels in the DQOs and sampling design prepared for each site. [↑](#footnote-ref-16)
16. Laboratory RLs and MDLs will be reviewed prior to award of an analytical services subcontract to a laboratory. Laboratory RLs and MDLs will be compared with RSLs or other appropriate action levels in the DQOs and sampling design prepared for each site. [↑](#footnote-ref-17)
17. MS/MSD and Laboratory duplicates are not required but are left in this table to alert the sampler that they are not required. [↑](#footnote-ref-18)
18. Laboratory RLs and MDLs will be reviewed prior to award of an analytical services subcontract to a laboratory. Laboratory RLs and MDLs will be compared with RSLs or other appropriate action levels in the DQOs and sampling design prepared for each site. [↑](#footnote-ref-19)
19. MS/MSD and Laboratory duplicates are not required but are left in this table to alert the sampler that they are not required. [↑](#footnote-ref-20)
20. 12 Toxic Congeners (WHO list) = PCB77, PCB81, PCB105, PCB114, PCB118, PCB123, PCB126, PCB156/157, PCB167, PCB169, and PCB189. [↑](#footnote-ref-21)
21. Laboratory RLs and MDLs will be reviewed prior to award of an analytical services subcontract to a laboratory. Laboratory RLs and MDLs will be compared with RSLs or other appropriate action levels in the DQOs and sampling design prepared for each site. [↑](#footnote-ref-22)
22. Individual laboratory RLs (practical quantitation limits) and method detection limits (MDLs) will vary. [↑](#footnote-ref-23)
23. MS/MSDs will be based on statistically derived limits and will vary between laboratories. In the absence of laboratory limits, use NFG guidelines, if applicable.

    Project Action Limits (PALs) vary by matrix and data use; the PALs will be defined as part of the project planning process. Laboratory RLs and MDLs should be reviewed during the project planning to ensure that laboratories can achieve the project’s quality objectives. [↑](#footnote-ref-24)
24. Individual laboratory RLs (practical quantitation limits) and method detection limits (MDLs) will vary. [↑](#footnote-ref-25)
25. MS/MSDs will be based on statistically derived limits and will vary between laboratories. In the absence of laboratory limits, use NFG guidelines, if applicable. [↑](#footnote-ref-26)
26. Individual laboratory RLs (practical quantitation limits) and method detection limits (MDLs) will vary. [↑](#footnote-ref-27)
27. MS/MSDs will be based on statistically derived limits and will vary between laboratories. In the absence of laboratory limits, use NFG guidelines, if applicable [↑](#footnote-ref-28)
28. Individual laboratory RLs (practical quantitation limits) and method detection limits (MDLs) will vary. [↑](#footnote-ref-29)
29. MS/MSDs will be based on statistically derived limits and will vary between laboratories. In the absence of laboratory limits, use NFG guidelines, if applicable. [↑](#footnote-ref-30)
30. Individual laboratory RLs (practical quantitation limits) and method detection limits (MDLs) will vary. [↑](#footnote-ref-31)
31. \*\* MS/MSDs will be based on statistically derived limits and will vary between laboratories. In the absence of laboratory limits, use NFG guidelines, if applicable. [↑](#footnote-ref-32)
32. Individual laboratory RLs (practical quantitation limits) and method detection limits (MDLs) will vary. [↑](#footnote-ref-33)
33. MS/MSDs will be based on statistically derived limits and will vary between laboratories. In the absence of laboratory limits, use NFG guidelines, if applicable. [↑](#footnote-ref-34)
34. Project Action Limits (PALs) vary by matrix and data use; the PALs will be defined as part of the site scoping process. [↑](#footnote-ref-35)
35. The QA/QC criteria presented in this table reflect program values; the site-specific criteria will reflect the most recently updated values as reported by the laboratory and presented in the SOP. [↑](#footnote-ref-36)
36. These RLs and QC limits are laboratory specific and may be modified and documented in the site-specific plans as needed. State regulation may specify RLs and PALs. Project RLs and MDLs are achievable laboratory limits. GRO includes analytes detected between the Retention Times of C6 and C10 alkane standards. DRO includes analytes detected between the Retention Times of C10 and C28 alkane standards. ORO includes analytes detected between the Retention Times of C28 and C36 alkane standards. [↑](#footnote-ref-37)
37. Individual laboratory RLs (practical quantitation limits) and method detection limits (MDLs) will vary. [↑](#footnote-ref-38)
38. MS/MSDs will be based on statistically derived limits and will vary between laboratories. In the absence of laboratory limits, use NFG guidelines, if applicable. [↑](#footnote-ref-39)
39. The 20% RPD applies when laboratory duplicate concentrations are greater than 5x RL. For laboratory duplicate concentrations at or above the RL and less than 5x RL, the control limit is ±CRQL [↑](#footnote-ref-40)
40. 50-150 %R applies to ICP-AES only. For IPC-MS, limits are 70-130 %R. [↑](#footnote-ref-41)
41. Mercury is analyzed by Cold Vapor Atomic Absorption. [↑](#footnote-ref-42)
42. Cyanide is analyzed by Spectrophotometry rather than by ICP-AES or ICP-MS. [↑](#footnote-ref-43)
43. Individual laboratory RLs (practical quantitation limits) and method detection limits (MDLs) will vary. [↑](#footnote-ref-44)
44. MS/MSDs will be based on statistically derived limits and will vary between laboratories. In the absence of laboratory limits, use NFG guidelines, if applicable. [↑](#footnote-ref-45)
45. The 20% RPD applies when laboratory duplicate concentrations are greater than 5x RL. For laboratory duplicate concentrations at or above the RL and less than 5x RL, the control limit is ±CRQL. [↑](#footnote-ref-46)
46. 50-150 %R applies to ICP-AES only. For IPC-MS, limits are 70-130 %R. [↑](#footnote-ref-47)
47. Mercury is analyzed by Cold Vapor Atomic Absorption. [↑](#footnote-ref-48)
48. Cyanide is analyzed by Spectrophotometry rather than by ICP-AES or ICP-MS. [↑](#footnote-ref-49)
49. Individual laboratory RLs (practical quantitation limits) and method detection limits (MDLs) will vary. [↑](#footnote-ref-50)
50. MS/MSDs will be based on statistically derived limits and will vary between laboratories. In the absence of laboratory limits, use NFG guidelines, if applicable. [↑](#footnote-ref-51)
51. Individual laboratory RLs (practical quantitation limits) and method detection limits (MDLs) will vary. [↑](#footnote-ref-52)
52. Individual laboratory RLs (practical quantitation limits) and method detection limits (MDLs) will vary. [↑](#footnote-ref-53)
53. MS/MSDs will be based on statistically derived limits and will vary between laboratories. In the absence of laboratory limits, use NFG guidelines, if applicable. [↑](#footnote-ref-54)
54. Solids can include soil, sediment, tissues, ash, and oil. Note that for this SOW, laboratories must establish MDLs. [↑](#footnote-ref-55)
55. Accuracy and Precision criteria presented in this table are from the referenced CLP Statement of Work (SOW) for HRSM02.1. [↑](#footnote-ref-56)
56. The target list on this page is the World Health Organization (WHO) Toxic Congeners list, only 12 of the 209 congeners which can be reported by this method. The Ballschmiter-Zell (BZ) number (e.g., PCB-77) is listed rather than the chemical name for convenience. All 209 Chlorinated Biphenyl Congeners can be reported from this method; for all 209 congeners, CRQLs for solids are 2.0 ng/kg and CRQLs for waters are 20 pg/L. [↑](#footnote-ref-57)
57. Solids can include soil, sediment, tissues, ash, and oil. Note that for this SOW, laboratories must establish MDLs. [↑](#footnote-ref-58)
58. Accuracy and Precision criteria presented in this table are from the CLP Statement of Work (SOW) HRSM02.1. [↑](#footnote-ref-59)
59. Matrix Codes may be used (e.g., ACM - asbestos, LBP – lead-based paint, SB-subsurface soil, SS-surface soil, SD-sediment, SW-surface water, GW-groundwater, DW-potable water, IA – Indoor Air, AA – Ambient Air, SA – sub-slab air, and W-waste, etc.) [↑](#footnote-ref-60)
60. Type may include tools used to collect samples (GP-GeoProbe, Scoop-disposable scoop, HA-hand auger, etc.) or quality control sample type (e.g., FD-field duplicate) [↑](#footnote-ref-61)
61. Equipment rinsate blanks will be collected for non-dedicated sampling equipment. [↑](#footnote-ref-62)