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United States
Environmental Protection Agency

General Electric (GE) Housatonic River Project

Pittsfield, Massachusetts

Contract No. 68-W7-0026

FINAL
QUALITY ASSURANCE PROJECT PLAN
Volume I

DCN: RFW033-2E-AEOQ

November 2000

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WESTON
MANAGERS DESIGNERS/CONSULTANTS

FINAL

QUALITY ASSURANCE PROJECT PLAN

GENERAL ELECTRIC (GE) HOUSATONIC RIVER PROJECT PITTSFIELD, MASSACHUSETTS

Volume I, Revision 04

Contract No. 68-W7-0026
DCN: RFW033-2E-AEOQ

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY

Prepared by

ROY F. WESTON, INC.
West Chester, Pennsylvania 19380

November 2000

W.O. No. 20064.033.100.5030

FINAL

QUALITY ASSURANCE PROJECT PLAN (QAPP)

GENERAL ELECTRIC (GE) HOUSATONIC RIVER PROJECT
Pittsfield, Massachusetts

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LIST OF ACRONYMS

% R	percent recovery
%D	percent difference
%RSD	percent relative standard deviation
AA	atomic absorption
AAS	Atomic Absorption Spectrophotometer
ASTM	American Society for Testing and Materials
BFB	p-bromofluorobenzene
BNA	base/neutral/acid
BS	blank spikes
CARs	Corrective Action Reports
CBB	Continuing Calibration Blanks
CCC	Calibration Check Compounds
CCV	Continuing Calibration Verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
CRDL	contract required detection limit
CV	Calibration Verification
DFTPP	decafluorotriphenylphosphine
DNAPL	dense nonaqueous phase liquid
DQIs	data quality indicators
DQOs	data quality objectives
DVR	Data Validation Reviewer
EE/CA	Engineering Evaluation/Cost Analysis
EDD	Electronic Data Deliverables
EPA	U.S. Environmental Protection Agency
ERLs	Effects Range Low
GC	gas chromatography
GC/ECD	gas chromatography/electron capture detector
GC/MS	gas chromatography/mass spectroscopy
GE	General Electric Company
GPC	gel permeation chromatography
HPLC	high performance liquid chromatography
ICP	inductively coupled plasma spectroscopy
ICS	interference check sample

LIST OF ACRONYMS (Continued)

LCS	laboratory control sample
LNAPL	light nonaqueous phase liquid
LRA	linear range analysis
LRS	linearity range standard
MADEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
MS/MSD	matrix spike/matrix spike duplicate
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
OUs	operable units
PCBs	polychlorinated biphenyls
PE	performance evaluation
PQL	practical quantitation limit
PRRL	project-required reporting limit
QA	quality assurance
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RF	response factor
RI/FS	remedial investigation/feasibility study
RPD	relative percent difference
RRF	relative response factors
RTW	retention time window
SDG	sample delivery group
SDRs	Sample Discrepancy Reports
SELs	Severe Effect Levels
SIM	selected ion monitoring
SOPs	Standard Operating Procedures
SOW	Scope of Work
SPCCs	System Performance Check Compounds
SQL	Sample Quantitation Limit
SSERC	Site-Specific Environmental Remediation Contract

LIST OF ACRONYMS (Continued)

SVOCs	semivolatile organic compounds
TICs	Tentatively Identified Compounds
TSA	technical system audit
USTs	underground storage tanks
VOCs	volatile organic compounds

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PROJECT PERSONNEL SIGNATURE PAGE
GE HOUSATONIC RIVER PROJECT

Company Name _____

As confirmed by the signature(s) below, the following individuals have read and acknowledge compliance to this QAPP:

Signature	Date

Region I, EPA-NE QAPP Requirement Summarization

EPA QA/R-5 QAPP Elements	Required EPA-NE QAPP Elements and Corresponding Sections	EPA-NE QAPP Worksheet #	Quality Assurance Project Plan for General Electric Housatonic River Project	GE-HRP QAPP Section/Page Reference
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Region I, EPA-NE QAPP Requirement Summarization

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INTRODUCTION

The objective of this Quality Assurance Project Plan (QAPP) is to provide a framework to ensure that analytical data are scientifically valid and defensible. The QAPP establishes the analytical protocols and documentation requirements to ensure that the data are collected, reviewed, and analyzed in a consistent manner. The QAPP establishes or makes provisions for:

- Developing performance standards related to various elements of the design/ implementation process.
- Monitoring actual performance in comparison to, and in compliance with, the established standards.
- Reporting the monitored performance.
- Rectifying performance not conforming to the established standards.

The QAPP describes policy, organization, functional activities, and the data quality objectives (DQOs) and measures necessary to achieve adequate data for use in selecting the appropriate remedy. This QAPP is considered a generic document and will be appended as necessary in order to accommodate site activities.

This QAPP and the site-specific Field Sampling Plan (FSP) (00-0476) shall constitute, for project purposes, a Sampling and Analysis Plan (SAP) that provides a process for obtaining data of sufficient quality and quantity to satisfy project needs. The FSP will be referenced wherever possible.

Specifically, the FSP addresses:

- General information concerning project organization and responsibilities, field activities, contractor chemical quality control, and corrective action.
- Standard Operating Procedures (for various matrices, field and sample documentation, sample packing and shipping, and quality assurance/quality control [QA/QC] procedures).

In addition to the sitewide FSP, individual Work Plans will be generated, which:

- Outline team members, specifically subcontractors.
- Describe field investigation tasks in detail.
- Provide specific DQOs.
- Address sampling locations and depths.
- Establish sample types and sampling methods, and provide SOPs, where applicable.
- Delineate field work episodes and schedule.

The combination of the QAPP, FSP, and Work Plans comprise the life cycle of field activities, laboratory activities, and contract deliverables related to the acquisition and reporting of chemical data for these studies, as discussed in Section 3.

This QAPP is required reading for all staff participating in the work effort, as documented by the sign-off page within this document. The QAPP shall be in the possession of or available to the field personnel, laboratories performing analytical methods, contractors, and subcontractors. All parties shall comply with the procedures documented in this QAPP in order to maintain comparability and representativeness of the data produced. In addition, the quality control requirements specified within this QAPP take precedence over any criteria presented in the attached laboratory SOPS (see Appendix A).

Distribution of this QAPP shall be WESTON's responsibility to ensure that the most current revision is being implemented. Copies will be provided to key personnel, including U.S. Environmental Protection Agency (EPA) staff, the U.S. Army Corps of Engineers (USACE) Manager, and WESTON staff and subcontractors.

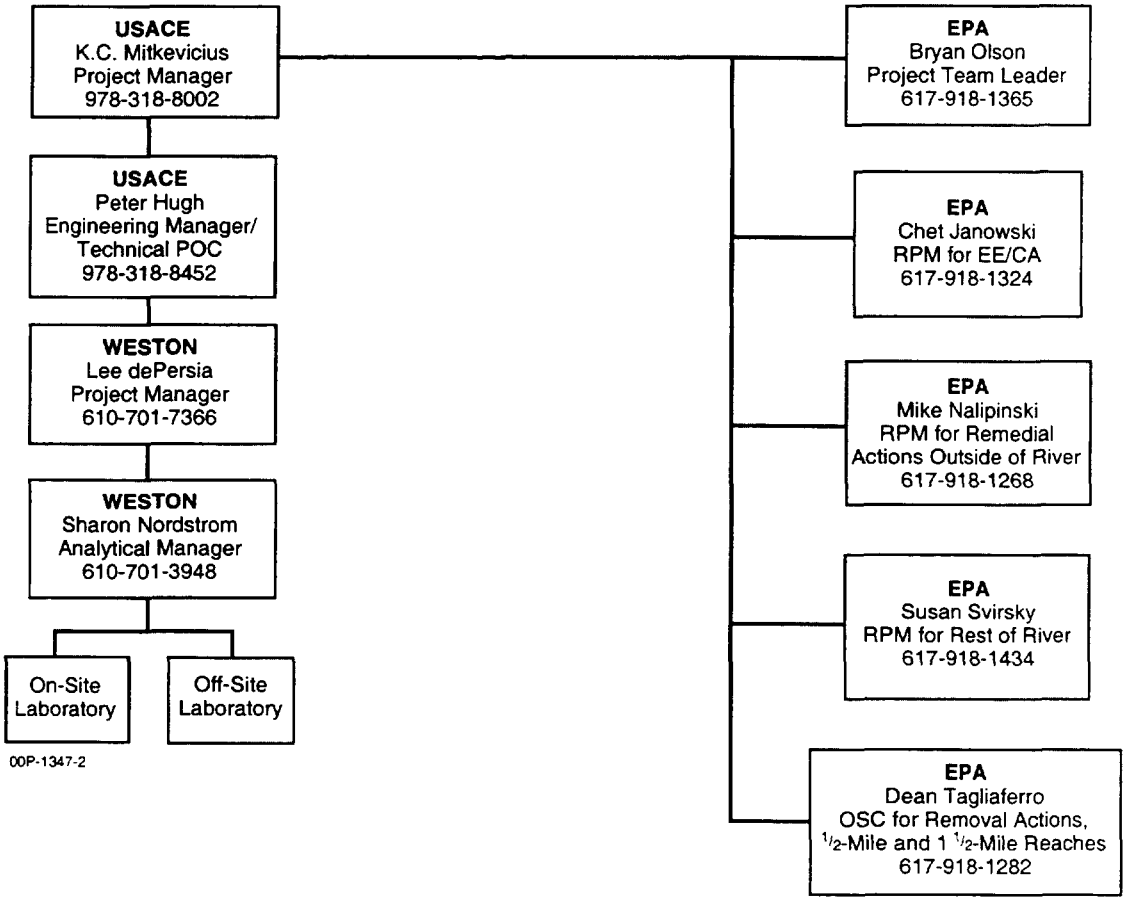
Section 1

A. PROJECT MANAGEMENT

1. PROJECT ORGANIZATION

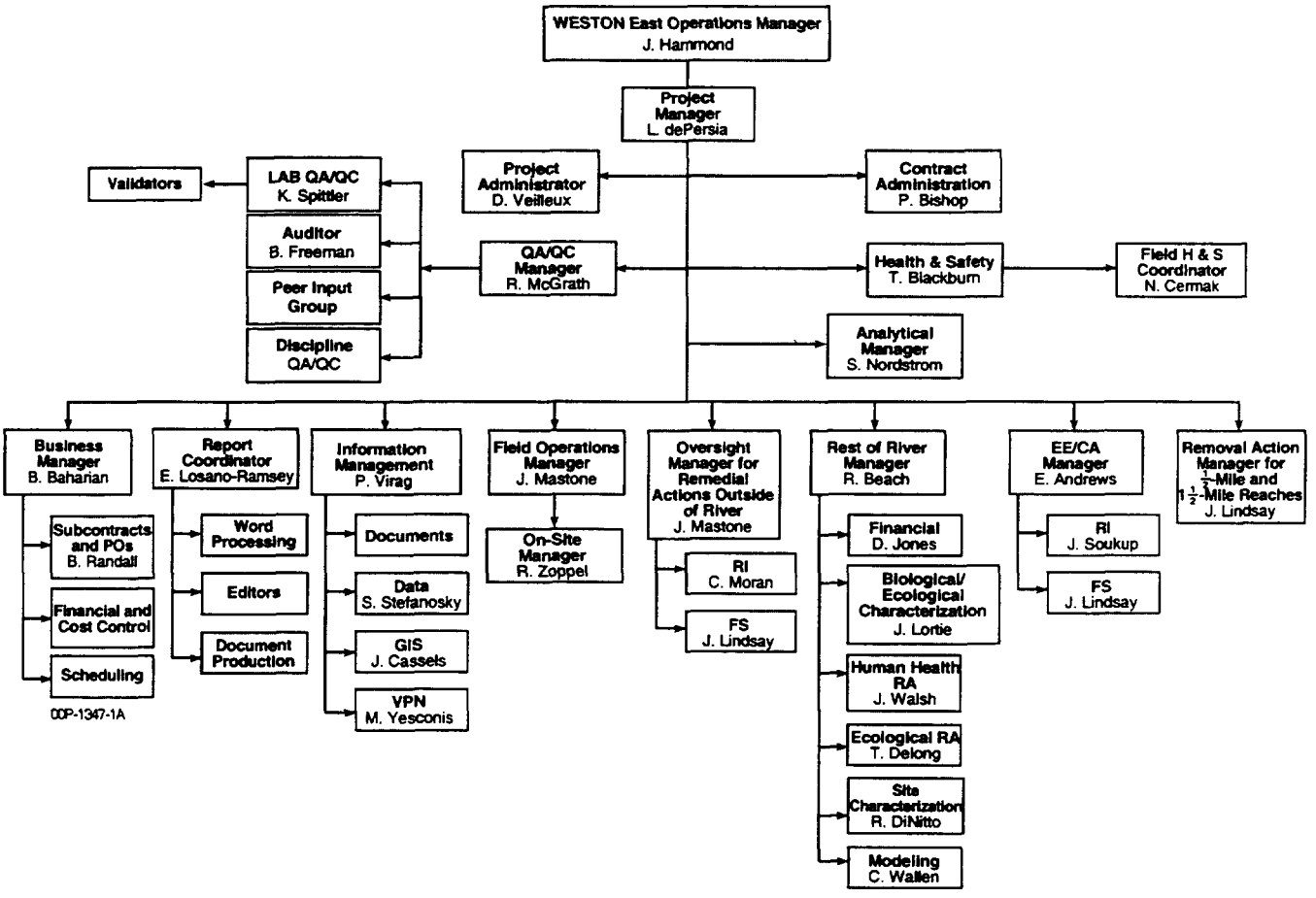
The project team is composed of an interdisciplinary team of several government agencies, WESTON, other contractors, and subcontractors. Figure 1-1 below summarizes the entity and its respective role/responsibility as currently identified.

Figure 1-1 Project Team



In addition to the interdisciplinary team, WESTON has assembled a project organization with assigned personnel, as outlined in Figure 1-2.

Figure 1-2 WESTON Organization Chart for GE Housatonic River Project



This section describes the project management organization, the responsibilities of the key project staff directly relating to this QAPP, and the management of subcontractors. Other project personnel, as outlined above, are discussed in the *Field Sampling Plan* (00-0476).

1.1 MANAGEMENT STAFF

1.1.1 Project Manager

The WESTON Project Manager is responsible for implementing the contracted services, managing the project staff, complying with performance schedules, implementing the QAPP, and taking corrective measures for planned, observed, or reported deficiencies from the QAPP. He is the primary contact for overall project-related issues and events and is responsible for orchestrating and managing the interdisciplinary communication network.

1.1.2 Field Operations Manager

The WESTON Field Operations Manager is responsible for coordinating on-site work, complying with the specifications in the QAPP, and reporting planned and observed deviations from the QAPP specifications to the Project Manager. The Field Operations Manager has overall responsibility for scheduling, in coordination with the GE Housatonic River Project Schedule, and is the direct point of contact with the EPA RPMs. The Field Operations Manager works with the task manager for the EE/CA, Removal Actions for ½-mile and 1½-mile Reaches, and Rest of River tasks to ensure meeting project objectives.

1.1.3 Analytical Manager

The Analytical Manager is responsible for managing analytical projects from initiation to completion. Responsibilities include negotiating project specifications with clients and ensuring that specifications are met by the laboratory and delivered to the client in the required time frame. During this project, the Analytical Manager, or designee, will monitor the general laboratory performance, sample turnaround time, and quality control problems reported by the laboratory. If a laboratory's performance is determined to be unacceptable, the Analytical Manager will implement a corrective action. The Analytical Manager has the authority and responsibility to stop work activities related to, or affected by, noncompliant conditions until actions can be taken to correct the condition or prevent it from affecting related or subsequent work. If a laboratory's

performance is determined to be unacceptable at the end this project, based on the laboratory monitoring and the data assessment, the Analytical Manager will notify the Purchasing Department of the poor performance. The Purchasing Department will maintain a list of complaints and assess whether laboratories will be permitted to continue to receive subcontracts.

1.2 QUALITY ASSURANCE STAFF

1.2.1 Quality Assurance/Quality Control Manager

The QA/QC Manager is responsible for assessing the implementation of WESTON's quality assurance/quality control system and initiating corrective actions, as needed, to ensure the system is uniform and compliant with the WESTON Quality Assurance Program and the Contractor Quality Control Plan. The QA/QC Manager is also responsible for assisting with the development of QA/QC budgets, facilitating the assignment of QA representatives and QC System Managers to the project, performing quality system audits, and mentoring project QA/QC representatives.

1.2.2 Laboratory QA/QC Coordinator

The Laboratory QA/QC Coordinator is responsible for verifying that the QC requirements are appropriate and are communicated and implemented. The Laboratory QA/QC Coordinator is also responsible for performing the quality assurance requirements specified by the contract documents, any WESTON applicable plans, internal procedures, or instructions for the projects to which he/she is assigned. The coordinator is also responsible for providing QA/QC guidance to the Project Manager and project staff.

1.2.3 Data Validator

Data validators are responsible for performing either data validation or data evaluation in accordance with specified procedures. The procedures required for data evaluation and data validation will be specified in this plan or explicitly cited in this plan (see Section 14).

1.2.4 Auditor

The auditor is responsible for performing audits in accordance with Section 12 of this plan. In the event project requirements conflict with the corporate requirements, the auditor will comply with the project requirements or will seek resolution through the QA/QC Manager.

1.3 LABORATORY SUBCONTRACTING/ORGANIZATION

Prior to subcontracting a laboratory to perform work, the Analytical Manager, or designee, will verify that the following requirements are met by the laboratory. If a requirement is not met and the laboratory is subcontracted, the basis for the decision to subcontract the laboratory will be documented.

- The laboratory will be actively participating in at least one performance evaluation (PE) sample program, i.e., the EPA Water Pollution Study, the EPA Water Study, the National Institute for Occupational Safety and Health (NIOSH) Round Robin, etc. The program must include analyses similar to the type required for the project. For example, if samples will be submitted for a chemical analysis, then the PE program the laboratory is participating in must include chemical analyses, preferably of similar parameters. Additionally, the laboratory must have performed adequately (≥75% correct) on at least one of the last two performance evaluation samples and have initiated corrective actions required by any PE program failures.

- The laboratory must have a sample management system in place. The sample management system must be capable of tracking sample location in the laboratory and status of the samples.

- The fixed laboratory must have a laboratory-specific Quality Assurance Program Plan and a system of Standard Operating Procedures (SOPs) (see Appendix A). The on-site laboratory will have established/approved SOPs for all analyses and procedures (see Appendix A).

- The laboratory must have SOPs for analyses required by this project.

- The laboratory must have a Quality Assurance Manager or equivalent.

- The laboratory must agree to announced and unannounced audits by WESTON, as required by this project.

- The laboratory must appoint a Project Manager to communicate with WESTON's project contact. The communications must include notification of sample receipt,

sample receipt deficiencies, problems encountered during the analysis of the samples that may impact the data quality, and notification of deviations from an agreed upon schedule.

- The laboratory must have the ability to communicate electronically by Internet electronic mail.
- The laboratory must notify the project analytical manager of changes to key analytical personnel.

The minimum responsibilities for key laboratory personnel are outlined in Subsections 1.3.1 through 1.3.7.

1.3.1 Analyst/Technician

It is the individual responsibility of all analysts and technicians to perform their assigned tasks according to this master QAPP, sampling SOPs in the FSP, field and/or fixed laboratory SOPs, Scope of Work, and all applicable Work Plans. This includes responsibility for performing quality control analyses as specified in the method SOP and for entering the QC data in the appropriate logbook, electronic database, or method control file system. The analyst shall report out-of-control results to the Supervisor and will initiate corrective action for out-of-control events.

1.3.2 Sample Custodian

The Sample Custodian is responsible for receiving and processing all samples that come to the laboratory for analysis. This includes checking the sample for acceptable conditions on receipt, accepting custody of the sample, coordination with the Project Manager to ensure that client shipments are accurate and complete, storing samples appropriately to preserve their integrity, entering sample and project information into the Laboratory Information System, and distributing forms and sample receipt material to initiate scheduling of analysis.

1.3.3 Laboratory Supervisors

Laboratory Supervisors shall ensure that analysts and technicians are instructed in the requirements of the QAPP, study-specific QA Project Plans, SOPs, Protocols, and Work Plans for the analytical

method or other procedure. Supervisors shall review sample QC data at frequent intervals designed to ensure that QC analyses are being performed at the required frequency; that data are documented in the appropriate logbook, electronic database, or method control file system; and that established corrective action procedures for out-of-control situations are followed and the results documented. It is the responsibility of the Supervisor to ensure that data have been validated and reported to the Reporting/Data Management Group or Operations Manager, as appropriate. Supervisors shall report to the Laboratory Operations Manager. In the absence of the Supervisor, it shall be the responsibility of a designated senior analyst, other department supervisor, or the Operations Manager to carry on his/her duties.

1.3.4 Laboratory Operations Manager

The Laboratory Operations Manager shall take overall responsibility for technical conduct, evaluation, and reporting of all tasks associated with analytical work performed by the laboratory. The Operations Manager ensures that approved procedures are documented and followed, that all data are recorded and verified, and that all deviations are documented. The Operations Manager shall ensure that Supervisors are instructed in the requirements of the Laboratory QA Manual, study-specific QA Project Plans, SOPs, Protocols, and Work Plans. The Operations Manager provides guidance and assistance in the development of laboratory quality control procedures, approves quality control limits for methods, works with Supervisors to bring out-of-control methods back to within established acceptance limits, and assists Supervisors in correcting analytical problems revealed by QA audits. The Operations Manager shall report to the General Manager. In the absence of the Operations Manager, it shall be the responsibility of his/her designee, who may be a senior technical person, Supervisor, Client Services Manager, or the General Manager, to carry on his/her duties.

1.3.5 Laboratory QA/QC Manager

The Laboratory Quality Assurance Department shall be responsible for conducting systems audits and inspections for compliance with this QAPP, SOPs, and QA Project Plans, or other project-specific protocols. The individual is also responsible for maintaining historical files of all

QA documents, reviewing QC control charts, documenting findings and corrective actions, reviewing training records, managing performance evaluations, maintaining conformance with certification requirements, and reporting findings related to all of the above to management. All of the documents and procedures are addressed in the Laboratory or method-specific SOPs (see Appendix A). The laboratory QA/QC Manager shall report directly to the General Manager. In the absence of the QA/QC Manager, it shall be the responsibility of his/her designee, who shall not be involved in the direct production of the work in the area of concern, to carry out his/her duties. For this project, all quality related issues will be directed through the Laboratory Project Manager to the WESTON Analytical Manager, who will implement the appropriate action.

1.3.6 Project Manager

The Laboratory Project Manager will be the key point of contact for all laboratory issues relating to this project. The Project Manager will monitor all activities from bottle shipment to package submission and will relay any QC issues to the WESTON Analytical Manager, as well as orchestrate all project activities. In the absence of the Project Manager, it is the responsibility of his/her designee to carry out the manager's duties.

1.3.7 General Manager

The General Manager shall designate the Laboratory Operations Manager and is responsible for managing all activities related to laboratory services, including the Quality Assurance Program. The General Manager shall ensure that there is a Quality Assurance Department, that personnel and other resources are adequate, that personnel have been informed of their responsibilities, that deficiencies are reported to the appropriate Operations Manager, that corrective actions are taken and documented, and that the Quality Assurance Program is effective in accomplishing the underlying goals. Any significant changes to written SOPs shall be authorized in writing by the General Manager. In the absence of the General Manager, it shall be the responsibility of his/her designee, who shall not be responsible for the direct production of the work in the area of concern, to carry out his/her duties. Such designees may include the Client Services Manager, senior data management personnel, or the Vice President.

1.4 MODIFICATIONS TO APPROVED QAPP

All modifications to the analytical procedures, data assessment and/or reporting will be submitted for approval in the form of QAPP addendums. Each addendum will include an approval/sign-off page, similar to the original QAPP, that will encompass key personnel, including EPA Project Team Leader, USACE QA Representative, and WESTON's Project Manager and QA/QC Manager.

All key project staff, as outlined in Figures 1-1 and 1-2, have the authority to initiate QAPP modifications. All preliminary modifications will be orchestrated through WESTON's Analytical Manager and Laboratory QA/QC Coordinator. These individuals will consult all affected parties, compile and format QAPP Addendum documentation, and organize addendum distribution/ approval to the interdisciplinary team members in a timely manner.

Section 2

2. PROBLEM DEFINITION/BACKGROUND

The General Electric (GE) Housatonic River site is located in Pittsfield, Berkshire County, Massachusetts, and extends along the river from the GE facility in Pittsfield to Rising Pond Dam (approximately 30 miles), and beyond. The 254-acre main facility is composed of the former electrical component manufacturing plant that had been operational since the 1940s. As part of routine operations, this plant was responsible for the production and handling of polychlorinated biphenyls (PCBs), until production and distribution of PCBs were banned by the EPA in 1977.

The site consists of waste sources at the GE facility, other areas in Pittsfield where PCB wastes from the facility have been disposed, and soils/sediments contaminated by the migration of GE wastes via the Housatonic River. The site has been evaluated based on the following waste source areas:

- Eleven oxbows on the Housatonic River, created in the 1940s, in an effort to straighten the river in the Pittsfield reach. These oxbows were at least partially filled with soils containing GE waste.
- A PCB storage tank located at GE Building 68 collapsed in 1968, releasing liquid Aroclor 1260 onto the riverbank soil and into the river sediments.
- Approximately 8 miles of PCB-contaminated floodplain soils that coincide with the 10-year floodplain of the Housatonic River.
- Two landfills; two former stormwater retention ponds; areas of contamination along East Street, Newell Street, Longfellow Avenue; the Allendale School; Silver Lake; and other areas of contamination.

The presence of PCBs, dioxin/furan, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and inorganic constituent contamination in the areas listed above, including more than 100 residential and commercial properties, has been documented through a series of investigations. These investigations (in accordance with the Massachusetts Contingency Plan [MCP], the Resource Conservation and Recovery Act [RCRA], and the Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA]) span two decades and have been conducted by GE, the Massachusetts Department of Environmental Protection

(MADEP), and the EPA. A fish consumption advisory has been in effect since 1982 for the Housatonic River from Dalton, Massachusetts, to the Connecticut border.

EPA, MADEP, GE, and other state and federal agencies have negotiated the terms of the Consent Decree that identifies specific requirements for each entity in the evaluation and remediation of the Housatonic River and the GE facility.

The Consent Decree (00-0388, 00-0389, and 00-0390) was lodged in U.S. District Court, Massachusetts, Western Division, in October 1999. The Consent Decree identifies the following specific areas for cleanup:

- GE Plant Site, including Unkamet Brook and its floodplain, Hill 78 and Building 71 consolidation areas, and non-GE-owned property within the GE Plant Site.
- Former oxbow areas.
- Allendale School.
- Residential properties in 1½-Mile Reach and downstream of 2-Mile Reach of Housatonic River.
- Nonresidential areas in 1½-Mile Reach of Housatonic River.
- Silver Lake.
- Housatonic River-Upper ½-Mile Reach.
- Housatonic River-Next 1½-Mile Reach from the Lyman Street Bridge to the Confluence of the East and West Branches.
- Housatonic River-"Rest of River."

Section 3

3. PROJECT DESCRIPTION

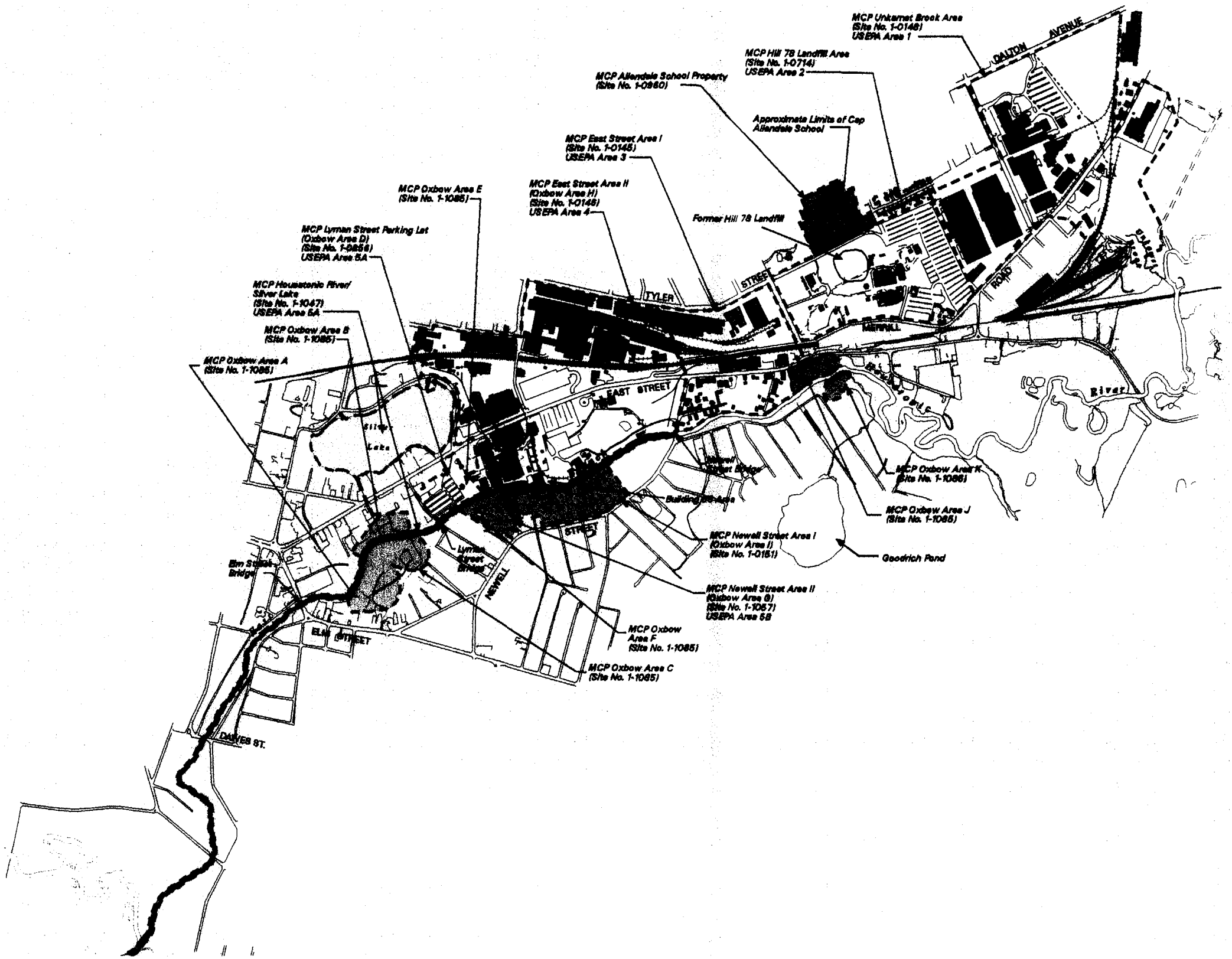
For administrative purposes, the site was subdivided into areas based on property ownership (i.e., GE versus non-GE properties) and jurisdictional limits. The GE facility and the Housatonic River were separated into six distinct study areas, called operable units (OUs). The following table summarizes the subdivisions of the site, including the designations applied by MADEP and EPA Region I RCRA. A site map showing the OUs is presented in Figure 3-1.

Table 3-1

Summary of Historical Site Subdivisions

OU Designation	MADEP Designation	EPA Region I RCRA Designation
OU 1	Unkamet Brook Area	EPA Area 1
	Hill 78 Area	EPA Area 2
	East Street Area 1	EPA Area 3
	East Street Area 2	EPA Area 4
	Lyman Street Parking Lot (Former Oxbow D)	EPA Area 5A
OU 2	Housatonic River	Housatonic River
OU 3	Allendale School	Allendale School
OU 4	Silver Lake	Silver Lake
OU 5	Newell Street Parking Lot (Former Oxbow G)	EPA Area 5B
	Former Oxbow I	*
OU 6	Former Oxbows A, B, C, E, F, J, K	*

*= out of EPA Region I RCRA jurisdiction; assessed under EPA Region I CERCLA.



Original includes color coding.

LEGEND

- O.U. #1 - GE Facility
- O.U. #2 - Housatonic River
- O.U. #3 - Allendale School
- O.U. #4 - Silver Lake
- O.U. #5 - Newell Street
- O.U. #6 - Oxbows A, B, C, J, and K

N

Scale in Feet

700 0 700 1400 2100 2800

Map produced by WESTON, adapted from Geographic Information System (GIS) database provided by TechLaw Inc.

Quality Assurance Project Plan
GE Housatonic River Project
Pittsfield, Massachusetts

FIGURE 3-1
LOCATIONS OF OPERABLE UNITS (OUs)

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3.1 DESCRIPTION OF OPERABLE UNITS

3.1.1 OU 1—GE Facility

The GE facility comprises 254 acres with approximately five million square feet of buildings and building footprints located on the property. OU 1 includes mostly GE-owned property located between Tyler Street/Dalton Avenue on the north, Unkamet Brook on the east, Merrill Road and the Housatonic River on the south, and Lyman Street and Silver Lake on the west. Many areas of past waste disposal or PCB-contaminated fill disposal have been identified in OU 1. Main areas of investigation include the interior landfill, former waste stabilization basin, Hill 78 Landfill, Former Oxbows D and H, Building 68 area, locations of light nonaqueous phase liquid (LNAPL) and dense nonaqueous phase liquid (DNAPL) occurrence, and underground storage tanks (USTs) (00-0275).

3.1.2 OU 2—Housatonic River

The Housatonic River flows approximately 150 miles from its origin in Hinsdale, Massachusetts, near Pittsfield to Long Island Sound in Connecticut. For the purposes of this work assignment, emphasis will be placed on the approximately 54-mile stretch in Berkshire County, Massachusetts, between Dalton, Massachusetts, to the Massachusetts/Connecticut border. This 54-mile stretch of the east branch of the Housatonic River was divided into nine study reaches.

These reach designations are summarized below:

- Reach 1: Dalton to Unkamet Brook Confluence, approximately 3 miles.
- Reach 2: Unkamet Brook Confluence to the Newell Street Bridge, approximately 2 miles.
- Reach 3: Newell Street Bridge to Lyman Street Bridge, approximately 0.5 miles.
- Reach 4: the Lyman Street Bridge to the confluence of the west branch of the Housatonic River, approximately 1.5 miles.
- Reach 5: the confluence of the east and west branches of the Housatonic River to Woods Pond, approximately 8 miles.

- Reach 6: Woods Pond, approximately 60 acres.
- Reach 7: Woods Pond to Rising Pond, approximately 17 miles.
- Reach 8: Rising Pond, approximately 45 acres.
- Reach 9: Rising Pond to the Massachusetts/Connecticut border, approximately 20 miles.

OU 2 includes sediments and stream bank materials of the Housatonic River that are contaminated with hazardous substances, especially PCBs. Numerous studies since 1982 have included sediment, fish tissue, and benthic organism samples collected from the river. The release of PCBs and other hazardous substances to the Housatonic River are mostly attributable to releases from the sources within OUs 1, 3, 4, 5, and 6. These releases have occurred due to surficial runoff as well as discharge of contaminated groundwater and free product to the Housatonic River (00-0275).

3.1.3 OU 3—Allendale School

OU 3 (Allendale School) is located to the north of the Hill 78 Landfill, across the Tyler Street Extension. The Allendale School was constructed in 1950 on a 12-acre parcel. At the time of construction, GE and the City of Pittsfield entered into an agreement under which the city removed approximately 40,000 cubic yards of soil material from the GE property for use as fill material on the school property. The detection of PCBs at the school was identified by MADEP during the construction of the Altresco Corporation Cogeneration Facility. Several subsequent sampling events occurred between 1990 and 1996 to characterize the extent of PCBs present as well as to assess the potential presence of other hazardous substances. Analytical results also documented the presence of VOCs, SVOCs, herbicides, PCBs, polychlorinated dibenzofurans, and inorganic constituents (00-0275).

3.1.4 OU 4—Silver Lake

Silver Lake has been the subject of numerous investigations since the 1970s. Silver Lake was used by GE in the 1940s for testing torpedo launch mechanisms, and the iron testing rails are still visible on the northeastern side of the lake (00-0275).

3.1.5 OU 5—Newell Street Area

OU 5 comprises three former Oxbows, F, G, and I, between the north side of Newell Street and the Housatonic. These areas were isolated from the river during the 1940s as part of the rechannelization efforts. Former Oxbow I was backfilled with material from GE, the Berkshire Gas Company, and possibly others (00-0275).

3.1.6 OU 6—Oxbows A, B, C, J, and K

Five of the former oxbows, designated A, B, C, J, and K, comprise OU 6. These oxbows were also isolated from the river during the 1940s as part of the rechannelization efforts. Former Oxbow A was backfilled with material from GE and possibly others. Much of the area covered by the five oxbows is undeveloped; however, portions of Oxbows A, B, and J have been developed and consist primarily of commercial properties (00-0275).

3.2 WORK ASSIGNMENT OBJECTIVES

As discussed in Section 2, EPA, MADEP, and other federal and state agencies have determined that PCBs and other potential contaminants in bottom sediments, banks, and floodplains of the Housatonic River may pose a potential risk to human health and the environment. WESTON has been tasked with identifying and evaluating sources of PCB contamination to the river and characterizing the extent and magnitude of contamination through direct sampling or through oversight of GE activities.

WESTON's scope of work includes the following work assignments:

- Identification and characterization of continuing sources of contamination into the river.

- Review of available data and investigative reports dating back to the early 1980s and preparation of a preliminary site characterization summary report.

- An extensive field sampling and analysis program to collect soil, sediment, and water samples to evaluate the extent of contamination in and around the Housatonic River from Dalton, Massachusetts, to the Massachusetts/Connecticut border.

- Defining the nature and extent of the soil and sediment contamination in the river and associated floodplains by PCBs and other contaminants to further delineate pathways of contaminant migration.

- Performing a Supplemental Remedial Investigation of the Housatonic River from Dalton, Massachusetts, to the Massachusetts/Connecticut border.

- Preparing a Data Summary Report.

- Sampling and characterizing biological media and ecological communities to support human health and ecological risk assessments.

- Comparing site soil and sediment concentrations against screening risk-based concentrations.

- Preparing site-specific human health and ecological risk assessments for the Housatonic River.

- Providing surface water, hydrology, and sediment data to support the development of a site-specific hydrodynamic model.

- Providing technical assistance and oversight in review of Remedial Design (RD) and Remedial Action (RA) work being performed by GE in compliance with various administrative consent orders, agreements in principle, and consent decrees.

- Supporting EPA's efforts to ensure that remedies specified by GE's RDs and used in GE's RAs protect the public health and the environment.

- Support in the oversight of investigative and remediation activities at various locations throughout the site, such as the GE facility, Allendale School, and Reach 3, the ~½-mile stretch of the river bordering the GE facility.

- An Engineering Evaluation/Cost Analysis (EE/CA) for Reach 4 of the Housatonic River, the ~1½-mile stretch of the river from Lyman Street Bridge and the confluence with the west branch. The EE/CA identifies the objectives of a non-time critical removal action and analyzes the effectiveness, implementability, and cost of various

alternatives that may satisfy these objectives. The EE/CA is analogous to, but more streamlined than, an RI/FS conducted for remedial actions.

- Feasibility Study for Allendale School.

Sampling and Analysis Plan Supplements are currently being developed for each OU (based on individual delivery orders). These supplements will discuss the sample collection activities for the specific OU, including estimated numbers and matrices of field samples, QC samples, required analyses, and sampling schedule.

Beginning in mid-August 1998, a field-based laboratory will provide rapid turnaround analysis for Aroclors 1248, 1254, and 1260 and 1,2,4-trichlorobenzene (1,2,4-TCB) in soil, river sediment, and river bank samples. The results will be reported as both individual Aroclor concentrations and as a Total PCB concentration (sum of the three target Aroclor concentrations). The field samples, and associated field QC samples and blanks, will be analyzed using a modified 8082 gas chromatography/electron-capture detector (GC-ECD), capillary column analysis, as described in Appendix A.

Approximately 10% of the soil/sediment samples submitted for analysis in the field laboratory will also be submitted to an off-site subcontract laboratory for PCB confirmation analysis (full PCB Aroclor list [Table 7-7], including 1,2,4-trichlorobenzene and a Total PCB concentration [sum of the seven target Aroclor concentrations]); Appendix IX semivolatiles, organochlorine pesticides, dioxins/furans; Appendix IX metals, inorganics; and selected geotechnical tests. In addition, approximately 2% of the soil/sediment samples will be analyzed at the off-site laboratory for organophosphorus pesticides and herbicides. Selected samples may be submitted for analysis for PCB congeners/homologs (the frequency and/or conditions for congener analysis will be specified in individual Work Plan documents). Individual analyte lists for all analyses are presented in Tables 7-4 through 7-21.

Surface and/or groundwater monitoring samples will be collected according to the requirements of the individual Work Plans. Water samples will be analyzed for selected Appendix IX analytes, PCB congeners, and water quality parameters as defined in the individual Work Plans. In

addition, surface water and suspended sediment samples collected during rain storm events will be analyzed for PCBs (Aroclors and congeners) TOC, and water quality parameters.

Training shall be provided to all project personnel to ensure compliance with the Health and Safety Plan and technical competence in performing the work effort. Documentation of this training shall be maintained in the project records designed by each contracted organization.

Specialized sampling techniques and field procedures are discussed in the *Field Sampling Plan* (00-0476). The associated training records are filed within the WESTON corporate master files and are available upon request.

Section 4

4. DATA QUALITY OBJECTIVES

4.1 PROJECT DATA QUALITY OBJECTIVES

The overall site data quality objective is to collect a sufficient quality and quantity of data so that scientifically based decisions can be made in order to (the DQOs for biological matrices are addressed in Appendix C):

- Determine the extent of contamination and migration of the primary compounds of concern, Aroclor-1254 and Aroclor-1260, for characterization/removal/risk assessment activities. The data collection approach utilizes a rapid turnaround field (on-site) screening laboratory supplemented by off-site conventional laboratory confirmation analysis.

- Evaluate the use of 1,2,4-Trichlorobenzene (known thinner of PCB transformer oil) as an indicator of the potential presence of PCB contamination. [Removed 1,2,4-TCB from project scope due to analytical protocol limitations; see Table 7-7.]

- Determine the potential migration/distribution of PCB contamination through the use of specific geotechnical analyses that provide physical characteristics of the matrix/substrate (i.e., do higher PCB concentrations correlate with higher TOC concentrations, do PCB concentrations correlate with particle size distribution of the soil/sediment matrix).

- Evaluate the behavior of PCBs and other contaminants in site sediments using standard testing procedures (DRET, SBLT, TCLP) to provide information necessary for the development of site-specific sediment removal and disposal/treatment methodologies.

- Examine congener and homolog-specific PCB composition to facilitate the risk assessment and modeling activities.

- Evaluate PCB concentration partitioning between the suspended solids and water phases utilizing large volume sampling/filtration techniques.

- Determine PCB partitioning between sediment and water phases of core samples by performing PCB analyses on both the pore water (interstitial water) and sediment fractions.

- Determine sediment deposition rates by performing radioisotope dating on sediment cores.

- Determine the absence or presence of other hazardous substances and their role as contaminants of concern via analysis for Appendix IX constituents.
- Monitor the potential volatized and particulate PCB concentrations in air during the remediation and construction phases.
- Determine the extent of hazardous substance migration off-site via waterway or other mode of redistribution.
- Determine extent of remediation needed to meet cleanup goals established for the site.
- Establish human health risk for residual soils remaining after remediation or without remediation.
- Evaluate ecological health risk for residual soils/sediments remaining after remediation or without remediation based on NOAA and Ontario Ministry of Environment sediment quality guidelines.
- Examine the ecological health risks relative to surface and groundwater matrices based on EPA ambient water quality criteria.
- Make effective use of modeling tools to predict long-term trends and potential risks associated with location-specific PCB redistribution/disposition/accumulation in soil and sediment media as well as any inter-related biological tissues.
- Use as support in litigation against the Potentially Responsible Parties (PRP).
- Determine the extent of NAPL adjacent to and beneath the riverbed through the use of field screening techniques for soil samples, including shake test and dye tests. Also through the use of visual observation and periodic gauging of piezometers (SSERC-EE/CA).
- Determine physical properties of bank soils and soil/sediment beneath the river through split-spoon sampling and analysis of material for relevant geotechnical parameters (SSERC-EE/CA).
- Determine groundwater flux rates and influent groundwater quality to the river through the use of seepage meters (SSERC-EE/CA).

Additional data quality objectives will be developed as work progresses, and addendums to the QAPP and/or Work Plans will be published as deemed necessary. Because of the complexity of the program Statement of Work, the specific sampling efforts and their anticipated use will be discussed within each Work Plan.

To obtain data of sufficient quality, measurement performance criteria for precision, selectivity, accuracy/bias, representativeness, sensitivity, completeness, and comparability need to be established for each matrix, analytical parameter, concentration level, and analyte. These parameters indicate the qualitative and quantitative degree of quality associated with measurement data and hence are also referred to as data quality indicators (DQIs). DQIs quantify the amount of error in the data collection process and the analytical measurement system. The general DQI descriptions are presented in Section 15, whereas numerous QC analyses and associated DQI designations are discussed in Section 8 of this QAPP. In addition, the specific measurement criteria are outlined in the following subsections. These QC criteria, presented in Tables 4-1 and 4-2, were established to be rigorous enough to fulfill the overall project DQOs.

4.2 MEASUREMENT PERFORMANCE CRITERIA

The quality control specifications for this project are listed in this section of the plan. They are established to interpret the degree of acceptability or usability of the data in relation to a data quality indicator. The definitions and descriptions of how these quality control specifications are used to assess the accuracy, precision, completeness, representativeness, and comparability of the data are addressed in Section 15 of this plan.

4.2.1 Field Measurements

Table 4-1 summarizes the quality control requirements for field measurements. In the event that an acceptance criteria is not met, the deficiency will be evaluated. If the cause of the deficiency can be identified or the instrument can simply be recalibrated, the measurement will be repeated. If the measurement cannot be repeated, the field team will follow corrective action requirements.

Table 4-1

Field Measurement Quality Control Specifications

Analysis Method	Parameter	Quality Control Check	Frequency	Acceptance Criteria	Corrective Action
SW-846 9040B	pH	2-point (4 and 7) calibration with pH buffers	1 per day or when continuing check fails	pH ± 0.01 units of true value	1. Check with new buffers 2. Repair meter; repeat calibration
		Continuing calibration with pH 7 buffer	1/10 samples	pH ± 0.01 units of true value	1. Recalibrate
		Field duplicate	1/10 samples	± 5%	1. Evaluate 2. Repeat measurement 3. Recalibrate and remeasure
SW-846 9050A	Conductivity	Calibration with KCl Standard	1 per day at beginning of testing	± 5%	1. Evaluate 2. Recalibrate
		Field duplicate	1/10 samples	± 5%	1. Evaluate 2. Correct problem 3. Repeat measurement
EPA170.1	Temperature	Field duplicate	1/10 samples	± 1.0°C	1. Evaluate 2. Repeat measurement
EPA180.1	Turbidity	Calibration with one formazin standard per instrument range used	1 per day or when continuing check fails	± 5%	1. Evaluate 2. Replace meter as needed 3. Recalibrate
		Field duplicate	1/10 samples	RPD <20%	1. Correct problem 2. Repeat measurement
SM4500-OC	Dissolved Oxygen	Initial calibration with standard near range of interest	1 per day or when continuing fails	± 5%	1. Evaluate 2. Recalibrate
		Continuing calibration	1/10 samples	± 5%	1. Evaluate 2. Recalibrate
		Field duplicate	1/10 samples	RPD <20%	1. Correct problem 2. Repeat measurement

4.2.2 Analytical Measurements

Table 4-2 summarizes the quality control sample requirements for the laboratory analytical measurements. In addition to the quality control samples specified in Table 4-2, a temperature blank will be included in each shipping container or cooler containing samples that must be kept cool. The temperature blank must be received by the laboratory at a temperature between 4 ± 2 degrees Celsius (°C).

In the event an acceptance criteria for a temperature blank or quality control requirement in Tables 4-2, 4-3, or 4-4 is not met, the Analytical Manager (WESTON) will be contacted and the deficiency will be evaluated. If the cause of the deficiency can be identified or the instrument can simply be recalibrated, the measurement will be repeated. If the measurement cannot be repeated, or there are other deficiencies that impact data generated from reanalysis, the WESTON Project Manager, or designee, will be contacted for resolution. If the measurement cannot be repeated, the field team will follow the corrective action specified below, and the laboratory will follow their internal corrective action procedures specified in their Quality Assurance Plan. See the laboratory SOPs in Appendix A.

Table 4-2

Analytical Measurements Quality Control Requirements

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8082 (SOPs A-24, A-48, A-49, A-50, A-73, A-74, A-75, and A-79)	PCBs (Aroclor-Specific)	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50% (soil) RPD < 30% (water)	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Matrix Spike and Matrix Spike Duplicate DQI-Accuracy/ Precision	Per Field Team submission	Per Table 4-3	1. Evaluate batch (Narrate)
			Initial Calibration DQI-Precision	Five-point prior to sample analysis	Linear mean RSD for all analytes ≤20%, with no individual analyte RSD >30%	1. Evaluate 2. Recalibrate when QC criterion is not met
			Second Source Calibration Verification DQI-Accuracy/Bias	Once per five-point initial calibration for PCB 1016/ 1260 mix	Mix within ±15% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met
			Retention Time Window DQI-Accuracy/Bias	Each initial calib. and calib. verif. for PCB 1016/1260 mix	±3 STD deviations for each analyte retention time in 72-hour period	1. Evaluate 2. Reanalyze all samples analyzed since the last retention time check
			Initial Calibration Verification DQI-Accuracy/Bias	Daily before sample analysis for PCB 1016/1260 mix	Within ±15% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met
			Calibration Verification DQI-Precision	After every 20 samples and at end of analysis sequence for PCB 1016/ 1260 mix	All analytes within ±15% of expected value	1. Evaluate 2. Clean system 3. Reanalyze calib. verif. and all samples since the last acceptable calib. verif.

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8082 (SOPs A-24, A-48, A-49, A-50, A-73, A-74, A-75, and A-79) (cont.)	PCBs (Aroclor-Specific)	Laboratory	Cleanup Blank DQI-Accuracy/Bias	1/batch or 1/20 samples per cleanup procedure performed	<½ PQL	1. Evaluate 2. Clean system 3. Reanalyze when QC criterion is not met
			Surrogate DQI-Accuracy/Bias	Every sample	Per Table 4-4	1. Rerun 2. Re-extract as necessary (Narrate)
			Method Blank DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	<½ PQL	1. Rerun 2. Evaluate batch (Narrate) 3. Re-extract as necessary
			Laboratory Control Sample DQI-Sensitivity	1/batch/ matrix or 1/20 samples, whichever is more frequent	See Table 4-3	1. Rerun 2. Evaluate batch (Narrate) 3. Re-extract as necessary
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 MOD8082 (Field Method) (SOPs A-37 and A-53)	PCBs (Aroclor-Specific)	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50% (soil) RPD < 30% (water)	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Matrix Spike and Matrix Spike Duplicate DQI-Accuracy/ Precision	Per Field Team submission	Per Table 4-3	1. Evaluate batch (Narrate)
			Initial Calibration DQI-Precision	Five-point prior to sample analysis (six-point after 6/23/00)	Linear regression curve, correlation coefficient >0.0995	1. Evaluate 2. Recalibrate when QC criterion is not met
			Second Source Calib. Verif. DQI-Accuracy/Bias	Once per five-point initial calibration for PCB 1248/ 1254/1260 mix + 1,2,4-TCB (six-point after 6/23/00 and 1,2,4-TCB eliminated 4/99)	Mix within ±30% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met (>50% of expected value)
			Retention Time Window DQI-Accuracy/Bias	Each initial calib. and calib. verif. for PCB 1260 + 1,2,4-TCB (1,2,4-TCB eliminated 4/99)	±3 STD deviations for each analyte retention time in 72-hour period	1. Evaluate 2. Reanalyze all samples analyzed since the last retention time check

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 MOD8082 (Field Method) (SOPs A-37 and A-53) (cont.)	PCBs-Aroclor Specific	Laboratory	Calibration Verification DQI-Precision	After every 10 samples and at end of analysis sequence for PCB 1260 + 1,2,4-TCB (1,2,4-TCB eliminated 4/99)	All analytes within ±25% of expected value	1. Evaluate 2. Clean system 3. Reanalyze calib. verif. and all samples since the last acceptable calib. verif.
			Instrument Blank DQI-Accuracy/Bias	1/10 samples	<½ PQL	1. Evaluate 2. Reanalyze as necessary
			Cleanup Blank DQI-Accuracy/Bias	1/batch or 1/20 samples per cleanup procedure performed	<½ PQL	1. Evaluate 2. Clean system 3. Reanalyze as necessary
			Surrogate DQI-Accuracy/Bias	Every sample	Per Table 4-4	1. Rerun 2. Re-extract as necessary (Narrate)
			Method Blank DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	<½ PQL	1. Rerun 2. Evaluate batch (Narrate) 3. Re-extract as necessary
			Laboratory Control Sample DQI-Sensitivity	1/batch/ matrix or 1/20 samples, whichever is more frequent	See Table 4-3	1. Rerun 2. Evaluate batch (Narrate) 3. Re-extract as necessary
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
Modified EPA1668 (SOP A-38)	PCBs (Congener/ Homolog-Specific) [HRGC/HRMS]	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50% (soil) RPD < 30% (water)	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
Modified EPA 1668 (SOP A-38) (cont.)	PCB (Congener/ Homolog-Specific) [HRGC/HRMS]	Laboratory	Instrument Performance Check DQI-Accuracy/Bias	Prior to initial and calibration verification perfluoro-kerosene (PFK)	Refer to SOP A-38	1. Evaluate 2. Retune instrument, verify
			Initial Calibration DQI-Precision	Five-point calibration for all analytes prior to sample analysis	Isotope dilution or internal standard, see SOP A-38	1. Evaluate 2. Recalibrate when QC criterion is not met
			Identification/Retention Times/Ion Ratios/Signal to Noise/ Inferences DQI-Accuracy/Bias	In accordance with SOP A-38	See SOP A-38 S/N exceeds 10:1 for all ions Ion Abundance Ratio: ±15% Absolute retention time within ±15 sec. of calibration	1. Evaluate 2. Rerun as necessary
			Calibration Verification DQI-Precision	Daily, before sample analysis and every 12 hours of analysis time	RF within method limits chromato-graphic resolution better than 25%	1. Evaluate 2. Repeat initial calibration when QC criterion is not met
			Internal Standards DQI-Sensitivity	Immediately after or during data acquisition for each sample	%R 25-150%	1. Evaluate 2. Inspect for malfunctions 3. Reanalyze sample as necessary

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
Modified EPA 1668 (SOP A-38) (cont.)	PCB (Congener/ Homolog-Specific) [HRGC/HRMS]	Laboratory	Method Blank DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	<½ PQL	1. Rerun 2. Evaluate batch (Narrate) 3. Reanalyze as necessary
			Initial Precision and Recovery (IPR) DQI-Accuracy/Bias	Prior to any analysis by this method	See SOP A-38	1. Evaluate 2. Repeat as necessary
			Ongoing Precision and Recovery (OPR) DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	See Table 4-3	1. Rerun 2. Evaluate batch (Narrate) 3. Reanalyze as necessary
SW-846 8081A 8150B 8141A (SOPs A-23, A-26, and A-25)	Organo-chlorine Pesticides, Herbicides, OP Pesticides	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD <50% (soil) RPD <30% (water)	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Matrix Spike and Matrix Spike Duplicate DQI-Accuracy/ Precision	Per Field Team submission	Per Table 4-3	1. Evaluate batch (Narrate)
			Initial Calibration DQI-Precision	Five-point calibration for all analytes prior to sample analysis	Linear mean RSD for all analytes ≤20%, with no individual analyte RSD >30%	1. Evaluate 2. Recalibrate when QC criterion is not met

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8081A 8150B 8141A (SOPs A-23, A-26, and A-25) (cont.)	Organo-chlorine Pesticides, Herbicides, OP Pesticides	Laboratory	Second Source Calibration Verification DQI-Accuracy/Bias	Once per five-point initial calibration for all analytes	All analytes within ±15% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met
			Retention Time Window DQI-Accuracy/Bias	Each initial calibration and calibration verification	±3 standard deviations for each analyte retention time in 72-hour period	1. Evaluate 2. Reanalyze all samples analyzed since the last retention time check
			Initial Calibration Verification DQI-Accuracy/Bias	Daily before sample analysis	Within ±15% of expected value	1. Evaluate 2. Repeat initial calibration
			Calibration Verification DQI-Precision	After every 10 samples and at end of sequence	All analytes within ±15% of expected value	1. Evaluate 2. Clean system 3. Reanalyze calibration verif. and all samples since last successful calibration verification
			Second Column Confirmation DQI-Precision	100% for all positive results (excluding toxaphene and chlordane)	Same as initial column analyses	1. Same as initial column analyses
			Cleanup Blank DQI-Accuracy/Bias	1/batch or 1/20 samples per cleanup procedure performed	<½ PQL	1. Evaluate 2. Clean system 3. Reanalyze as necessary
			Surrogate DQI-Accuracy/Bias	Every sample	Per Table 4-4	1. Rerun 2. Re-extract as necessary (Narrate)

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8081A 8150B 8141A (SOPs A-23, A-26, and A-25) (cont.)	Organo-chlorine Pesticides, Herbicides, OP Pesticides	Laboratory	Method Blank DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	<½ PQL	1. Rerun 2. Evaluate batch (Narrate) 3. Re-extract as necessary
			Laboratory Control Sample DQI-Sensitivity	1/batch/ matrix or 1/20 samples, whichever is more frequent	See Table 4-3	1. Rerun 2. Evaluate batch (Narrate) 3. Re-extract as necessary
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action
SW-846 8290 (SOPs A-36, A-51, and A-52)	Polychlorinated Dibenzo-p-dioxins/ Polychlorinated Dibenzofurans (PCDD/PCDF) Compounds	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50% (soil) RPD < 30% (water)	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Matrix Spike and Matrix Spike Duplicate DQI-Accuracy/ Precision	Per Field Team submission	Per Table 4-3	1. Evaluate batch (Narrate)
			Mass Spectrometer Tune DQI-Accuracy/Bias	As per SW-8290 Section 7.6.2	As per SW-8290 Section 7.6.2	1. Evaluate 2. Retune instrument, verify

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8290 (SOPs A-36, A-51, and A-52) (cont.)	Polychlorinated Dibenzo-p-dioxins/ Polychlorinated Dibenzofurans (PCDD/PCDF) Compounds	Laboratory	Initial and Continuing Calibrations DQI-Precision	As per SW-8290 Section 7.7	As per SW-8290 Section 7.7 chromato-graphic resolution >25%	1. Evaluate 2. Recalibrate when QC criterion is not met
			Identification/ Retention Times/ Ion Ratios/Signal to Noise/ Interferences DQI-Accuracy/Bias	As per SW-8290 Section 7.8.4	As per SW-8290 Section 7.8.4 S/N exceeds 10:1 for all ions. Ion abundance ratio ±15%	1. Evaluate 2. Rerun as necessary
			System Performance Check DQI-Accuracy/Bias	As per SW-8290 Section 8.2	As per SW-8290 Section 8.2	1. Evaluate 2. Rerun as necessary
			Quality Control Checks DQI-Accuracy/Bias	As per SW-8290 Section 8.3	As per SW-8290 Section 8.3	1. Evaluate 2. Rerun as necessary
			Internal Standards DQI-Accuracy/Bias	As per SW-8290 Section 8.4	As per SW-8290 Section 8.4 %R=40-135%	1. Evaluate 2. Rerun as necessary
			Surrogate DQI-Accuracy/Bias	Every sample	Per Table 4-4	1. Rerun 2. Re-extract as necessary (Narrate)
			Method Blank DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	<½ PQL	1. Rerun 2. Evaluate batch (Narrate) 3. Re-extract as necessary
			Laboratory Control Sample DQI-Sensitivity	1/batch/ matrix or 1/20 samples, whichever is more frequent	See Table 4-3	1. Rerun 2. Evaluate batch (Narrate) 3. Re-extract as necessary

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8290 (SOPs A-36, A-51, and A-52) (cont.)	Polychlorinated Dibenzo-p-dioxins/ Polychlorinated Dibenzofurans (PCDD/PCDF) Compounds	Laboratory	Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action
SW-846 6010B SOPs A-18, A-19, and A-20)	Metal Analytes	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50% (soil) RPD < 30% (water)	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Matrix Spike DQI-Accuracy/Bias	Per Field Team submission	Per Table 4-3	1. Evaluate batch 2. Redigest as necessary (Narrate)
			Laboratory Duplicate (Replicate) DQI-Precision	1/20 samples/matrix	RPD<20	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)
			Initial Calibration DQI-Precision	Daily prior to sample analysis (min. 1 standard and a blank)	N/A	N/A
			Initial Calibration Verification DQI-Accuracy/Bias	Daily after initial calibration	All analytes within ±10% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met
			Calibration Blank (ICB/CCB) DQI-Accuracy/Bias	After every calibration/ verification	No analytes detected ≥½ RL	1. Evaluate 2. Reanalyze calib. blank and previous 10 samples.

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 6010B SOPs A-18, A-19, and A-20) (cont.)	Metal Analytes	Laboratory	Calibration Verification (Instrument Check Standard) DQI-Precision	After every 10 samples at the end of the analysis sequence	All analytes within ±10% of expected value and RSD of replicate integrations <5%	1. Evaluate 2. Reanalyze calib. and all samples since last successful calibration
			Interference Check Solution DQI-Precision	At beginning of analytical run	Within ±20% of expected value	1. Terminate analysis 2. Evaluate 3. Reanalyze ICS and affected samples
			Method Blank DQI-Accuracy/Bias	1/batch/matrix	<½ PQL	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)
			Laboratory Control Sample DQI-Sensitivity	1/batch/matrix or 1/20 samples, whichever is more frequent	75-125%	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action
SW-846 9010B (SOP A-5)	Cyanide	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50% (soil) RPD < 30% (water)	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Matrix Spike DQI-Accuracy/Bias	Per Field Team submission	Per Table 4-3	1. Evaluate batch 2. Redigest as necessary (Narrate)

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 9010B (SOP A-5) (cont.)	Cyanide	Laboratory	Laboratory Duplicate (Replicate) DQI-Precision	1/20 samples/matrix	RPD<20	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)
			Multipoint Calibration Curve DQI-Precision	Daily prior to sample analysis	Correlation coefficient ≥0.995 for linear regression	1. Evaluate system 2. Recalibrate when QC criterion is not met.
			Distilled Standards DQI-Accuracy/Bias	Once per multipoint calibration	Cyanide within ±10% of true value	1. Evaluate 2. Repeat standards
			Second Source Calibration Verification DQI-Accuracy/Bias	Once per stock standard preparation	Cyanide within ±15% of expected value	1. Evaluate 2. Recalibrate initial calib.
			Method Blank DQI-Accuracy/Bias	1/batch/matrix	<½ PQL	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)
			Laboratory Control Sample DQI-Sensitivity	1/batch/matrix or 1/20 samples, whichever is more frequent	75-125%	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
Misc. EPA (SOPs – See Appendix A)	Misc. Wet Chemistry	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD < 50% (soil) RPD < 30% (water)	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Matrix Spike DQI-Accuracy/Bias	Per Field Team submission	Per Table 4-3	1. Evaluate batch 2. Re-prep/analyze as necessary (Narrate)
			Calibration curve (where applicable) DQI-Precision	Beginning of Analytical Sequence	Per SW-846	1. Evaluate system 2. Recalibrate when QC criterion is not met
			Initial Calibration Blank (where applicable) DQI-Accuracy/Bias	After Initial Calibration Curve	Per SW-846	1. Rerun 2. Clean system 3. Reanalyze affected samples
			Continuing Calibration (where applicable) DQI-Precision	Every 2 hrs or 1/10 samples	90-110% of true value	1. Evaluate System 2. Repeat calibration check 3. Recalibrate/ restandardize when QC criterion is not met
			Laboratory Duplicate DQI-Accuracy/Bias	1/20 samples/matrix	RPD<20	1. Evaluate System 2. Repeat calibration check 3. Recalibrate/ restandardize when QC criterion is not met
			Method Blank DQI-Accuracy/Bias	1/batch/matrix	<½ PQL	1. Rerun 2. Evaluate batch 3. Re-prep/analyze as necessary (Narrate)

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
Misc. EPA (SOPs – See Appendix A) (cont.)	Misc. Wet Chemistry	Laboratory	Laboratory Control Sample DQI-Sensitivity	1/batch/matrix or 1/20 samples, whichever is more frequent	See Table 4-3	1. Rerun 2. Evaluate batch 3. Re-prep/analyze as necessary (Narrate)
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action
SW-846 7470A 7471A (SOPs A-21 and A-22)	Mercury	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50% (soil) RPD < 30% (water)	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Matrix Spike DQI-Accuracy/Bias	Per Field Team submission	Per Table 4-3	1. Evaluate batch 2. Redigest as necessary (Narrate)
			Laboratory Duplicate (Replicate) DQI-Precision	1/20 samples/matrix	RPD<20	1. Evaluate system 2. Repeat calibration check 3. Recalibrate/ restandardize when QC criterion is not met
			Initial Calibration DQI-Precision	Daily prior to analysis	Correlation coefficient ≥0.995 for linear regression	1. Evaluate 2. Recalibrate when QC criterion is not met
			Second Source Calibration Check Standard DQI-Accuracy/Bias	Once per initial daily multipoint calibration	Analyte within ±10% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 7470A 7471A (SOPs A-21 and A-22) (cont.)	Mercury	Laboratory	Calibration Blank DQI-Accuracy/Bias	One per initial daily multipoint calibration	No analyte detected ≥PQL	1. Evaluate 2. Reanalyze blank and all samples associated with blank
			Calibration Verification DQI-Precision	After every 10 samples and at end of the analysis sequence	Analyte within ±20% of expected value	1. Evaluate 2. Recalibrate and reanalyze all samples since last successful calibration
			Method Blank DQI-Accuracy/Bias	1/batch/matrix	<½ PQL	1. Rerun 1. Evaluate batch 3. Redigest as necessary (Narrate)
			Laboratory Control Sample DQI-Sensitivity	1/batch/matrix or 1/20 samples, whichever is more frequent	75-125%	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action
SW-846 8260B (SOPs A-27 and A-34)	Volatile Organic Compounds	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50% (soil) RPD < 30% (water)	NA
			Trip Blank (VOC only) DQI-Accuracy/Bias	1 per cooler	<½ PQL	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8260B (SOPs A-27 and A-34) (cont.)	Volatile Organic Compounds	Laboratory	Matrix Spike/ Matrix Spike Duplicate DQI-Accuracy/ Precision	Per Field Team submission	Per Table 4-3	1. Evaluate batch (Narrate)
			Initial Calibration DQI-Precision	Five-point calibration for all analytes prior to sample analysis	SPCCs avg. RF≥0.3[a] and %RSD for RFs for CCCs ≤30% and mean RSD for all analytes ≤15% with no individual analyte RSD >30%	1. Evaluate 2. Recalibrate when QC criterion is not met
			Second Source Calibration Verification DQI-Accuracy/Bias	Once per five-point initial calibration	All analytes within ±25% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met
			Retention Time Window DQI-Accuracy/Bias	Each sample for each analyte	Relative retention time (RRT) of the analyte within ±0.06 RRT units of the RRT	1. Evaluate 2. Reanalyze all samples analyzed since the last retention time check
			Calibration Verification DQI-Precision	Daily, before sample analysis and every 12 hours of analysis time	SPCCs average RF ≥0.30[a] and CCCs ≤20% difference, all calibration analytes within ±20% of expected value	1. Evaluate 2. Repeat initial calibration when QC criterion is not met

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8260B (SOPs A-27 and A-34) (cont.)	Volatile Organic Compounds	Laboratory	Internal Standards DQI-Sensitivity	Immediately after or during data acquisition for each sample	Retention time ±30 seconds from RT of the midpoint standard in the initial calibration EICP area within -50% to +100% of initial calib. midpoint standard	1. Evaluate 2. Inspect for malfunctions 3. Reanalyze samples as necessary
			Instrument Performance Check DQI-Accuracy/Bias	Prior to initial and calibration verification BFB	Refer to SW-846	1. Evaluate 2. Retune instrument, verify
			Surrogate DQI-Accuracy/Bias	Every sample	See Table 4-4	1. Rerun 2. Reanalyze as necessary (Narrate)
			Method Blank DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	<½ PQL	1. Rerun 2. Evaluate batch (Narrate) 3. Reanalyze as necessary
			Laboratory Control Sample DQI-Sensitivity	1/batch/matrix or 1/20 samples, whichever is more frequent	See Table 4-3	1. Rerun 2. Evaluate batch (Narrate) 3. Reanalyze as necessary
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8270C (SOPs A-28 and A-78)	Semivolatile Organic Compounds	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50% (soil) RPD < 30% (water)	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Matrix Spike/ Matrix Spike Duplicate DQI-Accuracy/Bias	Per Field Team submission	Per Table 4-3	1. Evaluate batch (Narrate)
			Initial Calibration DQI-Precision	Five-point calibration for all analytes prior to sample analysis	SPCCs avg. RF≥0.050 and %RSD for RFs for CCCs ≤30% and mean RSD for all analytes ≤15% with no individual analyte RSD >30%	1. Evaluate 2. Recalibrate when QC criterion is not met
			Second Source Calibration Verification DQI-Accuracy/Bias	Once per five-point initial calibration	All analytes within ±25% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met
			Retention Time Window DQI-Accuracy/Bias	Each sample for each analyte	Relative retention time (RRT) of the analyte within ±0.06 RRT units of the RRT	1. Evaluate 2. Reanalyze all samples analyzed since the last retention time check
			Calibration Verification DQI-Precision	Daily, before sample analysis and every 12 hours of analysis time	SPCCs average RF ≥0.050 and CCCs ≤20% difference, all calibration analytes within ±20% of expected value	1. Evaluate 2. Repeat initial calibration when QC criterion is not met

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8270C (SOPs A-28 and A-78) (cont.)	Semivolatile Organic Compounds	Laboratory	Internal Standards DQI-Sensitivity	Immediately after or during data acquisition for each sample	Retention time ±30 seconds from RT of the midpoint standard in the initial calibration EICP area within -50% to +100% of initial calib. midpoint standard	1. Evaluate 2. Inspect for malfunctions 3. Reanalyze samples as necessary
			Instrument Performance Check DQI-Accuracy/Bias	Prior to initial and calibration verification DFTPP	Refer to SW-846	1. Evaluate 2. Retune instrument, verify
			Surrogate DQI-Accuracy/Bias	Every sample	See Table 4-4	1. Rerun 2. Reanalyze as necessary (Narrate)
			Method Blank DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	<½ PQL	1. Rerun 2. Evaluate Batch (Narrate) 3. Reanalyze as necessary
			Laboratory Control Sample DQI-Sensitivity	1/batch/matrix or 1/20 samples, whichever is more frequent	See Table 4-3	1. Rerun 2. Evaluate batch (Narrate) 3. Reanalyze as necessary
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SIM (SOP A-29)	Polynuclear Aromatic Hydrocarbons	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50% (soil) RPD < 30% (water)	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Initial Calibration DQI-Precision	Five-point calibration for all analytes prior to sample analysis	%RSD ≤25% and RRF ≥0.200	1. Evaluate 2. Recalibrate when QC criterion is not met
			Calibration Verification DQI-Precision	Daily, before sample analysis and every 12 hours of analysis time	%D ≤25% and RRF ≥0.200	1. Evaluate 2. Repeat initial calibration when QC criterion is not met
			Internal Standards DQI-Sensitivity	Immediately after or during data acquisition for each sample	Retention time ±30 seconds from RT of the midpoint standard in the initial calibration EICP area within -50% to +100% of initial calib. midpoint standard	1. Evaluate 2. Inspect for malfunctions 3. Reanalyze samples as necessary
			Instrument Performance Check DQI-Accuracy/Bias	Prior to initial and calibration verification DFTPP	Refer to SOP A-29	1. Evaluate 2. Retune instrument, verify
			Surrogate DQI-Accuracy/Bias	Every sample	See Table 4-4	1. Rerun 2. Reanalyze as necessary (Narrate)

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SIM (SOP A-29) (cont.)	Polynuclear Aromatic Hydrocarbons	Laboratory	Method Blank DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	<½ PQL	1. Rerun 2. Evaluate batch (Narrate) 3. Reanalyze as necessary
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action
EPA 680 (SOPs A-83, A-84, and A-85)	PCBs (Homolog-Specific) [Vegetation]	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50% (soil & vegetation)	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Initial Calibration DQI-Precision	Five-point calibration for all analytes prior to sample analysis	%RSD ≤25% or $R^2 \geq 0.99$	1. Evaluate 2. Recalibrate when QC criterion is not met
			Calibration Verification DQI-Precision	Daily, before sample analysis and every 12 hours of analysis time	%D ≤25% See SOP A-85	1. Evaluate 2. Repeat initial calibration when QC criterion is not met

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
EPA 680 (SOPs A-83, A-84, and A-85)	PCBs (Homolog-Specific) [Vegetation]	Laboratory	Internal Standards DQI-Sensitivity	Immediately after or during data acquisition for each sample	Retention time ±30 seconds from RT of the midpoint standard in the initial calibration EICP area within -50% to +100% of initial calib. midpoint standard	1. Evaluate 2. Inspect for malfunctions 3. Reanalyze samples as necessary
			Instrument Performance Check DQI-Accuracy/Bias	Prior to initial and calibration verification DFTPP	Refer to SOP A-85	1. Evaluate 2. Retune instrument, verify
			Surrogate DQI-Accuracy/Bias	Every sample	See Table 4-4	1. Rerun 2. Reanalyze as necessary (Narrate)
			Method Blank DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	<½ PQL	1. Rerun 2. Evaluate batch (Narrate) 3. Reanalyze as necessary
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
EPA Method TO-4 (SOP A-42)	PCBs (Aroclor-Specific) [AIR]	Field Sampling	Trip Blank DQI-Accuracy/Bias	1/batch or SDG, whichever is more frequent	< ½ POL	NA
		Laboratory	Matrix Spike and Matrix Spike Duplicate DQI-Accuracy/ Precision	Per Field Team submission	Per Table 4-3	1. Evaluate batch (Narrate)
			Initial Calibration DQI-Precision	Five-point prior to sample analysis	Linear mean RSD for all analytes ≤20%, with no individual analyte RSD >30%	1. Evaluate 2. Recalibrate when QC criterion is not met
			Second Source Calibration Verification DQI-Accuracy/Bias	Once per five-point initial calibration for PCB 1016/ 1260 mix	Mix within ±20% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met
			Retention Time Window DQI-Accuracy/Bias	Each initial calib. and calib. verif. for PCB 1016/1260 mix	±3 STD deviations for each analyte retention time in 72-hour period	1. Evaluate 2. Reanalyze all samples analyzed since the last retention time check
			Initial Calibration Verification DQI-Accuracy/Bias	Daily before sample analysis for PCB 1016/1260 mix	Within ±15% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met
			Calibration Verification DQI-Precision	After every 10 samples and at end of analysis sequence for PCB 1016/ 1260 mix	All analytes within ±15% of expected value	1. Evaluate 2. Clean system 3. Reanalyze calib. verif. and all samples since the last acceptable calib. verif.

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Quality Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
EPA Method TO-4 (SOP A-42) (cont.)	PCBs (Aroclor-Specific) [AIR]	Laboratory	Cleanup Blank DQI-Accuracy/Bias	1/batch or 1/20 samples per cleanup procedure performed	<½ PQL	1. Evaluate 2. Clean system 3. Reanalyze when QC criterion is not met
			Surrogate DQI-Accuracy/Bias	Every sample	Per Table 4-4	1. Rerun 2. Re-extract as necessary (Narrate)
			Method Blank DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	<½ PQL	1. Evaluate batch (Narrate)
			Laboratory Control Sample DQI-Sensitivity	1/batch/ matrix or 1/20 samples, whichever is more frequent	See Table 4-3	1. Rerun 2. Evaluate batch (Narrate) 3. Re-extract as necessary
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Auditing Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
Modified EPA1668 (SOP A-47)	PCBs (Congeners/ Homolog-Specific) [HRGC/LRMS]	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50% (soil) RPD < 30% (water)	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Instrument Performance Check DQI-Accuracy/Bias	Prior to initial and calibration verification FC-43	Refer to SOP A-47	1. Evaluate 2. Retune instrument, verify
			Initial Calibration DQI-Precision	Five-point calibration for all analytes prior to sample analysis	Isotope dilution or internal standard, see SOP A-47	1. Evaluate 2. Recalibrate when QC criterion is not met
			Identification/Retention Times/Ion Ratios/Signal to Noise/Interferences DQI-Accuracy/Bias	In accordance with SOP A-47	See SOP A-47 S/N exceeds 10:1 for all ions Ion Abundance Ratio: ±15% Absolute retention time within ±15 sec. of calibration	1. Evaluate 2. Rerun as necessary
			Calibration Verification DQI-Precision	Daily, before sample analysis and every 12 hours of analysis time	RF within method limits chromato-graphic resolution better than 30%	1. Evaluate 2. Repeat initial calibration when QC criterion is not met

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Auditing Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
Modified EPA 1668 (SOP A-47) (cont.)	PCBs (Congeners/ Homolog-Specific) [HRGC/LRMS]	Laboratory	Internal Standards DQI-Sensitivity	Immediately after or during data acquisition for each sample	%R 25-150%	1. Evaluate 2. Inspect for malfunctions 3. Reanalyze sample as necessary
			Method Blank DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	<½ PQL	1. Rerun 2. Evaluate batch (Narrate) 3. Reanalyze as necessary
			Ongoing Precision and Recovery (OPR) DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	See Table 4-3	1. Rerun 2. Evaluate batch (Narrate) 3. Reanalyze as necessary
SW-846 8081A 8150B (SOPs A-43, A-44, and A-45)	Organo-chlorine Pesticides, Herbicides (TCLP Extract)	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50%	NA
			Equipment Rinsate DQI-Accuracy Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Matrix Spike and Matrix Spike Duplicate DQI-Accuracy/ Precision	Per Field Team submission	Per Table 4-3	1. Evaluate batch (Narrate)
			Initial Calibration DQI-Precision	Five-point calibration for all analytes prior to sample analysis	Correlation Coefficient ≥ 0.995, or linear regression r^2 ≥ 0.990 or %RSD ≤ 20%	1. Evaluate 2. Recalibrate when QC criterion is not met
			Second Source Calibration Verification DQI-Accuracy/Bias	Once per five-point initial calibration for all analytes	All analytes within ±15% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Auditing Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8081A 8150B (SOPs A-43, A-44, and A-45) (cont.)	Organo-chlorine Pesticides, Herbicides, (TCLP Extract)	Laboratory	Breakdown Check Standard (BCS) for Pesticide Analyses Only DQI-Precision	After every 10 samples	< 20%	1. Evaluate 2. Clean system 3. Recalibrate 4. Reanalyze
			Retention Time Window DQI-Accuracy/Bias	Each initial calibration and calibration verification	±3 standard deviations for each analyte retention time in 72-hour period	1. Evaluate 2. Reanalyze all samples analyzed since the last retention time check
			Initial Calibration Verification DQI-Accuracy/Bias	Daily before sample analysis	Within ±15% of expected value	1. Evaluate 2. Repeat initial calibration
			Calibration Verification DQI-Precision	After every 10 samples and at end of sequence	All analytes within ±15% of expected value	1. Evaluate 2. Clean system 3. Reanalyze calibration verif. and all samples since last successful calibration verification
			Second Column Confirmation DQI-Precision	100% for all positive results (excluding toxaphene and chlordane)	Same as initial column analyses	1. Same as initial column analyses
			Cleanup Blank DQI-Accuracy/Bias	1/batch or 1/20 samples per cleanup procedure performed	<½ PQL	1. Evaluate 2. Clean system 3. Reanalyze as necessary
			Surrogate DQI-Accuracy/Bias	Every sample	Per Table 4-4	1. Rerun 2. Re-extract as necessary (Narrate)

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Auditing Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8081A 8150B (SOPs A-43, A-44, and A-45) (cont.)	Organo-chlorine Pesticides, Herbicides, (TCLP Extract)	Laboratory	Method Blank DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	<½ PQL	1. Rerun 2. Evaluate batch (Narrate) 3. Re-extract as necessary
			TCLP Extraction Blank DQI-Accuracy/Bias	1/batch	<½ PQL	1. Rerun 2. Evaluate batch (Narrate) 3. Re-extract as necessary
			Laboratory Control Sample DQI-Sensitivity	1/batch/matrix or 1/20 samples, whichever is more frequent	See Table 4-3	1. Rerun 2. Evaluate batch (Narrate) 3. Re-extract as necessary
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action
SW-846 6010B SOPs A-43, A-18, and A-46)	Metal Analytes (TCLP Extract)	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50%	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Matrix Spike DQI-Accuracy/Bias	Per Field Team submission	Per Table 4-3	1. Evaluate batch 2. Redigest as necessary (Narrate)
			Laboratory Duplicate (Replicate) DQI-Precision	1/20 samples/matrix	RPD<20	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Auditing Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 6010B SOPs A-43, A-18, and A-46) (cont.)	Metal Analytes (TCLP Extract)	Laboratory	Initial Calibration DQI-Precision	Daily prior to sample analysis (min. 1 standard and a blank)	N/A	N/A
			Initial Calibration Verification DQI-Accuracy/Bias	Daily after initial calibration	All analytes within ±10% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met
			Calibration Blank (ICB/CCB) DQI-Accuracy/Bias	After every calibration/ verification	No analytes detected ≥½ RL	1. Evaluate 2. Reanalyze calib. blank and previous 10 samples
			Calibration Verification (Instrument Check Standard) DQI-Precision	After every 10 samples at the end of the analysis sequence	All analytes within ±10% of expected value and RSD of replicate integrations <5%	1. Evaluate 3. Reanalyze calib. and all samples since last successful calibration
			Interference Check Solution DQI-Precision	At beginning of analytical run	Within ±20% of expected value	1. Terminate analysis 2. Evaluate 3. Reanalyze ICS and affected samples
			Method Blank DQI Accuracy/Bias	1/batch/matrix	<½ PQL	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)
			TCLP Extraction Blank DQI Accuracy/Bias	1/batch	<½ PQL	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Auditing Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 6010B SOPs A-43, A-18, and A-46) (cont.)	Metal Analytes (TCLP Extract)	Laboratory	Laboratory Control Sample DQI-Sensitivity	1/batch/matrix or 1/20 samples, whichever is more frequent	75-125%	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)
			Performance Evaluation Sample DQI Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action
SW-846 8270C (SOP A-28 and A-43)	Semivolatile Organic Compounds (TCLP Extract)	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50%	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Matrix Spike/ Matrix Spike Duplicate DQI-Accuracy/ Precision	Per Field Team submission	Per Table 4-3	1. Evaluate batch (Narrate)
			Initial Calibration DQI-Precision	Five-point calibration for all analytes prior to sample analysis	SPCCs avg. RF≥0.050 and %RSD for RFs for CCCs ≤30% and mean RSD for all analytes ≤15% with no individual analyte RSD >30%	1. Evaluate 2. Recalibrate when QC criterion is not met

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Auditing Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8270C (SOP A-28 and A-43) (cont.)	Semivolatile Organic Compound (TCLP Extract)	Laboratory	Second Source Calibration Verification DQI-Accuracy/Bias	Once per five-point initial calibration	All analytes within ±25% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met
			Retention Time Window DQI-Accuracy/Bias	Each sample for each analyte	Relative retention time (RRT) of the analyte within ±0.06 RRT units of the RRT	1. Evaluate 2. Reanalyze all samples analyzed since the last retention time check
			Calibration Verification DQI-Precision	Daily, before sample analysis and every 12 hours of analysis time	SPCCs average RF ≥0.050 and CCCs ≤20% difference, all calibration analytes within ±20% of expected value	1. Evaluate 2. Repeat initial calibration when QC criterion is not met
			Internal Standards DQI-Sensitivity	Immediately after or during data acquisition for each sample	Retention time ±30 seconds from RT of the midpoint standard in the initial calibration EICP area within -50% to +100% of initial calib. midpoint standard	1. Evaluate 2. Inspect for malfunctions 3. Reanalyze samples as necessary

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Auditing Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 8270C (SOP A-28 and A-43) (cont.)	Semivolatile Organic Compounds (TCLP Extract)	Laboratory	Instrument Performance Check DQI-Accuracy/Bias	Prior to initial and calibration verification DFTPP	Refer to SW-846	1. Evaluate 2. Retune instrument, verify
			Surrogate DQI-Accuracy/Bias	Every sample	See Table 4-4	1. Rerun 2. Reanalyze as necessary (Narrate)
			Method Blank DQI-Accuracy/Bias	1/batch/matrix or 1/20 samples, whichever is more frequent	<½ PQL	1. Rerun 2. Evaluate batch (Narrate) 3. Reanalyze as necessary
			TCLP Extraction Blank DQI-Accuracy/Bias	1/batch	<½ PQL	Rerun 2. Evaluate batch (Narrate) 3. Reanalyze as necessary
			Laboratory Control Sample DQI-Sensitivity	1/batch/matrix or 1/20 samples, whichever is more frequent	See Table 4-3	1. Rerun 2. Evaluate batch (Narrate) 3. Reanalyze as necessary
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Auditing Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 7470A (SOPs A-21 and A-43)	Mercury (TCLP Extract)	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50%	NA
			Equipment Rinsate DQI-Accuracy/Bias	See Subsection 8.1.3	<½ PQL	NA
		Laboratory	Matrix Spike DQI-Accuracy/Bias	Per Field Team submission	Per Table 4-3	1. Evaluate batch 2. Redigest as necessary (Narrate)
			Laboratory Duplicate (Replicate) DQI-Precision	1/20 samples/matrix	RPD<20	1. Evaluate system 2. Repeat calibration check 3. Recalibrate/ restandardize when QC criterion is not met
			Initial Calibration DQI-Precision	Daily prior to analysis	Correlation coefficient ≥0.995 for linear regression	1. Evaluate 2. Recalibrate when QC criterion is not met
			Second Source Calibration Check Standard DQI-Accuracy/Bias	Once per initial daily multipoint calibration	Analyte within ±10% of expected value	1. Evaluate 2. Recalibrate when QC criterion is not met
			Calibration Blank DQI-Accuracy/Bias	One per initial daily multipoint calibration	No analyte detected ≥PQL	1. Evaluate 2. Reanalyze blank and all samples associated with blank
			Calibration Verification DQI-Precision	After every 10 samples and at end of the analysis sequence	Analyte within ±20% of expected value	1. Evaluate 2. Recalibrate and reanalyze all samples since last successful calibration

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Auditing Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SW-846 7470A (SOPs A-21 and A-43) (cont.)	Mercury (TCLP Extract)	Laboratory	Method Blank DQI-Accuracy/Bias	1/batch/matrix	<½ PQL	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)
			TCLP Extraction Blank DQI-Accuracy/Bias	1/Batch	<½ PQL	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate
			Laboratory Control Sample DQI-Sensitivity	1/batch/matrix or 1/20 samples, whichever is more frequent	75-125%	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)
			Performance Evaluation Sample DQI-Accuracy/Bias	Per USACE submission	Per Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)	1. Evaluate PE score report 2. Evaluate batch 3. Recommend action
SOP A-61	Cs-137/Be-7 (Core Dating)	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD< 50% (soils)	NA
		Laboratory	Matrix Spike DQI-Accuracy/Bias	Per Field Team submission	Per Table 4-3	1. Evaluate batch 2. Redigest as necessary (Narrate)
			Laboratory Duplicate (Replicate) DQI-Precision	1/20 samples/matrix	RPD<25%	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Auditing Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SOP A-61 (cont.)	Cs-137/Be-7 (Core Dating)	Laboratory	Instrument Calibration DQI-Precision	Daily prior to sample analysis. After every 10 samples at the end of the analysis sequence	See SOP A-61	1. Reset range 2. Evaluate 3. Reanalyze calib. and all samples since last successful calibration
			Standard Reference Material DQI-Sensitivity	At beginning of analytical run	%D≤30%	1. Terminate analysis 2. Evaluate 3. Reanalyze SRM and affected samples
			Method Blank DQI-Accuracy/Bias	1/batch/matrix	<½ PQL	1. Rerun 2. Evaluate batch 3. Redigest as necessary (Narrate)
SOP A-60	Pb-210 (Core Dating)	Field Sampling	Field Duplicate DQI-Precision	1/20 samples	RPD < 50% (soils)	NA
		Laboratory	Matrix Spike DQI-Accuracy/Bias	Per Field Team submission	Per Table 4-3	1. Evaluate batch 2. Re-prep/analyze as necessary (Narrate)
			Standard Reference Material DQI-Sensitivity	Beginning of Analytical Sequence	Per SOP A-60	1. Evaluate system 2. Reanalyze as necessary
			Laboratory Duplicate DQI-Precision	1/20 samples/matrix	RPD<20	1. Evaluate System 2. Repeat calibration check 3. Recalibrate/ restandardize when QC criterion is not met
			Reagent Blank DQI-Accuracy/Bias	1/batch/matrix	<½ PQL	1. Rerun 2. Evaluate batch 3. Re-prep/analyze as necessary (Narrate)

Table 4-2

Analytical Measurements Quality Control Requirements (Continued)

Analysis Method (SOP Reference, See Appendix A)	Parameter (See Section 7 for Analyte Lists)	Field/Lab Req.	Quality Control Check/Data Auditing Indicator (DQI) (See Section 8)	Frequency	Acceptance Criteria	Corrective Action
SOP A-60 (cont.)	Pb-210 (Core Dating)	Laboratory	Air Blank DQI-Accuracy/Bias	1/batch/matrix	< ½ PQL	1. Rerun 2. Evaluate batch 3. Re-prep/analyze as necessary (Narrate)

[a] Except >0.10 for bromoform, and ≥0.10 for chloromethane and 1,1-Dichloroethane

Table 4-3

Spike Accuracy and Precision Limits[a]

Fraction	Spike Compound[b]	Water		Soil/Sediment	
		% Recovery	RPD	% Recovery	RPD
Volatiles	Dichlorodifluoromethane	78-116	40	78-116	40
	Chloromethane	68-118	40	68-118	40
	Vinyl Chloride	78-118	40	78-118	40
	Bromomethane	72-118	40	72-118	40
	Chloroethane	65-113	40	65-113	40
	Trichlorofluoromethane	67-111	40	67-111	40
	Acrolein	60-140	40	60-140	40
	1,1-Dichloroethene	75-113	40	75-113	40
	Acetone	60-140	40	60-140	40
	Iodomethane	60-140	40	60-140	40
	Carbon Disulfide	60-140	40	60-140	40
	3-Chloropropene	60-140	40	60-140	40
	Methylene Chloride	80-110	40	80-110	40
	Acrylonitrile	60-140	40	60-140	40
	trans-1,2-Dichloroethene	77-109	40	77-109	40
	1,1-Dichloroethane	81-111	40	81-111	40
	Vinyl Acetate	60-140	40	60-140	40
	2-Butanone	60-140	40	60-140	40
	Propionitrile	60-140	40	60-140	40
	Methacrylonitrile	60-140	40	60-140	40
	Chloroform	74-106	40	74-106	40
	1,1,1-Trichloroethane	74-122	40	74-122	40
	Carbon Tetrachloride	62-106	40	62-106	40
	Isobutanol	60-140	40	60-140	40
	Benzene	78-116	40	78-116	40
	1,2-Dichloroethane	80-110	40	80-110	40
	Trichloroethene	70-109	40	70-109	40
	1,2-Dichloropropane	79-115	40	79-115	40
	Methyl Methacrylate	60-140	40	60-140	40
	Dibromomethane	83-117	40	83-117	40
	1,4-Dioxane	60-140	40	60-140	40
	Bromodichloromethane	78-112	40	78-112	40

Table 4-3

Spike Accuracy and Precision Limits[a] (Continued)

Fraction	Spike Compound[b]	Water		Soil/Sediment	
		% Recovery	RPD	% Recovery	RPD
Volatiles (cont.)	2-Chloroethyl Vinyl Ether	60-140	40	60-140	40
	cis-1,3-Dichloropropene	60-140	40	60-140	40
	4-Methyl-2-pentanone	60-140	40	60-140	40
	Toluene	78-126	40	78-126	40
	Trans-1,3-Dichloropropene	60-140	40	60-140	40
	Ethyl Methacrylate	60-140	40	60-140	40
	1,1,2-Trichloroethane	81-126	40	81-126	40
	Tetrachloroethene	71-107	40	71-107	40
	2-Hexanone	60-140	40	60-140	40
	Dibromochloromethane	72-112	40	72-112	40
	1,2-Dibromoethane	90-114	40	90-114	40
	Chlorobenzene	81-115	40	81-115	40
	1,1,1,2-Tetrachloroethane	72-108	40	72-108	40
	Ethylbenzene	74-124	40	74-124	40
	Xylene (total)	60-140	40	60-140	40
	Styrene	80-124	40	80-124	40
	Bromoform	82-120	40	82-120	40
	1,1,2,2-Tetrachloroethane	74-108	40	74-108	40
	1,2,3-Trichloropropane	81-137	40	81-137	40
	trans-1,4-Dichloro-2-butene	60-140	40	60-140	40
	1,2-Dibromo-3-Chloropropane	33-132	40	33-132	40
Semivolatiles	Pyridine	21-93	40	10-146	40
	N-Nitrosodimethylamine	27-103	40	29-139	40
	Aniline	38-114	40	10-122	40
	Phenol	23-68	40	54-118	40
	bis(2-Chloroethyl) Ether	64-119	40	54-132	40
	2-Chlorophenol	67-110	40	47-112	40
	1,3-Dichlorobenzene	41-122	40	58-118	40
	1,4-Dichlorobenzene	28-131	40	58-117	40
	1,2-Dichlorobenzene	45-121	40	63-113	40
	Benzyl Alcohol	35-158	40	32-162	40

Table 4-3

Spike Accuracy and Precision Limits[a] (Continued)

Fraction	Spike Compound[b]	Water		Soil/Sediment	
		% Recovery	RPD	% Recovery	RPD
Semivolatiles (cont.)	2,2'-oxybis(1-Chloropropane)	64-116	40	57-125	40
	2-Methylphenol	31-131	40	47-125	40
	Hexachloroethane	21-133	40	57-118	40
	N-Nitroso-di-n-propylamine	65-129	40	59-117	40
	4-Methylphenol	48-111	40	55-121	40
	Nitrobenzene	69-121	40	60-125	40
	Isophorone	69-124	40	63-123	40
	2-Nitrophenol	71-115	40	56-128	40
	2,4-Dimethylphenol	58-121	40	50-116	40
	bis (2-Chloroethoxy) methane	62-130	40	59-131	40
	2,4-Dichlorophenol	67-121	40	61-127	40
	1,2,4-Trichlorobenzene	41-129	40	64-118	40
	Naphthalene	54-125	40	65-118	40
	4-Chloroaniline	14-137	40	10-106	40
	Hexachlorobutadiene	68-123	40	60-128	40
	4-Chloro-3-Methylphenol	60-128	40	60-128	40
	2-Methylnaphthalene	58-126	40	70-120	40
	Hexachlorocyclopentadiene	10-83	40	10-134	40
	2,4,6-Trichlorophenol	67-121	40	57-122	40
	2,4,5-Trichlorophenol	50-136	40	52-121	40
	2-Chloronaphthalene	55-125	40	69-116	40
	2-Nitroaniline	70-122	40	62-127	40
	Dimethylphthalate	12-129	40	65-125	40
	Acenaphthylene	60-114	40	65-114	40
	2,6-Dinitrotoluene	73-119	40	63-130	40
	3-Nitroaniline	28-134	40	23-116	40
	Acenaphthene	66-115	40	65-114	40
	2,4-Dinitrophenol	12-143	40	10-194	40
	Dibenzofuran	65-123	40	67-119	40
	4-Nitrophenol	13-74	40	46-141	40
	2,4-Dinitrotoluene	67-122	40	64-124	40
	Fluorene	66-122	40	64-117	40

Table 4-3

Spike Accuracy and Precision Limits[a] (Continued)

Fraction	Spike Compound[b]	Water		Soil/Sediment	
		% Recovery	RPD	% Recovery	RPD
Semivolatiles (cont.)	Diethylphthalate	50-125	40	67-121	40
	4-Chlorophenyl-phenylether	63-118	40	64-117	40
	4-Nitroaniline	51-140	40	34-131	40
	4,6-Dinitro-2-methylphenol	44-134	40	33-151	40
	N-nitrosodiphenylamine	64-132	40	52-131	40
	Azobenzene	61-138	40	53-144	40
	4-Bromophenyl-phenylether	60-131	40	61-126	40
	Hexachlorobenzene	64-128	40	61-126	40
	Pentachlorophenol	13-156	40	25-137	40
	Phenanthrene	72-118	40	64-121	40
	Anthracene	76-121	40	65-120	40
	Di-n-butylphthalate	70-122	40	65-118	40
	Fluoranthene	63-134	40	66-117	40
	Pyrene	59-137	40	49-140	40
	Butylbenzylphthalate	52-128	40	57-129	40
	Benzo(a)anthracene	72-115	40	57-117	40
	3,3'-Dichlorobenzidine	19-158	40	10-139	40
	Chrysene	70-122	40	66-121	40
	Bis(2-Ethylhexyl)phthalate	55-150	40	57-140	40
	Di-n-octylphthalate	41-175	40	44-146	40
	Benzo(b)fluoranthene	50-141	40	54-132	40
	Benzo(k)fluoranthene	56-135	40	47-136	40
	Benzo(a)pyrene	64-125	40	66-122	40
	Indeno(1,2,3-cd)pyrene	65-119	40	25-156	40
	Dibenz(a,h)anthracene	71-124	40	41-145	40
	Benzo(g,h,i)perylene	58-130	40	10-169	40
Chlorinated Pesticides	alpha-BHC	46-117	30	35-125	30
	beta-BHC	60-118	30	42-137	30
	delta-BHC	59-113	30	1-167	30
	gamma-BHC (Lindane)	58-115	30	35-130	30

Table 4-3

Spike Accuracy and Precision Limits[a] (Continued)

Fraction	Spike Compound[b]	Water		Soil/Sediment	
		% Recovery	RPD	% Recovery	RPD
Chlorinated Pesticides (cont.)	Heptachlor	66-113	30	1-248	30
	Aldrin	48-107	30	40-137	30
	Heptachlor epoxide	70-115	30	44-146	30
	Endosulfan I	70-118	30	48-137	30
	Dieldrin	66-113	30	36-146	30
	4,4'-DDE	55-128	30	45-157	30
	Endrin	56-131	30	37-152	30
	Endosulfan II	73-120	30	42-160	30
	4,4'-DDD	67-126	30	47-159	30
	Endosulfan sulfate	56-124	30	25-162	30
	4,4'-DDT	65-125	30	43-157	30
	Methoxychlor	70-140	30	54-159	30
	Endrin aldehyde	70-140	30	5-145	30
	Isodrin	30-140	30	30-140	30
	Kepone	30-140	30	30-140	30
PCBs	Aroclor 1260	60-140	30	60-140	30
	1, 2, 4 -Trichlorobenzene	60-140	30	60-140	30
Herbicides	2,4-D	40-150	30	40-150	30
	2,4,5-TP	40-150	30	40-150	30
	2,4,5-T	40-150	30	40-150	30
Organophosphorus Pesticides	Dimethoate	40-140	30	40-140	30
	Disulfoton	40-140	30	40-140	30
	Methyl Parathion	40-140	30	40-140	30
	Parathion	40-140	30	40-140	30
	o,o,o-Triethylphosphorothioate	40-140	30	40-140	30
	Thionazin	40-140	30	40-140	30
	Famphur	40-140	30	40-140	30
	Phorate	40-140	30	40-140	30
	Sulfotep	40-140	30	40-140	30
PCDDs/PCDFs	2,3,7,8-TCDD	70-130	25	70-130	25
	1,2,3,7,8-PeCDD	70-130	25	70-130	25

Table 4-3

Spike Accuracy and Precision Limits[a] (Continued)

Fraction	Spike Compound[b]	Water		Soil/Sediment	
		% Recovery	RPD	% Recovery	RPD
PCDDs/PCDFs (cont.)	1,2,3,4,7,8-HxCDD	70-130	25	70-130	25
	1,2,3,6,7,8-HxCDD	70-130	25	70-130	25
	1,2,3,7,8,9-HxCDD	70-130	25	70-130	25
	1,2,3,4,6,7,8-HpCDD	70-130	25	70-130	25
	OCDD	70-130	25	70-130	25
	2,3,7,8-TCDF	70-130	25	70-130	25
	1,2,3,7,8-PeCDF	70-130	25	70-130	25
	2,3,4,7,8-PeCDF	70-130	25	70-130	25
	1,2,3,4,7,8-HxCDF	70-130	25	70-130	25
	1,2,3,6,7,8-HxCDF	70-130	25	70-130	25
	2,3,4,6,7,8-HxCDF	70-130	25	70-130	25
	1,2,3,7,8,9-HxCDF	70-130	25	70-130	25
	1,2,3,4,6,7,8-HpCDF	70-130	25	70-130	25
	1,2,3,4,7,8,9-HpCDF	70-130	25	70-130	25
	OCDF	70-130	25	70-130	25
Inorganics	Inorganics	75-125[c]	20[d]	75-125[c]	20[d]
PCB (on-site)	Aroclor-1260	50-130	40	50-130	40
	1, 2, 4-Trichlorobenzene	50-130	40	50-130	40
PCB Congeners[e] (HRGC/HRMS)	PCB-1	70-140	NA	70-140	NA
	PCB-3	70-140	NA	70-140	NA
	PCB-8	70-140	NA	70-140	NA
	PCB-15	70-140	NA	70-140	NA
	PCB-18	70-140	NA	70-140	NA
	PCB-28	70-140	NA	70-140	NA
	PCB-37	70-140	NA	70-140	NA
	PCB-44	60-140	NA	60-140	NA
	PCB-49	70-140	NA	70-140	NA
	PCB-52	60-140	NA	60-140	NA
	PCB-66	70-140	NA	70-140	NA
	PCB-70	70-140	NA	70-140	NA
	PCB-74	70-140	NA	70-140	NA

Table 4-3

Spike Accuracy and Precision Limits[a] (Continued)

Fraction	Spike Compound[b]	Water		Soil/Sediment	
		% Recovery	RPD	% Recovery	RPD
PCB Congeners[c] (HRGC/HRMS) (cont.)	PCB-77	70-160	NA	70-160	NA
	PCB-81	70-140	NA	70-140	NA
	PCB-87/115	70-140	NA	70-140	NA
	PCB-90/101	70-140	NA	70-140	NA
	PCB-99	70-140	NA	70-140	NA
	PCB-110	70-140	NA	70-140	NA
	PCB-119	70-140	NA	70-140	NA
	PCB-118	64-160	NA	64-160	NA
	PCB-123	14-330	NA	14-330	NA
	PCB-105	68-160	NA	68-160	NA
	PCB-114	14-330	NA	14-330	NA
	PCB-126	68-160	NA	68-160	NA
	PCB-151	70-140	NA	70-140	NA
	PCB-128/167	64-170	NA	64-170	NA
	PCB-138/158	70-140	NA	70-140	NA
	PCB-149	70-140	NA	70-140	NA
	PCB-153/168	70-140	NA	70-140	NA
	PCB-156	64-170	NA	64-170	NA
	PCB-157	64-170	NA	64-170	NA
	PCB-169	64-170	NA	64-170	NA
	PCB-170	70-140	NA	70-140	NA
	PCB-177	70-140	NA	70-140	NA
	PCB-180	70-140	NA	70-140	NA
	PCB-183	70-140	NA	70-140	NA
	PCB-184	70-140	NA	70-140	NA
	PCB-187	70-140	NA	70-140	NA
	PCB-189	70-140	NA	70-140	NA
	PCB-201	70-140	NA	70-140	NA
	PCB-202	70-140	NA	70-140	NA
	PCB-194	70-140	NA	70-140	NA
	PCB-195	70-140	NA	70-140	NA

Table 4-3

Spike Accuracy and Precision Limits[a] (Continued)

Fraction	Spike Compound[b]	Water		Soil/Sediment	
		% Recovery	RPD	% Recovery	RPD
PCB Congeners[c] (HRGC/HRMS) (cont.)	PCB-206	70-140	NA	70-140	NA
	PCB-207	70-140	NA	70-140	NA
	PCB-209	70-140	NA	70-140	NA
	13C-PCB-3	25-150	NA	25-150	NA
	13C-PCB-28	25-150	NA	25-150	NA
	13C-PCB-37	25-150	NA	25-150	NA
	13C-PCB-77	20-175	NA	20-175	NA
	13C-PCB-101	25-250	NA	20-250	NA
	13C-PCB-118	13-328	NA	13-328	NA
	13C-PCB-105	13-328	NA	13-328	NA
	13C-PCB-126	13-328	NA	13-328	NA
	13C-PCB-138	25-250	NA	25-250	NA
	13C-PCB-156	17-205	NA	17-205	NA
	13C-PCB-157	17-205	NA	17-205	NA
	13C-PCB-169	17-205	NA	17-205	NA
	13C-PCB-180	20-186	NA	20-186	NA
	13C-PCB-202	25-150	NA	25-150	NA
	13C-PCB-194	25-150	NA	25-150	NA
	13C-PCB-208	25-150	NA	25-150	NA
	13C-PCB-209	25-150	NA	25-150	NA
PCB Congeners[c] (HRGC/LRMS)	PCB-1	70-140	NA	70-140	NA
	PCB-3	70-140	NA	70-140	NA
	PCB-8	70-140	NA	70-140	NA
	PCB-15	70-140	NA	70-140	NA
	PCB-18	70-140	NA	70-140	NA
	PCB-28	70-140	NA	70-140	NA
	PCB-37	70-140	NA	70-140	NA
	PCB-44	60-140	NA	60-140	NA
	PCB-49	70-140	NA	70-140	NA
	PCB-52	60-140	NA	60-140	NA
	PCB-66	70-140	NA	70-140	NA
	PCB-70	70-140	NA	70-140	NA

Table 4-3

Spike Accuracy and Precision Limits[a] (Continued)

Fraction	Spike Compound[b]	Water		Soil/Sediment	
		% Recovery	RPD	% Recovery	RPD
PCB Congeners[c] (HRGC/LRMS) (cont.)	PCB-74	70-140	NA	70-140	NA
	PCB-77	70-160	NA	70-160	NA
	PCB-81	70-140	NA	70-140	NA
	PCB-87/115	70-140	NA	70-140	NA
	PCB-90/101	70-140	NA	70-140	NA
	PCB-99	70-140	NA	70-140	NA
	PCB-110	70-140	NA	70-140	NA
	PCB-119	70-140	NA	70-140	NA
	PCB-118	64-160	NA	64-160	NA
	PCB-123	14-330	NA	14-330	NA
	PCB-105	68-160	NA	68-160	NA
	PCB-114	14-330	NA	14-330	NA
	PCB-126	68-160	NA	68-160	NA
	PCB-151	70-140	NA	70-140	NA
	PCB-128/167	64-170	NA	64-170	NA
	PCB-138/158	70-140	NA	70-140	NA
	PCB-149	70-140	NA	70-140	NA
	PCB-153/168	70-140	NA	70-140	NA
	PCB-156	64-170	NA	64-170	NA
	PCB-157	64-170	NA	64-170	NA
	PCB-169	64-170	NA	64-170	NA
	PCB-170	70-140	NA	70-140	NA
	PCB-177	70-140	NA	70-140	NA
	PCB-180	70-140	NA	70-140	NA
	PCB-183	70-140	NA	70-140	NA
	PCB-184	70-140	NA	70-140	NA
	PCB-187	70-140	NA	70-140	NA
	PCB-189	70-140	NA	70-140	NA
	PCB-201	70-140	NA	70-140	NA
	PCB-202	70-140	NA	70-140	NA
	PCB-194	70-140	NA	70-140	NA
	PCB-195	70-140	NA	70-140	NA

Table 4-3

Spike Accuracy and Precision Limits[a] (Continued)

Fraction	Spike Compound[b]	Water		Soil/Sediment	
		% Recovery	RPD	% Recovery	RPD
PCB Congeners[c] (HRGC/LRMS) (cont.)	PCB-206	70-140	NA	70-140	NA
	PCB-207	70-140	NA	70-140	NA
	PCB-209	70-140	NA	70-140	NA
	13C-PCB-3	25-150	NA	25-150	NA
	13C-PCB-15	25-150	NA	25-150	NA
	13C-PCB-28	25-150	NA	25-150	NA
	13C-PCB-52	25-150	NA	25-150	NA
	13C-PCB-118	13-328	NA	13-328	NA
	13C-PCB-153	17-205	NA	17-205	NA
	13C-PCB-180	20-186	NA	20-186	NA
	13C-PCB-194	25-150	NA	25-150	NA
	13C-PCB-208	25-150	NA	25-150	NA
	13C-PCB-209	25-150	NA	25-150	NA
Semivolatiles (TCLP)	Pyridine	21-93	40	NA	NA
	1,4-Dichlorobenzene	28-131	40	NA	NA
	2-Methylphenol	31-131	40	NA	NA
	Hexachloroethane	21-133	40	NA	NA
	3/4-Methylphenol	48-111	40	NA	NA
	Nitrobenzene	69-121	40	NA	NA
	Hexachlorobutadiene	68-123	40	NA	NA
	2,4,6-Trichlorophenol	67-121	40	NA	NA
	2,4,5-Trichlorophenol	50-136	40	NA	NA
	2,4-Dinitrotoluene	67-122	40	NA	NA
	Hexachlorobenzene	64-128	40	NA	NA
	Pentachlorophenol	13-156	40	NA	NA
Chlorinated Pesticides (TCLP)	Heptachlor	34-111	30	NA	NA
	Gamma-BHC	32-127	30	NA	NA
	Heptachlor epoxide	37-142	30	NA	NA
	Technical Chlordane	45-119	30	NA	NA
	Toxaphene	41-126	30	NA	NA
	Endrin	30-147	30	NA	NA

Table 4-3

Spike Accuracy and Precision Limits[a] (Continued)

Fraction	Spike Compound[b]	Water		Soil/Sediment	
		% Recovery	RPD	% Recovery	RPD
Chlorinated Pesticides (TCLP) (cont'd)	Methoxychlor	37-142	30	NA	NA
Herbicides (TCLP)	2,4-D	40-150	30	NA	NA
	2,4,5-TP	40-150	30	NA	NA
Inorganics (TCLP)	Inorganics	75-125[c]	20[d]	NA	NA
Fraction	**Spike Compound[b]**	**Vegetation**		**Soil/Sediment**	
		% Recovery	**RPD**	**% Recovery**	**RPD**
PCB (Homolog-Specific) [Vegetation]	PCB-1	40-140	50	40-140	50
	PCB-5	40-140	50	40-140	50
	PCB-29	40-140	50	40-140	50
	PCB-50	40-140	50	40-140	50
	PCB-87	40-140	50	40-140	50
	PCB-154	40-140	50	40-140	50
	PCB-188	40-140	50	40-140	50
	PCB-200	40-140	50	40-140	50
	PCB-209	40-140	50	40-140	50
Fraction	**Spike Compound[b]**	**Air**			
		% Recovery	**RPD**		
PCBs (TO-4)	Aroclor 1260	50-150	20		

Notes:

[a] Except where applicable, the limits are based on CLP-SOW. The limits provided in this table are advisory for both matrix spike and matrix spike duplicate analyses. Laboratory-determined limits may be used in their place if they are within the bounds of these lists. Corrective action based on matrix spike recoveries of relative percent of difference (RPDs) should be based on method protocols and professional judgment. MS/MSD recoveries will not be obtained for the SIM Method because the 8270C concentrations are too high for the low-level SIM calibration.

[b] Spiking compounds are suggested. Alternate compounds may be determined to be appropriate.

[c] Except where sample concentration exceeds the spike concentration by a factor of four or more.

[d] For sample less than 5x the contract required detection limit (CRDL); a control limit of +/- CRDL is used.

[e] For PCB congener analysis, Modified EPA 1668, an ongoing precision and recovery (OPR) analysis will be performed in lieu of the MS/LCS analyses.

Table 4-4

Surrogate Spike Recovery Limits

Fraction	Surrogate Compound	Water	Low/Medium Soil
Volatile organic compounds (VOCs)	Toluene-d_8	88-110	81-117
	4-Bromofluorobenzene	72-122	74-121
	1,2-Dichloroethane-d_4	72-141	80-120
	1,2-Dichlorobenzene-d_4	69-124	80-120
Base/neutral/acid (BNA)	Nitrobenzene-d_5	35-114	23-120
	2-Fluorobiphenyl	43-116	30-115
	p-Terphenyl-d_{14}	33-141	18-137
	Phenol-d_5	10-110	24-113
	2-Fluorophenol	21-110	25-121
	2,4,6-Tribromophenol	10-123	19-122
	2-Chlorophenol-d_4[a]	(33-110)[a]	(20-130)[a]
	1,2-Dichlorobenzene-d_4[a]	(16-110)[a]	(20-130)[a]
Pesticide/PCBs	Tetrachloro-m-xylene	30-140	36-132
	Decachloro-biphenyl	30-140	30-140
Herbicides	2,4-Dichlorophenyl Acetic Acid (DCAA)	40-150[a]	40-150[a]
OP Pesticides	Triphenylphosphate	40-140[a]	40-140[a]
	Tributylphosphate	40-140[a]	40-140[a]
PAHs (SIM)[b]	Naphthalene-d_8	20-130	20-130
	Acenaphthene-d_{10}	20-130	20-130
	Phenanthrene-d_{10}	20-130	20-130
	Chrysene-d_{12}	20-130	20-130
	Perylene-d_{12}	20-130	20-130
Dioxin/Furan	^{37}Cl-2,3,7,8-TCDD	60-140	60-140
PCB (On-site)	Tetrachloro-m-xylene	30-150	30-150
	Decachloro-biphenyl	30-150	30-150
Fraction	**Surrogate Compound**	**Air**	**Soil**
PCB (Homolog-Specific) [Vegetation]	4,4'-Dibromo-Octafluoro biphenyl (DBOB) PCB-198	50-125 50-125	50-125 50-125

Table 4-4

Surrogate Spike Recovery Limits (Continued)

Fraction	Surrogate Compound	Water	Low/Medium Soil
Base/neutral/acid (BNA) (TCLP)	Nitrobenzene-d_5	35-114	NA
	2-Fluorobiphenyl	43-116	NA
	p-Terphenyl-d_{14}	33-141	NA
	Phenol-d_5	10-110	NA
	2-Fluorophenol	21-110	NA
	2,4,6-Tribromophenol	10-123	NA
	2-Chlorophenol-d_4[a]	(33-110)[a]	NA
	1,2-Dichlorobenzene-d_4[a]	(16-110)[a]	NA
Herbicides (TCLP)	2,4-Dichlorophenyl Acetic Acid (DCAA)	40-150[a]	NA
OC Pesticides (TCLP)	Tetrachloro-m-xylene	60-150[a]	NA
	Decachloro-biphenyl	60-150[a]	NA
Fraction	**Surrogate Compound**	**Air**	
PCBs (TO-4) [AIR]	Tetrachloro-m-xylene	60-150	
	Decachloro-biphenyl	60-150	

[a]These limits are for advisory purposes only. They are not used to determine if a sample should be reanalyzed.

[b]Surrogates will be added prior to analysis, not during extraction, because the samples will be initially extracted for SW-846 Method 8270C.

Section 5

5. DOCUMENTATION AND RECORDS

5.1 CHAIN-OF-CUSTODY PROCEDURES

Chain-of-custody procedures document the historical possession of sample containers and samples, sample extracts, and sample digestates. The associated documentation provides traceability of sample containers from the time of sample collection through shipment, storage, analysis, and disposal of the sample. This document defines sample custody as:

- It is in someone's actual possession, or
- It is in someone's view, after being in their physical possession, or
- It was in someone's possession and then locked, sealed, or secured in a manner that prevents unsuspected tampering, or
- It is placed in a designated and secured area.

5.2 FIELD RECORDS

All sample collection activities performed at the site will be documented, using waterproof, non-erasable black ink or marker, either in a bound field notebook or on a data form. During sampling, the following information will be entered into the field notebook:

- The sample location.
- The sample identification number.
- The date and time the sample was collected.
- The sample matrix and a simple description of the matrix.
- Any unusual sample characteristics.
- The parameters for analysis.

At the completion of the sampling event, the original or copies of the original field data will be placed into the project file. More detailed information regarding procedures for field recordkeeping are presented in the project *Field Sampling Plan* (00-0476).

5.3 CORRECTIONS TO DOCUMENTS

Corrections to notebook entries or data forms are made by drawing a single line through the erroneous entry and writing the correct entry next to the one crossed out. All corrections are initialed and dated by the individual performing the correction.

5.4 LABORATORY DOCUMENTATION

Analytical reports comprise final results (uncorrected for blanks and recoveries, unless specified), methods of analysis, levels of reporting, surrogate recovery data, and method blank data. In addition, special analytical problems will be noted in the case narratives. The number of significant figures reported will be consistent with the limits of uncertainty inherent in the analytical method. Consequently, most analytical results will be reported to no more than two or three significant figures. Data are normally reported in units commonly used for the analyses performed.

Concentrations in liquids are expressed in terms of weight or activity per unit volume (e.g., micrograms per liter [µg/L], or milligrams per liter [mg/L]). Concentrations in solid or semisolid matrices are expressed in terms of weight or activity per unit weight of sample (e.g., micrograms per kilogram [µg/kg], or milligrams per kilogram [mg/kg]). Solid and semisolid matrices will also be reported on a dry weight basis. Reporting limits take into account all appropriate concentration, dilution, and/or extraction factors.

If any analytical anomalies were encountered during the analyses (e.g., an out-of-control matrix duplicate), it is documented in a case narrative and copies of the Sample Discrepancy Reports (SDRs) or Corrective Action Reports (CARs) must be included in the data packages.

5.4.1 Reporting Requirements/Schedule

5.4.1.1 Field Laboratory (On-Site)

The results of on-site PCB analyses will be reported in electronic and hardcopy data summary formats (Form Is) on a 24-hour turnaround schedule (close of business following day). The file

structure for reporting electronic data is presented in Table 5-1. In addition, a Region I EPA-NE Complete SDG File Inventory Sheet (DC-2 form) will be completed by the on-site laboratory personnel and submitted with the hard copy deliverable (see Appendix B).

The final hard copy report will be reported within 2 business days of sample collection and will consist of all QA/QC summary forms and support documentation.

1. A cross-reference summarizing the WESTON field sample identification and any truncated on-site laboratory identification must be included at the beginning of the data package. For traceability, the laboratory must be consistent in identifying the samples on all of the summary forms, run logs, extraction logs, etc. The data package should follow the order listed below. All photocopies must be clear and legible. A case narrative for the method must summarize any problems or observations noted by the laboratory.

2. Information regarding the condition of samples upon receipt at the laboratory must be included in the data package. This information may be written on the chain-of-custody records, or presented on a separate sample receipt log.

3. When a secondary dilution or reanalysis of samples is required, the data for all required analyses must be provided within the data package. In addition, all summary forms for the standards, QC samples, and blanks associated with the reanalyzed samples must be provided within the data package.

4. The laboratory must provide all matrix spike/matrix spike duplicate (MS/MSD), laboratory control sample (LCS), spiking levels, and amounts for each analytical method.

5. The surrogate recoveries for all the samples must be reported.

6. Result summaries must be provided for all instrument blank analyses.

7. For traceability, the date and time of sample analysis should be included in the header information. In addition, the same analysis date and time (whether the time is the time of sample injection or the time of compound detection, etc.) must be used on all of the QC forms and summary logs.

8. The Sample Results Summary (spreadsheet) must include the client sample ID, the laboratory sample ID, and sample delivery group (SDG) number, the sample matrix, the percent solids, the concentration units, and concentrations (three significant figures). A unique Sample Delivery Group (SDG) identifier is to be assigned for every batch of approximately 20 samples. All compound results detected between ½ the PQL and the PQL are to be reported and flagged with a "J."

9. For gas chromatography (GC) analysis, retention time windows (RTWs) should be updated once per day. The updated RTWs should be reported on the continuing calibration form on which the RTWs are updated.

10. The laboratory must narrate if less than 3 peaks are used for aroclor identification or if a mixture of aroclors are present in the sample. In addition, the WESTON Analytical Manager will be contacted.

11. If the % solids are less than 30% and positive results were not detected, the sample will be dried, re-extracted, and reanalyzed.

12. Screening and/or dilution analysis explanations will be thoroughly discussed in the case narrative.

13. Sulfuric acid cleanup will be required for all PCB analyses.

More specifically, the following outline summarizes the recommended order for summary forms required in the full on-site documentation package (PCBs).

Section A:

- Case Narrative
- Corrective Action Forms/Phone Logs (if applicable)
- Other Laboratory-Related Documentation or Tables

Section B (Form Is):

- Result Spreadsheets, including surrogate recoveries and percent solids values for all samples, dilutions, and reanalyses in the SDG.

Section C (QC Summary):

- Calibration Forms
- Analytical Sequence
- Method Blank Summary and LCS Recovery Results
- MS/MSD Recovery
- Cleanup Forms (if applicable)

Section D (Raw Data):

- Chromatograms*
- Integration Tables*
- Instrument Log*

- Extraction Log*
- Standard Preparation Log, Percent Solids Log*
- Other Laboratory Logs, Charts, or Documentation (if applicable)*
- Chain-of-Custody/Traffic Report

*This documentation will be supplied by the on-site laboratory; however, it will be supplied in weekly batch submittals. The WESTON data management staff, under the supervision of the Analytical Manager, will separate and distribute the information into the associated analytical batch file, which contains the other batch data deliverables and chain-of-custody documentation.

5.4.1.2 Off-Site Laboratory

The off-site laboratory will report all analytical results using full Contract Laboratory Program (CLP)-type documentation reports. Data will be reported by sample delivery group or chain-of-custody number (i.e., in the same batches as received at the laboratory).

As indicated in Table 6-1, the analytical methods required for this program reference *The Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA SW-846), Third Edition Revision 0, June 1997, and Final Updates I, II, IIA, IIB, and III (99-0026).

Additional requirements specific to this program include:

- Dual column analysis is required for off-site pesticide and PCB analyses.
- Acid cleanup (SW-846 Method 3655A) is required for all PCB analyses. Sulfur cleanup (SW-846 Method 3660B) is recommended on an as-needed basis, particularly for soil and sediment samples.
- Soxhlet extraction is the preferred preparation method for soil/sediment matrices. Method 3550B (sonication) may be substituted (with approval) for rapid turnaround samples.

All sediment/soil samples will be reported on a dry weight basis. In some cases, a modification of the referenced method may be necessary to achieve the required reporting limits or provide analysis of difficult sample matrices. When modifications are performed, the specific alterations, as well as the justification for the change, will be presented in the case narrative accompanying the data report. It is anticipated that individual sample reporting units may vary as a result of dilution requirements, variability in sample weight or volume used to perform the analysis, dry

weight adjustment for solid samples, the presence of analytical background contaminants, or other sample- or analysis- related conditions.

Samples will be submitted to the laboratory on a 7-, 14- or 21-day turnaround; both the full documentation package and electronic data will be provided on the actual due date. (PCB split confirmation analyses will be performed on a 7-day turnaround time.)

In general, the following requirements shall apply to all CLP-type data packages submitted for this program:

1. When reasonably achievable and practical, the laboratory should analyze only samples for this program (and as many as possible) within the same batch. Regardless, all sample batches must be clearly defined and traceable throughout the summary forms, logbook pages, extraction logs, preparation logs, and raw data. If WESTON samples are analyzed with samples from other clients, the laboratory must bracket the WESTON samples with additional laboratory blank samples. These additional laboratory blank samples must be reported in the data package. In addition, the laboratory must provide all raw data for any QC sample (e.g., matrix spike sample) analyzed on a batch sample that is associated with a WESTON sample.

2. The entire data package must be paginated. A cross-reference summarizing the WESTON field sample identification and any truncated laboratory identification must be included at the beginning of the data package. For traceability, the laboratory must be consistent in identifying the samples on all of the summary forms, raw data, run logs, extraction logs, etc. The data package should follow the order listed below, and should include a table of contents that identifies sections/page numbers (including the page number at the end of the package). All photocopies must be clear and legible. A case narrative for each method or fraction must summarize any problems or observations noted by the laboratory.

3. Information regarding the condition of samples upon receipt at the laboratory, including the temperature blank and pH of samples requiring acid or base preservation, must be included in the data package. This information may be written on the chain-of-custody records, or presented on a separate sample receipt log.

4. The laboratory must provide an example of the sample result quantitation for the analysis. The laboratory must indicate whether a calibration curve, average response factor from the initial calibration, or response factor from the continuing calibration, etc., was used for sample result quantitation. In addition, for pesticide and PCB analysis, the laboratory must indicate which multicomponent peaks were used in the quantitation of the sample results.

5. When a secondary dilution or reanalysis of samples is required, the data for all required analyses must be provided within the data package. In addition, all summary forms and raw data for the standards, QC samples, and blanks associated with the reanalyzed samples must be provided within the data package.

6. The laboratory must provide all MS/MSD, laboratory control sample (LCS), and surrogate spiking levels and amounts for each analytical method. Initial and continuing calibration information must be provided for surrogate compounds.

7. The surrogate recoveries for all the sample, blank, spike, MS/MSD, and LCS analyses within a particular matrix must be summarized on the same QC summary form (Form II). For analysis in which an internal standard calibration is used, internal/standard areas and retention times for all the samples associated with a continuing calibration must be summarized on the same QC summary form (Form VIII).

8. For volatile analysis by Method 8260B, xylenes must be reported as total xylenes for all project and QC samples.

9. When the analytical method requires instrument blanks, these blanks must be analyzed on each instrument and on each GC column used in the analysis of project samples and associated with QA/QC samples. Result summaries (Form I) and raw data must be provided for the instrument blank analyses.

10. For traceability, the date and time of sample analysis must be included in the header of the raw data. In addition, the same analysis date and time (whether the time is the time of sample injection or the time of compound detection, etc.) must be used on all of the QC forms and summary logs.

11. When the project samples have a solid matrix, a percent solid (or percent moisture) summary form must be included in the data package.

12. The Sample Results Summary (Form I or equivalent) must include the client sample ID, the laboratory sample ID and SDG number, the sample matrix, the percent solids, the concentration units, and concentrations.

13. All chromatogram peaks must be on scale with the highest peak at no less than 50% of the full scale. In addition, for GC and high performance liquid chromatography (HPLC), integration lines and baselines must clearly show peak integration.

14. For GC analysis, RTWs should be updated once per day. The updated RTWs should be reported on the continuing calibration form upon which the RTWs are updated.

More specifically, the following outline summarizes the recommended order for raw data and summary forms required in the full documentation package (organics).

Section A:

- Table of Contents
- Case Narrative
- Chain-of-Custody/Traffic Report
- Corrective Action Forms/Phone Logs (if applicable)
- Other Laboratory-Related Documentation or Tables

Section B (Form Is):

- Form Is for all samples included in the SDG, including, but not limited to, Reanalysis, Dilutions, Blanks, LCS, MS, and MSD

Section C (QC Summary):

- Surrogate Percent Recovery Summary (Form II)
- MS/MSD Recovery (Form III)
- LCS Recovery
- Method Blank Summary (Form IV)
- Gas chromatography/mass spectroscopy (GC/MS) Instrument Performance Check (Form V)
- Calibration Forms (Form VI and Form VII)
- Internal Standard Area and RT Summary (Form VIII)

Section D (Sample Data):

- Sample Results (Form Is)
- TIC Results (Form Is)
- Quantitation Report and Reconstructed Total Ion Chromatograms
- Mass Spectra for Identified Compounds
- Library Search Mass Spectra for Tentatively Identified Compounds (TICs) (if applicable)
- Quantitation/Calibration of TICs (if applicable)

Section E (Standard Data):

- Form VI and Initial Calibration Data
- Form VII and Continuing Calibration Data (Each Initial Calibration should be followed by the associated continuing calibrations.)
- Form VIII (analytical sequence)
- Form IX (Florisil check, if applicable)
- Form IX (GPC calibration, if applicable)
- Form X (identification summary, if applicable)

Section F (Raw Data):

- Bromofluorobenzene (BFB)
- Blank Data
- MS Data
- MSD Data
- LCS Data
- Injection Log
- Extraction Log
- Standard Preparation Log, Percent Solids Log
- Other Laboratory Logs, Charts, or Documentation (if applicable)

For metals/inorganics analyses, the data package order should follow the CLP Scope of Work (SOW).

5.4.2 Electronic Data Deliverables (EDD)

The laboratory will have an IBM-compatible PC capable of storing data on a 3.5-inch, 1.44-megabyte diskette in ASCII text file in accordance with the following format. The starting and ending column requirements must be followed. The length is the maximum length of the field. The column type states what characters are allowed in the field (e.g., CHAR = Character, NUM = Numeric, DATE = Valid date format [MM/DD/YYYY], and VVL = Valid Value List, which is included in the field detentions). See Table 5-1.

Table 5-1

EDD Specification Table

Field	Start Col.	End Col.	Length	Type	Required
Lab Delivery Group	1	15	15	CHAR	Yes
Lab Sample ID	16	25	10	CHAR	Yes
Field Sample ID	26	50	25	CHAR	Yes
Date Sample Collected	51	60	10	DATE	Yes
Date Sample Received	61	70	10	DATE	Yes
EDD Transfer Date	71	80	10	DATE	Yes
Sample Matrix	81	86	6	VVL	Yes
Sample Type	87	88	2	VVL	Yes
Analysis Method	89	96	8	VVL	Yes
Prep Batch Number	97	106	10	CHAR	Yes
Lab Prep Date	107	116	10	DATE	Yes
Prep Method 1	117	126	10	VVL	Yes
Prep Method 2	127	136	10	CHAR	No
CAS Number	137	146	10	VVL	Yes
Lab Analysis Date	147	156	10	DATE	Yes
Analyte Name	157	196	40	VVL	Yes
Result Type	197	198	2	VVL	Yes
Final Result	199	211	13	CHAR	Yes
Result Units	212	219	8	CHAR	Yes
Result Flag	220	222	3	VVL	Yes
Detection Limit	223	235	13	CHAR	Yes
Dilution Type	236	237	2	VVL	Yes
Dilution Factor	238	245	8	NUM	Yes
Spike Amount	246	255	10	NUM	Yes
Percent Solids	256	263	8	NUM	Yes
Weston Work Order No.	264	293	30	CHAR	Yes
Laboratory Code	294	301	8	CHAR	Yes
Leachate Prep Date	302	311	10	DATE	Yes

5.4.3 EDD Field Definitions

Refer to the EDD Specification Table (Table 5-1) for the positioning of the field and to the Analytical Method Valid Value Lists where appropriate.

Laboratory Delivery Group—A unique laboratory identifier assigned to a chain-of-custody form for that set of samples. This identifier must be included on the hard copy reports.

Laboratory Sample ID—A number assigned by the laboratory that corresponds to a single sample on the chain-of-custody form. This number will remain the same for that sample, even if there are multiple runs of a particular method for that sample, or if an MS, MSD, laboratory duplicate, dilution, reprep, or confirmations were run. No additional prefixes or suffixes should be attached to the laboratory sample ID.

Field Sample ID—The Field Sample ID as specified on the chain-of-custody form as assigned by the sampling teams. For QC generated from the field samples (e.g., MS), the Field Sample ID should be as it appears on the chain-of-custody form. No additional prefixes or suffixes should be attached to the field sample ID. For laboratory QC samples, this field may contain "Method Blank," "Blank Spike," or other identifiers as given by the laboratory.

Sample Collection Date—The date the sample was collected as specified on the chain-of-custody form. The format is MM/DD/YYYY (e.g., 01/01/1998).

Date Sample Received at Laboratory—The date the samples were received at the laboratory. The format is MM/DD/YYYY (e.g., 01/01/1998).

EDD Transfer Date—The date the EDD was transferred from the laboratory to the WESTON Data Management Group. The format is MM/DD/YYYY (e.g., 01/01/1998).

Sample Matrix—The chain-of-custody matrix for field samples. The laboratory QC samples should be assigned the same matrix as the associated field samples. The following Valid Value List must be followed (see Table 5-2).

Table 5-2

Valid Value List for Sample Matrix

Code	Description
S	Soil
W	Water
A	Air
F	Fish
O	Oil
SE	Sediment
SO	Solids
WI	Wipe
DS	Drum solids
DL	Drum liquids
L	EP/TCLP leachate
DN	DNAPL
LN	LNAPL
HX	Hexane
TI	Tissue
WI	Wipe
X	Other

Sample Type—The sample type is an identifier that describes the sample. The following Valid Value List must be followed (see Table 5-3).

Table 5-3

Valid Value List for Sample Type

Code	Description
F	Normal field sample
MS	Matrix spike
MD	Matrix spike duplicate
LD	Laboratory duplicate
MB	Method blank
KN	Known (laboratory control sample)

Analysis Method—The analysis method code, as listed in the following Valid Value List, must be followed (see Table 5-4).

Table 5-4

Valid Value List for Analytical Methods

Method Code	Description	Applicable Matrix
% Lipids	Percent Lipids	T
% Solids	Percent Solids	S
% Water	Percent Water Content	S
ASTM2937	Bulk Density	S
ASTM2974	Organic Content	S
ASTMD422	Grain Size Distribution (Standard List)	S
ASTM422M	Grain Size Distribution (Special List)	S
AST422M2	Grain Size Distribution (Special List)	S
ASTM4318	Atterberg Limits	S
ASTMD854	Specific Gravity	S
ASTM2850	Undrained Triaxial Compression	S
ASTM4767	Drained Triaxial Compression	S
EPA10200	Chlorophyll-A	W
EPA130.2	Hardness	W (Total or Dissolved)
EPA160.1	TDS	W
EPA160.2	TSS	W
EPA1668	PCB Congeners/Homologs (LRMS)	S or W (Total or Dissolved)
EPA1668A	PCB Congeners/Homologs (HRMS)	W (Total or Dissolved)
EPA1668P	PCB Congeners/Homologs-Particulate (LRMS)	S
EPA180.1	Turbidity	W
EPA310.1	Alkalinity	W
EPA350.2	NH_3	W or S
EPA351.3	TKN	W
EPA353.2	NO_3	W
EPA354.1	NO_2	W
EPA3652A	Orthophosphate	W
EPA3652B	Total Phosphate	W
EPA3652C	Organic Phosphate	W

Table 5-4

Valid Value List for Analytical Methods (Continued)

Method Code	Description	Applicable Matrix
EPA3652D	Hydrolyzable Phosphate	W
EPA405.1	BOD5	W
EPA410.1	COD	W
EPA415.1	TOC	W (Total or Dissolved)
EPA451P	POC	W
FRACTION	Sediment Fractionation (Storm)	S
FRACTION2	Sediment Fractionation (River)	S
FRACTION3	Sediment Fractionation (Baseline)	S
RADCS	Cesium-137	S
RADPB	Lead-210	S
RADBE	Beryllium-7	S
SM4500OC	Dissolved Oxygen	W
SW6010B	APP IX Metals	S or W (Total or Dissolved)
SW6010C	APP IX Metals, Mg & Ca	S or W (Total or Dissolved)
SW6010T	TCLP Metals	S
SW6010TI	APP IX Metals	T
SW6010TS	Metals (As/Pb/Ni)	T
SW7470A	Mercury	W (Total or Dissolved)
SW7470T	TCLP Mercury	S
SW7471A	Mercury	S
SW7471TI	Mercury	T
SW8081A	APP IX OC Pesticides	S or W
SW8081T	TCLP OC Pesticides	S
SW8081TI	APP IX OC Pesticides	T
SW8082	PCBs	W (Total or Dissolved)

Table 5-4

Valid Value List for Analytical Methods (Continued)

Analytical Code	Description	Matrix
SW8082A	PCBs (Long)[a]	S or W
SW8082B	PCBs (Short)[b]	S or W
SW8082M	PCBs (Field - Short)[b]	S or W
SW8082M2	PCBs (Field-Short)[b], without 1,2,4-TCB	S or W
SW8082T	PCBs	T
SW8141A	OP Pesticides	S or W
SW8150B	Herbicides	S or W
SW8150T	TCLP Herbicides	S
SW8260B	APP IX Volatile Organics	S or W
SW8270C	APP IX Semivolatile Organics	S or W
SW8270T	TCLP Semivolatile Organics	S
SW8290	PCDD/PCDF - High Res	S or W
SW8290TI	PCDD/PCDF	T
SW9010B	Cyanide	S or W
SW9030B	Sulfide	S or W
SW9040B	pH	W
SW9050A	Specific Conductance	S
SW9060M	TOC	S
SWSIM	Polynuclear Aromatic Hydrocarbons	S or W
SWSIMTI	Polynuclear Aromatic Hydrocarbons	T
SW1010	Ignitability	W
SW9014	Reactive Cyanide	W
SW9034	Reactive Sulfide	W
TO-4	PCBs (Air)	A
EPA680	PCB-Homologs (Vegetation)	S or T

[a] Full list of the seven aroclors and 1,2,4-trichlorobenzene (see Table 7-7).

[b] Short list of aroclors include Aroclor 1248, Aroclor 1254, Aroclor 1260, and 1,2,4-trichlorobenzene (see Table 7-7).

Prep Batch Number—A unique number assigned to no more than 20 samples that are prepared or extracted simultaneously. This is the identifier used to tie the laboratory QC samples to field samples. The field sample and corresponding laboratory QC samples must have the same prep batch numbers. **Note:** Laboratory QC may apply to more than one delivery group. It should be included in each hard copy report and EDD. The MS and MSD samples should only be included in the delivery group if the original sample was on the chain-of-custody form being processed.

Prep Date—The date the sample was extracted or prepared. The format is MM/DD/YYYY (e.g., 01/01/1998). If no preparation is required, it is acceptable to leave this field blank.

Prep Method 1—The preparation or extraction method code as listed on the Analytical Method Value Valid Lists.

Prep Method 2—This field is only used for 1311 TCLP preparation method.

CAS Number—The chemical number as listed on the Analytical Method Valid Value Lists.

Laboratory Analysis Date—The date the sample was analyzed. The format is MM/DD/YYYY (e.g., 01/01/1998).

Analyte Name—The caption or name of the analyte as listed on the Analytical Method Valid Value Lists.

Result Type—The result type from the following Valid Value List:

- FR = Final Result (as concentration).
- FS = Spike Recovery (as percent, e.g., 90 for 90%).
- UR = Surrogate Result (as concentration).
- US = Surrogate Recovery (as percent, e.g., 90 for 90%).

For every surrogate, two lines must exist in the EDD:

- A result type = UR for the amount found (surrogate result).
- A result type = US for the % surrogate recovery.

For every spike, two lines must exist in the EDD:

- A result type = FR for the amount found (spike result).
- A result type = FS for the % recovery spike.

Final Result—If the result type = FR, the final result is reported in the appropriate units in dry weight corrected for variations in the analytical sample amount and for dilutions. If the result type = FS, the final result contains the spike recovery reported in percent. If the result type = UR, the final result is the surrogate result reported in the appropriate units in dry weight corrected for variations in the analytical sample amount and for dilutions. If the result type = US, the final result contains the surrogate recovery reported in percent. If a spiked analyte was diluted out, leave the result field blank. If there was no recovery of a spiked analyte and it wasn't diluted out, then the result must be 0.

Result Units—The appropriate reporting units of the result, detection limit, and spike amount as listed on the Analytical Method Valid Value Lists.

Result Flag—The result flag from the Valid Value List:

- For positive results a blank value in the result flag field is acceptable.
- D = Diluted out.
- I = Interference.
- NS = Not spiked.
- NA = Not applicable.
- * = For organic analyses, if the surrogate or spike recovery is not within the appropriate control limits as specified in the applicable analytical method, an asterisk (*) should be in the flag field for the % recovery record (used on records with a result type of US or FS).
- E = Flag is used when the compound concentration is out of the instrument calibration range. All analytes for both the original analysis and subsequent dilutions must be reported. This flag applies only to organic analysis.
- U = Flag indicates a compound was analyzed for but not detected at or above the sample-specific, project-required reporting limit (PRRL).
- B = Flag is used on organic methods to indicate that a hit on the analyte was also found in the corresponding laboratory method blank.

- J = Flag is used for organic analyses to indicate estimation resulting from a quantifiable value below the sample detection limit.

- N = Flag is used on organic methods to indicate tentative identification or estimation resulting from interference from other compounds.

If the appropriate flag is not listed, contact the WESTON Data Management Group.

Detection Limit—The sample-specific PRRL is reported in the appropriate units in dry weight corrected for variations in the analytical sample amount and for dilutions.

Dilution Type—Dilution types from the following Valid Value List provide a means of identifying a straight sample, dilution, re-extraction, etc.:

- 00 - Straight sample or least diluted run.
- 01 - 98 Dilution (01 - first, 02 - second).
- D1 - D9 VOC dilution.
- A1 - Reanalysis.
- A2 - A9 Reanalysis and dilution.
- R1 - Re-extract.
- R2 - R9 Re-extract and dilution.
- S1 - Re-extract and reanalysis.
- S2 - S9 Re-extract, dilution, and reanalysis.
- M1 - Medium level.
- M2 - M9 Medium level and dilution.
- N1 - Re-extract and medium level.
- N2 - N9 Re-extract, medium level, and dilution.

Dilution Factor—The factor required for adjustment (e.g., if there was a 1:10 dilution, the dilution factor = 10).

Spike Amount—The amount that the sample was spiked, reported in the same units as the detection limit corrected for variations in the analytical sample amount and for dilutions. Even though it is not a percent recovery value, this field should be used for records with a result type = FS or US (include matrix spikes, surrogates, and LCSs).

Percent Solids—The percent solids of that sample.

Sampling Contractor Work Order Number—The work order number (if any) listed on the field chain-of-custody form.

Laboratory Code—The laboratory code as approved by WESTON Data Management Group.

Leachate Prep Date—The date the leachate extraction was completed. The format is MM/DD/YYYY (e.g., 01/01/1998).

Additional Requirements:

- All character fields are left justified.
- All numeric fields are right justified.
- In numeric fields, no leading or preceding zeros are required.
- There are no delimiters between fields.
- Follow the specified columns as stated in the EDD Specification Table.
- No control codes or hidden characters are appropriate in any field.
- No blank lines are accepted in the EDD. Note: Upon the export command, some software packages include a blank line.
- It is expected that the laboratory will perform a comparison of the electronic data with the hard copy report prior to submittal to ensure that the EDD and hard copy data are identical. Appropriate legible disc labeling must be used. The chain-of-custody number, laboratory batch number, and transfer date (date of submittal) must be clearly identified on all electronic deliverables.

5.4.4 EDD Loading

Initially, the data deliverables receipt dates are recorded in the SAMPLE TRACKING module by a WESTON data management staff member, as discussed in Subsection 6.9. The EDD is copied to the operating drive of the data management server and the EDD is run through the "Load EDD" phase of the LOADER module of the system and an "EDD Validation Log" is printed. EDD issues (e.g., incorrect units, misspelled compound names, incomplete analyte lists) are listed on the "EDD Validation Log." All issues are to be reconciled; hard copy and major EDD issues are to be addressed by the laboratory, while minor changes can be made by the Data

Management Coordinator. All changes are to be documented on the "EDD Validation Log," whereas the laboratory issues are to be outlined on a modification form and faxed to the laboratory for response. All documentation is to be maintained in the analytical batch file.

Once errors are corrected and the EDD is considered valid for loading, the EDD is rerun through the LOADER module and is loaded into the Master Analytical Database. A "Load Master Log" is printed, and is initialed and dated by the coordinator to confirm the analytical batch load was complete.

The data LOADER module of the system loads the EDD via the information established in the e-SAP. The EDD is loaded into the Master Analytical Database, which is temporary storage for both laboratory and field results. After evaluation (see Subsection 14.2), the EDD is loaded to the Central Database, which is a repository for only field sample data.

5.5 LABORATORY RECORDKEEPING

At a minimum, subcontracted laboratories will retain all data related to sample preparation, analysis, and general observations in appropriate hardbound laboratory notebooks or files. Laboratory notebook pages must be reviewed, signed, and dated by the author and receive an independent secondary review by a peer or supervisor who signs/initials and dates the data pages.

Corrections to notebook entries are made by drawing a single line through the erroneous entry and writing the correct entry next to the one that is crossed out. All corrections are initialed and dated by the individual performing the correction.

After delivering acceptable hard copy and/or electronic data deliverables, the laboratory will store the original project data for at least 5 years unless otherwise specified in the subcontract agreement.

5.5.1 Electronic Data Storage

Electronic project data will be stored on a secure system, excluding dedicated data systems such as those used for GC/MS. A secure system is defined as a computer system on which reasonable precautions, such as password required access, have been implemented to control access to the

project data. The electronic project data must be backed up at regular intervals of not less than once a week to minimize potential data losses. After the completion of the project, a backup of the final data must be retained for 1 year. The backup does not have to be project specific.

Additionally, reasonable precautions will be taken to ensure electronic media and files are free of computer viruses. Reasonable precautions include using commercial anti-virus software and current virus definitions. Virus definitions are usually updated monthly. "Current" is defined to be not more than 3 months old. Individual scanning of media and electronic files is not required for anti-virus software, which is memory resident and is configured to automatically scan media and files as they are used.

Section 6

B. MEASUREMENT DATA ACQUISITION

6. SAMPLING PROCESS DESIGN

Based on the examination of historical data, development of a conceptual model will be described in each Work Plan.

6.1 SAMPLING METHODS REQUIREMENTS

Table 6-1 lists the minimum sample volumes, sample preservatives, types of sample containers (bottles), and holding times for the measurements and analyses that are required for this project. The sample containers used for this project will be certified clean by the manufacturer according to EPA standards. The manufacturer's statement of certification and analytical results will accompany each bottle lot and be kept as part of the field records.

Table 6-1

Required Containers, Preservation Techniques, and Holding Times

Parameter	Analytical Reference (SOP Reference)	Sample Container[e]	Sample Volume	Preservation[a]	Maximum Holding Time[b]
Water Samples					
Volatile Organics	SW-846 Method 8260B (SOPs A-27 and A-34)	Glass vial with Teflon-lined septum cap	(2) 40 mL	No head space, 4 drops concentrated HCl, Cool, 4°C	14 days
PCBs (Aroclor-Specific)	SW-846 Method 8082 (SOPs A-24, A-48, A-49, A-50, A-74, A-75, and A-79)	Amber glass with Teflon-lined cap	(2) 1 liter	Cool, 4°C	Extract within 7 days, analyze within 40 days following extraction

Table 6-1

Required Containers, Preservation Techniques, and Holding Times (Continued)

Parameter	Analytical Reference (SOP Reference)	Sample Container[c]	Sample Volume	Preservation[a]	Maximum Holding Time[b]
PCBs (Congener/Homolog-Specific) (Large Volume Collection)	SW-846 Modified EPA 1668 (SOP A-79)	Amber glass with Teflon-lined cap	(4) 4 liter	Cool, 4°C	Extract within 1 year of collection, analyze within 1 year of extraction
PCBs (Congener/Homolog-Specific) (Filter)	SW-846 Modified EPA 1668 (SOP A-47)	Clear glass petri dish (Prefired glass microfiber filter-0.7 µm pore size)	(1) 7 inch	Cool, 4°C	Extract within 1 year of collection, analyze within 1 year of extraction
PCBs (Congener/Homolog-Specific)	Modified EPA 1668 (SOPs A-38 and A-47)	Amber glass with Teflon-lined cap	1 liter	Cool, 4°C	Extract within 1 year of collection, analyze within 1 year of extraction
Semivolatile Organics/Organochlorine Pesticides/Herbicides/ Organophosphorus Pesticides Polynuclear Aromatic Hydrocarbons	SW-846 Methods 8270C, 8081A, 8150B, 8141A, SIM (SOPs A-28, A-23, A-26, A-25, A-29, and A-78)	Amber glass with Teflon-lined cap	1 liter per analysis method	Cool, 4°C	Extract within 7 days, analyze within 40 days following extraction
Polychlorinated Dibenzo-p-dioxins/Polychlorinated Dibenzofurans (PCDDs/PCDFs)	SW-846, Method 8290 (SOPs A-36 and A-52)	Amber glass with Teflon-lined cap	(2) 1 liter	Cool, 4°C	Extract within 30 days, analyze within 45 days of extraction.
Metals-except Mercury	SW-846 Method 6010B (SOPs A-18 and A-20)	Plastic	1 liter	Adjust to pH<2 with Nitric Acid	6 months
Cyanide	SW-846 Method 9010B (SOP A-5)	Plastic	1 liter	Adjust to pH>12 with NaOH + Asc. Acid, cool, 4°C	14 days
Sulfide	SW-846 Method 9030B (SOP A-12)	Plastic	250 mL	No head space, 15 drops 2N zinc Acetate, adjust to pH>9 with NaOH, cool, 4°C	7 days

Table 6-1

Required Containers, Preservation Techniques, and Holding Times (Continued)

Parameter	Analytical Reference	Sample Container[e]	Sample Volume	Preservation[a]	Maximum Holding Time[b]
Mercury	SW-846 Method 7470A (SOP A-21)	Plastic	500 mL	Adjust to pH<2 with 35% HNO_3, cool, 4°C	28 days
Soil and Sediment Samples[h]					
PCBs (On-Site Aroclor-Specific) Field Lab	SOP A-37	Amber glass with Teflon-lined cap	500mL	Cool, 4°C	NA[c]
PCBs (On-Site Aroclor-Specific) Field Lab (Hexane Decon Blanks)	SOP A-37	40 mL glass vial with Teflon-lined cap	40 mL	Cool, 4°C	NA[c]
PCBs (Off-Site Aroclor-Specific)	SW-846 Method 8082 (SOPs A-24, A-48, A-49, A-50, A-73, and A-75)	Widemouth amber glass	500 mL	Cool, 4°C	Extract within 14 days, analyze within 40 days following extraction
PCBs (Congener/Homolog-Specific)	Modified EPA1668 (SOPs A-38 and A-47)	Widemouth amber glass with Teflon liner	500 mL	Cool, 4°C	Extract within 1 year of collection, analyze within 1 year of extraction
Volatile Organics	SW-846 Methods 5035, 8260B (SOP A-34)	Encore Sampler	25 gram	Cool, 4°C 1 gram Sodium Bisulfate, 5mL Methanol[f]	Transfer Encore Samples within 48 hrs to preserved vial, analyze within 14 days of collection
Semivolatile Organics/Organochlorine Pesticides/Herbicides/ Organophosphorus Pesticides/ Polynuclear Aromatic Hydrocarbons	SW-846 Methods 8270C, 8081A, 8150B, 8141A SIM (SOPs A-28, A-23, A-26, A-25, A-29, and A-78)	Widemouth amber glass with Teflon liner	500 mL[d]	Cool, 4°C	Extract within 14 days, analyze within 40 days following extraction
PCDDs/PCDFs	SW-846, Method 8290 (SOPs A-36 and A-51)	Widemouth amber glass	250 mL[d]	Cool, 4°C	Extract within 30 days, analyze within 45 days of extraction
Metals – except Mercury	SW-846 Method 6010B (SOPs A-19 and A-20)	Glass or plastic	500 mL[d]	Cool, 4°C	6 months

Table 6-1

Required Containers, Preservation Techniques, and Holding Times (Continued)

Parameter	Analytical Reference	Sample Container[e]	Sample Volume	Preservation[a]	Maximum Holding Time[b]
Mercury	SW-846 Method 7471A (SOP A-22)	Glass or plastic	Analyze from metals jar	Cool, 4°C	28 days
Cyanide	SW-846 Method 9010B (SOP A-5)	Glass or plastic	Analyze from metals jar	Cool, 4°C	14 days
Sulfide	SW-846 Method 9030B (SOP A-13)	Glass or plastic	500 mL	Minimize head space, cool, 4°C	7 days
Cesium-137/Beryllium-7/Lead-210	(SOPs A-60 and A-61)	Widemouth amber glass with Teflon liner	500 mL	Cool, 4°C	NA
% Solids	(SOPs A-17 and A-57)	Glass or plastic	Analyze from metals jar	Cool, 4°C	NA
Water Quality Samples					
Dissolved Organic Carbon (DOC) Total Organic Carbon (TOC) Particulate Organic Carbon (POC)	EPA 415.1 (SOPs A-15, A-63, and A-77)	Plastic or glass	500 mL (2) 40 mL	1) Field filter 2) Transfer to (2) 40 mL VOA vials. 3) Adjust to pH<2 with HCl Cool, 4°C	28 days
Total Dissolved Solids (TDS)	EPA Method 160.1 (SOP A-2)	Plastic or glass	250 mL	Cool, 4°C	7 days
Total Suspended Solids (TSS)	EPA Method 160.2 (SOP A-3)	Plastic or glass	1 liter	Cool, 4°C	7 days
Chlorophyll-A	EPA Method 10200 (SOP A-39)	Plastic or glass (opaque container or foil wrapped)	500 mL	Cool, 4°C	ASAP, if not possible—filter sample, retain filter only, and freeze up to 3 weeks
Biological Oxygen Demand (BOD_5)	EPA 405.1 (SOPs A-14 and A-62)	Plastic or glass	1 liter	Cool, 4°C	48 hours
Hardness	EPA 130.2 (SOP A-1)	Plastic or glass	500 mL	Adjust to pH <2 with HNO_3. Cool, 4°C	6 months

Table 6-1

Required Containers, Preservation Techniques, and Holding Times (Continued)

Parameter	Analytical Reference	Sample Container[c]	Sample Volume	Preservation[a]	Maximum Holding Time[b]
Orthophosphate as P	EPA 365.2 (SOP A-11)	Plastic or glass	250 mL	Cool, 4°C	48 hours
Total Kjeldahl Nitrogen (TKN)	EPA 351.3 (SOP A-7)	Plastic or glass	500 mL	Adjust to pH<2 with H_2SO_4 Cool, 4°C	28 days
NH_3	EPA 350.2 (SOP A-6)	Plastic or glass	1 liter	Adjust to pH<2 with H_2SO_4 Cool, 4°C	28 days
NO_3/No_2 as N	EPA 353.2 (SOP A-8)	Plastic or glass	100 mL	Adjust to pH<2 with H_2SO_4 Cool, 4°C	28 days
NO_2 as N	EPA 354.1 (SOP A-9)	Plastic or glass	250 mL	Cool, 4°C	48 hours
Total Phosphate as P Hydrolyzable Phosphate as P Organic Phosphate as P (Calculation)	EPA 365.2 (SOP A-10)	Plastic or glass	250 mL	Adjust to pH<2 with H_2SO_4 Cool, 4°C	28 days
COD	EPA 410.1 (SOP A-80)	Plastic or glass	250 mL	Adjust to pH<2 with H_2SO_4 Cool, 4 °C	28 days
Alkalinity	EPA 310.1 (SOP A-4)	Plastic or glass	250 mL	Cool, 4°C	14 days
Turbidity	EPA 180.1 (See FSP)	Plastic or glass	On-site	Cool, 4°C	On-site (48 hrs)
Conductivity	SW 9050A (See FSP)	Plastic or glass	On-site	Cool, 4°C	On-site (immed.)
Dissolved Oxygen	SM4500-OC (See FSP)	Plastic or glass	On-site	Cool, 4°C	On-site (immed.)
pH	SW-846 9040B (SOP A-33)	Plastic or glass	On-site	Cool, 4°C	On-site (immed.)
Geotechnical Samples – Soil					
TOC	SW-846 9060 (SOP A-16, A-64, and A-76)	Glass	125 mL (4 oz.)	Cool, 4°C	28 days
Grain Size Distribution	ASTMD 422 (SOP A-35 and SOP A-58)	Glass	500 mL	Cool, 4°C	NA

Table 6-1

Required Containers, Preservation Techniques, and Holding Times (Continued)

Parameter	Analytical Reference	Sample Container[e]	Sample Volume	Preservation[a]	Maximum Holding Time[b]
Porosity	ASA 18-2.1 (SOP A-41)	Glass	125 mL (4 oz.)	Cool, 4°C	NA
Atterberg Limits	ASTM D 4318 (SOP A-40 and SOP-55)	Glass	125 mL (4 oz.)	Cool, 4°C	NA
Bulk Density	ASTM D 2937 (SOP A-59)	Glass	125 mL (4 oz.)	Cool, 4°C	NA
Specific Gravity	ASTM D 853 (SOPs A-41 and A-54)	Glass	250 mL	Cool, 4°C	NA
% Water Content	ASTM D 2216 (SOP A-56)	Glass	Analyze from Specific Gravity Jar	Cool, 4°C	NA
Waste Disposal Samples[g]					
Total Petroleum Hydrocarbons (TPH)	EPA 418.1 (SOP A-30)	Amber glass with Teflon-lined cap	1 liter	Adjust to pH<2 with H_2SO_4 Cool, 4°C	28 days
Ignitability	SW-846 1010 (SOP A-31)	Glass or plastic	250 mL	Cool, 4°C	NA
Reactive Cyanide	SW-846 9014 (SOP A-32)	Plastic	1 liter	Adjust to pH<2 with NaOH Cool, 4°C	14 days
Reactive Sulfide	SW-846 9034 (SOP A-32)	Plastic	500 mL	No head space, 15 drops 2N zinc acetate, adjust to pH>9 with NaOH, cool, 4°C	7 days
Corrosivity as pH	SW-846 9040B (SOP A-33)	Plastic or glass	250 mL	Cool, 4°C	Immediate
TCLP Extracts (Soil Sample)					
Semivolatile Organics Organochlorine Pesticides Herbicides	SW-846 methods 8270C, 8080, 8151 (SOPs A-28, A-44, A-43, and A-45)	Widemouth amber glass with Teflon liner	500 mL[d]	Cool, 4°C	TCLP Extract within 14 days, then follow water HT criteria by method

Table 6-1

Required Containers, Preservation Techniques, and Holding Times (Continued)

Parameter	Analytical Reference	Sample Container[e]	Sample Volume	Preservation[a]	Maximum Holding Time[b]
Metals-except Mercury	SW-846 Method 6010B (SOPs A-46 and A-43)	Glass or plastic	500 mL[d]	Cool, 4°C	TCLP Extract within 180 days, analyze within 180 days of extraction
Mercury	SW-846 7470A (SOP A-22 and A-43)	Glass or plastic	Analyze from metals jar	Cool, 4°C	TCLP Extract within 28 days, analyze within 28 days of extraction
DNAPL/LNAPL Samples					
PCBs (Congener/Homolog-Specific)	Modified EPA 1668 (SOP A-47)	Widemouth amber glass with Teflon liner	250 mL	Cool, 4°C	Extract within 1 year of collection, analyze within 1 year of extraction
Air Samples					
PCBs	EPA TO-4 (SOP A-42)	PUF (3 inch)	NA	Cool, 4°C	Extract within 7 days, analyze within 40 days following extraction
Vegetation Samples					
PCBs (Homolog-Specific)	EPA 680 (SOPs A-83, A-84, and A-85)	Widemouth amber glass with Teflon liner	500 mL	Cool, 4°C (Freeze dry at laboratory)	Hold freeze dried up to 1 year, at -10°C, extract within 14 days of thawing, analyze within 40 days following extraction.

[a] Pre-preserved bottles will be supplied for volatile organics and TOC.
[b] Holding time measured from date of collection.
[c] Samples scheduled for the field lab will be analyzed on 24-hour turnaround time; Method 8082 holding times will apply.
[d] Sample volume requirements must be increased as necessary to accommodate low-solids sediment samples.
[e] Sample containers will meet all requirements established in *Specifications and Guidance for Contaminant Free Sample Containers*, EPA540/R-93/051, Dec. 1992 (99-0101).
[f] To be performed at the laboratory, prior to Encore Sample transfer.
[g] The analyses are to be conducted only on waste disposal samples generated on-site. These analyses will not be used for decision making purposes. Full hard copy data deliverables will not be required.
[h] Sample freezing may be utilized as deemed necessary by project staff. Soil/sediment samples may be frozen for up to 1 year from collection. Maximum holding times start upon thawing.

Sample preservation will be performed in the field, with the exception of the aqueous volatile organics and TOC bottles, which will be pre-preserved at the laboratory. The sampling personnel will use pre-measured ampules or disposable pipettes and stock solutions of reagent grade materials, which have been provided by a reputable vendor. The pH of the sample will be verified using SW-846 Method 9041A, which allows for the use of wide-range pH paper. If a more accurate pH determination is needed, the method specifies the use of narrow-range pH paper. The accuracy of this paper has been determined either by using a series of buffers or by comparison with a calibrated pH meter. This procedure is only to be used to verify and document preservation and is not to be used in lieu of SW-846 Method 9040B. The laboratory will perform a pH check prior to sample screening with the use of pH paper.

In addition, it is anticipated that field filtration will be performed (after preservation) on aqueous matrices for selected parameters; however, the specific frequency and procedure will be established within the appropriate Work Plan.

6.2 FIELD CHAIN-OF-CUSTODY PROCEDURES

To maintain a record of sample collection, transfer between personnel, shipment, and receipt by the laboratory, a chain-of-custody record (Figure 6-1) will be completed for each sample shipment by the field team. The chain-of-custody, which may be more than one page long, will list each sample in a shipping container (cooler). The chain-of-custody will be applicable only to the contents of a single shipping container and will be placed in a Ziploc ® bag and tapped 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 transfer, will be documented. The transfer from the field team to the shipper and from the shipper to the laboratory will be documented by the airbill instead of the chain-of-custody. The laboratory is required to maintain a copy of the chain-of-custody and airbill as part of the laboratory's project records.

Chain-of-custody seals (see Figure 6-2) are used to determine if any tampering has occurred during transport of samples. These signed and dated seals will be placed at the junction between

Figure 6-1 Example Chain-of-Custody Form

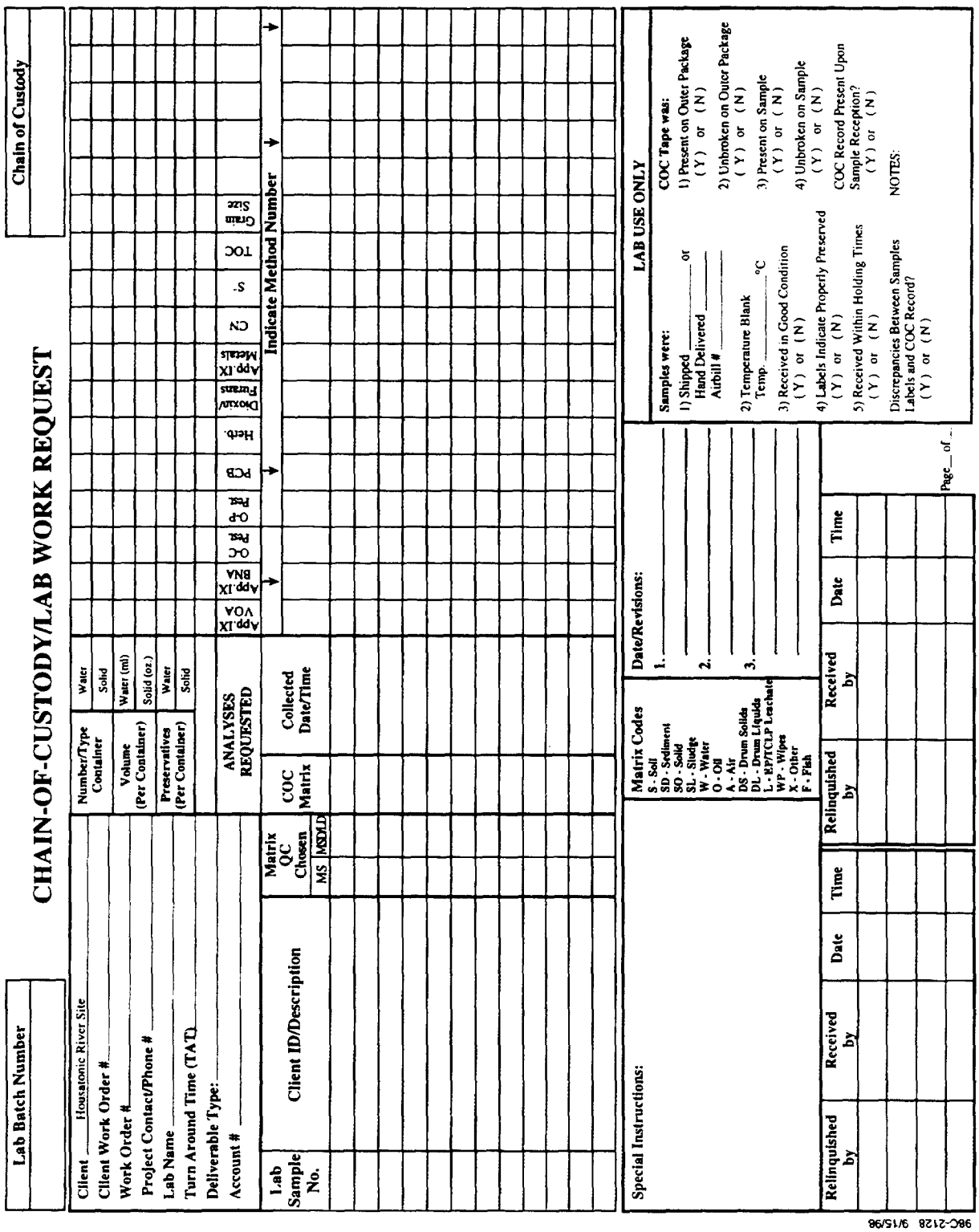


Figure 6-2
Chain-of-Custody Seal

WESTON® MANAGERS DESIGNERS/CONSULTANTS **OFFICIAL CUSTODY SEAL** WCS 1	Name _____ Date _____ W.O. # _ _ _ _ _ – _ _ _ – _ _ _ – _ _ _ _ _ – _ _

Figure 6-3
Jar/Bottle Label

PROJECT NAME	
SAMPLE ID	**SAMPLE DATE**
SAMPLED BY	**SAMPLE TIME**
PRESERVATIVE	___ GRAB ___ COMPOSITE
ANALYSIS REQUESTED	

the lid and the jar and on the cooler by the person responsible for packaging for both on-site and off-site sample analyses. If the coolers or jars are opened before receipt at the laboratory, the seals will not be intact. If the chain-of-custody seals are not intact, the Laboratory Project Manager will notify the WESTON Analytical Manager within 24 hours of receipt of the container. The WESTON Analytical Manager will then follow the corrective action procedures.

6.3 SAMPLE IDENTIFICATION PROCEDURE

Samples collected at the site must be uniquely labeled. All samples will be identified with a label attached directly to the container (see Figure 6-3). Sample label information will be completed using waterproof black marker. The labels will contain the following information:

- Sample ID.
- Time and date of collection.
- Project Name.
- Analysis Requested.
- Preservative (if any).
- Sample source/location.
- Sampler's initials.

From a data management perspective, the key requirement for the field sample identifier is that it is a unique name. In addition, for sample tracking purposes, the identifier has implicit coding of sample information, including site, location ID, sample type, sample depth or date collected. To present this information in a readable format, a sample attribute form has been created to record this information by the field personnel (see Figure 6-4) The sample attribute information will be explicitly recorded on a sample attribute field form (i.e., field sample ID, location ID, physical location description, sampling depths, split samples, and sample comments). The field sample identifier and its corresponding attribute information will be captured electronically on the day of collection and linked within the database.

Figure 6-4 Sample Attribute Form (Front)

LOCATION ID

GPS:		Comments
YES		
NO		

Program Code:

Location Description Code:

Transect Number:

Date Sample Collected: ____________

Comments: ____

Site	Location ID	QC Type	Starting Depth or Date Collected	Depth (in feet) starting	Depth (in feet) ending	If the sample is split:
-		- -				Split To:
						Split Sample ID
Comments:						

Site	Location ID	QC Type	Starting Depth or Date Collected	Depth (in feet) starting	Depth (in feet) ending	If the sample is split:
-		- -				Split To:
						Split Sample ID
Comments:						

Site	Location ID	QC Type	Starting Depth or Date Collected	Depth (in feet) starting	Depth (in feet) ending	If the sample is split:
-		- -				Split To:
						Split Sample ID
Comments:						

Site	Location ID	QC Type	Starting Depth or Date Collected	Depth (in feet) starting	Depth (in feet) ending	If the sample is split:
-		- -				Split To:
						Split Sample ID
Comments:						

Site	Location ID	QC Type	Starting Depth or Date Collected	Depth (in feet) starting	Depth (in feet) ending	If the sample is split:
-		- -				Split To:
						Split Sample ID
Comments:						

Site	Location ID	QC Type	Starting Depth or Date Collected	Depth (in feet) starting	Depth (in feet) ending	If the sample is split:
-		- -				Split To:
						Split Sample ID
Comments:						

Form Relinquished By:	Form Received By:	Date Form Completed	Time Form Completed

Figure 6-4 Sample Attribute Form (Back) (Continued)

Program Codes and Sampling Program Descriptions		
Program Code	Sampling Program Descriptions	
0001	Systematic Sampling	
0002	Modeling Transects	
0003	Discrete River Sampling	
0004	Terraces and Bars	
0005	Monthly Surface Water	
0006	Stormflow Sampling	
0007	Air Sampling	
0008	Non-Routine Surface Water	
0009	Vernal Pools	
0010	Fractionated Samples	
0012	Deep Cores	
0013	Benthic Macroinvertebrate	
0014	Tree Swallow	
0015	Sediment Toxicity	
0016	Mussel Exposure	
0017	Residential	
0018	Butler Farm	Agriculture
0020	EE/CA Cobble Box	
0021	Squash	
0022	Corn	
0023	Fiddleheads	
0024	Small Mammals	
0025	Impoundments	
0026	Soil Invertebrates	
0027	Macrophytes	
0028	Long-Term Remediation Monitoring	
0029	SBLT	
0030	DRET	
0031	Landfill	
0032	Leopard / Wood Frogs	
0033	AT&T	Commercial
0034	Electric Company	Commercial
0035	Miss Halls School	Commercial
0036	Sewer ROW	Commercial
0037	Tenn. Gas Co	Commercial
0038	Canoe Meadows	Recreational
0039	Decker Canoe	Recreational
0040	Devos Farm	Recreational
0041	Oct Mtn Access	Recreational
0042	Paintball	Recreational
0043	Sportsman Club	Recreational
0045	Noble Farm	Agriculture
0046	Woods Pond	Recreational
0047	Lee	Agriculture
0048	Lee	Commercial
0049	Lee	Recreational
0050	Stockbridge	Recreational
0051	Stockbridge Golf	Recreational
0052	Lenoxdale	Recreational
0053	Great Barrington	Agriculture
0054	Great Barrington	Commercial
0055	Great Barrington	Recreational
0056	Sheffield	Commercial
0057	Barts Cobble	Recreational
0058	Sheffield	Recreational
0059	Well Sampling	
0060	Duck Blinds	Recreational
0061	Sheffield	Agriculture
0062	Sediment Core Transects	
0063	Allendale School	
0064	Soil Sampling / Soil Boring	
0065	Round Robin	
0066	Pittsfield	Recreational
0067	Ground Water Sampling	

Location and Description Codes			
Biological Samples			
Tissue			
	TB	=	Brain
	TF	=	Fillet
	TL	=	Liver
	TO	=	Offal
	TR	=	Breast
	TV	=	Ovaries
	TW	=	Whole Body
Other			
	MI	=	Macro Invertebrate
	BX	=	Other Biological
Sediment Samples			
	DL	=	Lake or Pond
	DO	=	Sewer/Pipe Outfall
	DR	=	River/Stream
	DX	=	Other Sediment
Soil Samples			
Surface/Shallow			
	SF	=	Flood Plain
	SP	=	Paved/Covered
	SR	=	Riverbank
	SU	=	Unpaved
Soil Boring : Total Depth			
	BB	=	Bedrock
	BF	=	Fill
	BG	=	Glacial Till
	BL	=	Lower Alluvium
	BM	=	Middle Alluvium
	BT	=	Top of Till
	BU	=	Upper Alluvium
	BW	=	Water Table
	SX	=	Other Soil
Water Samples			
Monitoring Well: Screens			
	MB	=	Bedrock
	MFW	=	Fill and Water Table
	MG	=	Within Till
	MLV	=	Lower Alluvium
	MMA	=	Middle Alluvium
	MT	=	Top of Till
	MUA	=	Upper Alluvium
	MW	=	Water Table
	MWT	=	Water Table and Till
Other			
	PW	=	Public/Residential Well
	RW	=	Recovery Well
	WS	=	Surface Water
	WSD	=	Surface Water Suspended Sediment
	WX	=	Other Water
Other			
	AR	=	Air
	WD	=	Waste Disposal
	XI	=	Wipe
	VG	=	Vegetation
	OX	=	Other

The field sample identifier will be 18 characters long and be composed of 4 parts. Listed below are brief summaries of the identifier parts. For a more detailed description of sample ID assignment, refer to the *Field Sampling Plan* (00-0476):

[- -] - [- - - - - - - -] - [-] - [- - - -]
[Site]-[Location ID]-[QC Type]-[Start Depth or Date Collected]

Field Sample ID Part 1: Site

Part 1 of the field sample ID will be two characters representing a specific site or "PE" for performance evaluation samples.

Field Sample ID Part 2: Location ID

Part 2 of the field sample ID will be eight characters/numbers representing the location ID. Location IDs will be unique identifiers representing geographic x, y coordinates for all sample types, except for tissue and PE samples. There will be four different location ID Systems depending on what type of sample is being collected:

- Transect samples
- Non-transect samples
- Tissue samples
- PE samples

Field Sample ID Part 3: Sample QC Type

Part 3 of the field sample ID will be a single number representing the sample QC type.

Field Sample ID Part 4: Starting Sample Depth or Collection Date

Part 4 of the field sample ID will vary depending on whether the sample has associated depth or not. Samples with an associated depth will have this part as a starting depth, and it will be expressed in tenths of feet (e.g., 0105 represents a starting depth of 10.5 feet). This part will indicate date collected for all other samples.

The four-character date code will be:

- Position one equals the last number of the year.
- Position two equals a letter corresponding to a month (J=January, F=February, M=March, A=April, Y=May, U=June, L=July, G=August, S=September, C=October, N=November, D=December).
- Positions three and four equal the day of the month (e.g., 8S19 is the code for 19 September 1998).

A sample attribute form will be used to record location description codes, physical location descriptions, starting and ending depths, and, if a sample split, then to whom it is split and what the split sample ID is. The sample attribute form will also be used as a field chain of custody and "Relinquished by," "Received by," "Date," and "Time" will be entered on the form. This covers custody of samples from the sample collection location to the Pittsfield staging area.

In addition to the field sample identifier, the sample attribute form has entry fields for physical location description, associated split sampling, and comments. The Field Data Manager is responsible for assigning the location ID, Site Identifier Code, Location Identifier Code, Transect, Location Description Code, and Physical Location Description. The remaining information is to be completed under the guidance of the specific Work Plan.

6.4 SAMPLE SHIPPING PROCEDURE

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 the applicable regulations. The United States Department of Transportation (DOT) and the International Air Transport Association (IATA) have established specific regulations governing the packaging of hazardous and environmental samples for shipment. These regulations include specifications for packing materials, shipping containers, and shipping labels. All samples will be shipped in accordance with these regulations based on the best available knowledge of the samples being collected, see Appendix C of the *Field Sampling Plan* (00-0476).

6.5 SAMPLING EQUIPMENT DECONTAMINATION PROCEDURE

Sample collection equipment (spatulas, scoops, etc.) will be thoroughly cleaned between uses to prevent cross-contamination of samples. Equipment will be decontaminated as specified in Appendix C of the *Field Sampling Plan* (00-0476).

6.6 DISPOSAL OF INVESTIGATION-DERIVED WASTES

Waste generated during sampling efforts by WESTON will be disposed of in accordance with contract specifications, as outlined in Appendix C of the FSP; applicable federal, state, and local disposal regulations; and any disposal facility-specific requirements.

6.7 FIELD SAMPLE STORAGE PROCEDURES

WESTON expects to ship samples on the same day the samples are collected. 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 or the equivalent 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 the shipping service. Specific details for field sample storage are discussed in the *Field Sampling Plan* (00-0476).

6.8 LABORATORY CHAIN-OF-CUSTODY PROCEDURES

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 chain of custody assuming custody of the samples. If a chain of custody is not received with a set of samples, the laboratory will immediately notify the WESTON Project Manager.

- Inspect the sample cooler for integrity and then document the following information:

  - Type of courier and whether the samples were shipped or hand delivered (copies of the airbills are maintained).

  - Availability and condition of custody information.

  - Sample temperature ambient or chilled.

  - Actual temperature of the temperature blank.

  - Presence of leaking or broken containers and indication of sample preservation.

- Verify the holding time is not exceeded. If a sample has exceeded holding time, then the WESTON Project Manager will be notified.

- Match the sample container information (e.g., sample tag/label), chain-of-custody records, and all pertinent information associated with the sample. The sample custodian then verifies sample identity to ensure that all information is correct. Any inconsistencies are resolved with WESTON through the Laboratory Project Manager and corrective action measures are documented before sample analysis proceeds.

The laboratory chain-of-custody procedures are also addressed in Appendix C of the *Field Sampling Plan* (00-0476).

6.9 ELECTRONIC SAMPLE TRACKING

The electronic sample tracking process is initiated with the receipt of the hard copy chain of custody and the associated sample attribute forms. The field sample coordinator is responsible for faxing these documents to WESTON's Data Management Group at the end of each sampling day. In addition, the laboratory's sample custodian will also generate and fax a laboratory sample confirmation within 24 hours of the sample receipt. This laboratory confirmation contains laboratory sample IDs and analytical batch assignment information. The receipt date is stamped on these documents and an analytical batch file is created for storage of all hard copy documentation related to the specific batch. WESTON's data management sample coordinator

compares the chain of custody and the laboratory confirmation for discrepancies; any issues are documented and reconciled.

At this point, the analytical batch information is entered in the SAMPLE TRACKING module of the Technical Data Management System by a WESTON data management staff member. The "Chain-of-Custody Summary" is printed and manually reviewed by the sample coordinator for entry errors and corrections are made as needed. A final hard copy "Chain-of-Custody Summary" is stored in the analytical batch file, which is placed in a temporary repository until laboratory deliverable receipt.

The detailed implementation of the data management system is discussed in the *Environmental Information Management Systems Data Management Plan* (00-0336). The electronic data review process is also outlined in Subsection 14.1 of this QAPP.

6.10 LABORATORY SAMPLES STORAGE PROCEDURES

All samples submitted to the field laboratory will be stored in coolers at 4 ± 2°C for a minimum of 5 days following sample analysis. Following the 5-day storage period, samples will be transferred to long-term storage at -20°C. PCB extracts will be stored for a minimum of 14 days after analysis.

Samples submitted to off-site laboratories will be stored at 4 to 6°C for a minimum of 60 days following the completion of analyses and/or issue of final reports. Sample extracts and metals digestates will be stored for a period of 1 year following submittal 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.

Section 7

7. ANALYTICAL METHOD REQUIREMENTS

7.1 FIELD MEASUREMENTS

Table 7-1 lists the field measurements that will be performed for this project and the reporting limits for the measurements. The specific measurement procedures are described in detail in Appendix C of the *Field Sampling Plan* (00-0476).

Table 7-1

Target Analyte List and Report Limits

Parameter	Measurement Method Water	Reporting Limit Water
1. pH	SW-846 9041A	±0.2 pH units
2. Dissolved Oxygen	SM4500-OC	200 µg/L
3. Turbidity	EPA 180.1	0.2 NTU
4. Conductivity	SW-846 9050A	1.0 µS/cm

7.2 FIELD CORRECTIVE ACTION

Corrective action in the field can be needed when the sample network is changed or when sampling procedures and/or field analytical procedures require modification. In general, the field team member, Field Operations Manager, Project Manager, Agency Representative, and/or Analytical Manager may identify the need for corrective action, as well as recommend appropriate action. Corrective action in the field measurements may include:

- Repeating the measurement to check the error.
- Checking all proper adjustments for ambient conditions such as temperature.
- Checking instruments' batteries.
- Checking instruments' calibration.
- Recalibration.
- Replacing the instrument or measurement device.
- Stopping work (if necessary).

All corrective actions shall be approved and documented. If corrective actions result in fewer samples (or analytical fractions), alternate locations, etc., which may cause project quality assurance objectives not to be achieved, it will be necessary that all levels of project management concur with the proposed action.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected due to unapproved or improper use of approved methods. Corrective action will be documented in quality assurance reports and any field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels.

7.3 FIELD ANALYTICAL PROCEDURES

Based on the *Field Sampling Plan* (00-0476), a majority of samples will require on-site laboratory analysis for PCBs and 1,2,4-Trichlorobenzene. These samples will be analyzed according to a modified SW-846 Method 8082 (PCB Field Method SOP), as described in Appendix A. In addition, 10% of all on-site PCB samples will have confirmation analyses performed at an off-site laboratory.

To improve extraction efficiency for high-moisture samples in the on-site laboratory, a 12-hour drying process (75°C) was implemented in April 1999. Refer to SOP-A-37.

7.4 LABORATORY ANALYTICAL PROTOCOLS

Tables 7-2 through 7-21 list the parameters of interest, the analytical method, and the reporting limits required for this project. Routine analytical services are performed using standard EPA-approved methodologies, where applicable. In some cases, modification of standard methods may be necessary to provide accurate analyses of particularly complex matrices. When modifications to standard analytical methods are performed, the specific alterations, as well as the reason for the change, will be communicated to the WESTON Analytical Manager and

documented in all associated correspondence and records. The modifications will be reported with the results of analysis.

The reporting limits were selected 1) based on the data quality objectives identified in Section 4, and 2) to be significantly less than the action limits established within the individual work plans. The soil limits assume that solid waste and soil-like materials will be reported on a dry weight basis. It is acceptable and desirable for the laboratory to use lower reporting limits than those specified in Tables 7-4 through 7-21.

Every effort will be made to minimize excess liquid in the field. In addition, upon arrival of the containers at the laboratory, personnel should decant the standing water from each container, prior to homogenization and weighing. Preferably a percent solids analysis should be performed at this point to determine appropriate sample amounts necessary to achieve the reporting limit requirements. If due to time constraints, an initial percent solids is not able to be performed, the laboratory must extract or digest the largest amount of sample possible.

The laboratory's reporting limits are based on the project requirements and the sample matrix. Individual sample reporting limits may vary from the laboratory's routine reporting limits due to dilution requirements, variability in sample weight or volume used to perform the analysis, dry weight adjustment for solid samples, the presence of analytical background contaminants, or other sample- or analysis-related conditions.

In the event the laboratory's reporting limit exceeds the limit specified in Tables 7-4 through 7-21, with the exception of a required dilution, a laboratory representative must notify the WESTON Analytical Manager. If elevated reporting limits are a result of low percent solids (<30%), corrective action must be performed for the on-site samples, as outlined in this QAPP, refer to Subsection 5.4.1.1).

In addition, specialty sampling/preparation procedures are to be performed on various matrices as deemed necessary for their intended use (see Appendix A for associated SOPs):

- Toxicity Characteristic Leaching Procedure (TCLP)
- Dredged-Material Elutriation Test (DRET)

- Pore Water Separation
- Standard Sequential Batch Leaching Test (SBLT)
- Sediment Particle Size Fractionation

7.5 LABORATORY CORRECTIVE ACTION

The subcontracted laboratory will have a quality system in place that includes a deficiency reporting system. The deficiency reporting system will include documenting the deficiency, implementing both immediate and long-term corrective actions, and notifying the WESTON Project Manager or designee of deficiencies that impact the quality of the sample results.

When errors, deficiencies, unusual occurrences, or out-of control situations exist, the QA program provides systematic procedures, called corrective actions, to resolve problems and restore proper functioning to the analytical system. Within the laboratory, a distinction is made between out-of-control events and unusual occurrences for the purposes of requiring corrective actions.

An out-of-control event is any event that is beyond the acceptance limits established for laboratory operation by the laboratory SOPs, EPA methods, or client-specific contracts or protocols. An out-of-control event can be due to data that are outside the accepted bounds for accuracy and/or precision, method contamination, improper instrument calibration or maintenance, or deviations from the SOW or SOP detected by a QA audit.

An unusual occurrence is a situation in which the analytical system is, strictly speaking, compliant with the protocol or SOP and, therefore, in control but an atypical or undesirable incident has occurred that warrants further investigation. Such an occurrence could be a holding blank that is contaminated or differences in the pattern of nonspiked target compounds between a spiked and unspiked aliquot of a sample used as the matrix spike.

Both out-of-control events and unusual occurrences are to be noted in the laboratory batch file as well as addressed in the case narrative.

Table 7-2

Soil/Sediment and DNAPL/LNAPL Analytical Protocols

Parameter	Analysis		Extraction		Cleanup[b]	
	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified)
Appendix IX + 2[a]						
Semivolatile	Gas chromatography/ mass spectroscopy (GC/MS)	8270C (SOPs A-28 and A-78)	Soxhlet	3541, 3545 (SOPs A-28 and A-78)	GPC	3640
Chlorinated Pesticides	Gas chromatography/ electron capture detector (GC/ECD)	8081A (SOP A-23)	Soxhlet	3541, 3545 (SOP A-23)	Florisil GPC Sulfur	3620 3640 3660
Chlorinated Herbicides	GC/ECD	8150B (SOP A-26)	Wrist shaker/sep. funnel	8150B (SOP A-26)	Hydrolysis esterification	8150B
Organophosphorus Pesticides	GC/NPD	8141A (SOP A-25)	Soxhlet	3541, 3545 (SOP A-25)	Florisil Sulfur	3620 3660
PCDDs/PCDFs (Congener-Specific)	GC/MS	8290 (SOPs A-36 and A-51)	Soxhlet and Dean Stark	8290 (SOPs A-36 and A-51)	Acid/Base Silica gel Alumina Carbon	8290
Metals	Inductively coupled plasma/atomic absorption (ICP)	6010B (SOP A-20)	Acid digestion	3050B (SOP A-19)	NA	NA
Mercury	Cold vapor	7471A (SOP A-22)	Acid digestion	7471A (SOP A-22)	NA	NA
Cyanide	Spectrometric	9010B (SOP A-5)	Distillation	9010B (SOP A-5)	NA	NA
Sulfide	Titrimetric	9030B (SOP A-13)	Distillation	9030B (SOP A-13)	NA	NA
PCBs[d] (Aroclor-Specific)	GC/ECD	8082 (SOPs A-24, A-37, A-49, A-50, and A-75)	Sonication	3550A (SOPs A-24, A-37, A-48, A-49, A-50, and A-73)	Florisil GPC Sulfur Sulfuric Acid	3620 3640 3660 3665
Volatile[c]	Gas chromatography/ mass spectroscopy (GC/MS)	8260B (SOP A-34)	Purge and trap	5035 (SOP A-27)	NA	NA
Polynuclear Aromatic Hydrocarbons	Gas chromatography/ mass spectroscopy (GC/MS)	SIM (SOP A-29)	Soxhlet	3541, 3545 (SOP A-29)	GPC	3640
PCB[d] (Congener/ Homolog-Specific)	Gas chromatography/ mass spectroscopy (GC/MS)	Modified EPA 1668 (SOPs A-38 and A-47)	Sonication	EPA 1668 (SOPs A-38 and A-47)	Silica Gel Acid/Base Alumina Carbon	EPA1668

Table 7-2

Soil/Sediment and DNAPL/LNAPL Analytical Protocols (Continued)

Parameter	Analysis		Extraction		Cleanup[b]	
	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified)
TCLP Extraction	NA	See Water Method	TCLP Extractor (Acid Digestion)	1311 (SOP A-43)		See Water Methods
% Solids	NA	(SOPs A-17 and A-57)	NA	NA	NA	NA
Geotechnical						
Atterberg Limits	NA	ASTM D 4318 (SOPs A-40 and A-55)	NA	NA	NA	NA
Bulk Density	NA	ASTM D 2937 (SOP A-59)	NA	NA	NA	NA
Porosity	NA	ASA 18-2.1 (SOP A-41)	NA	NA	NA	NA
Total Organic Carbon[d]	Combustion/ oxidation-IR	9060 (SOPs A-16 A-64, A-65, and A-76)	Acid digestion	9060 (SOP A-16, A-64, A-65, and A-76)	NA	NA
Grain Size Distribution	NA	ASTM D 422 (SOPs A-35, A-58, and A-66)	NA	NA	NA	NA
Specific Gravity	Pyncometer	ASTM D 853 (SOP A-54)	NA	NA	NA	NA
% Water Content	NA	ASTM D 2216 (SOP A-56)	NA	NA	NA	NA
% Organic Content	NA	ASTM D 2974	NA	NA	NA	NA
Undrained Triaxial Compression	NA	ASTM D 2850	NA	NA	NA	NA
Drained Triaxial Compression	NA	ASTM D 4767	NA	NA	NA	NA
Core Dating						
Cesium-137/Beryllium-7	GeLi Detector	(SOP A-61)	NA	NA	NA	NA
Lead-210	Si (Li) Alpha Particle Spectrometer	(SOP A-60)	Acid Digestion	(SOP A-60)	NA	NA

Table 7-2

Soil/Sediment and DNAPL/LNAPL Analytical Protocols (Continued)

Parameter	Analysis		Extraction		Cleanup[b]	
	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified)
DNAPL/LNAPL[e]						
PCBs (Congener/Homolog-Specific)	Gas Chromatography/ Mass Spectroscopy (GC/MS)	Modified EPA 1668 (SOP A-47)	Sonication or Waste Dilution	EPA 1668 (SOP A-47)	Silica Gel Acid/Base Alumina Carbon	EPA 1668
Semivolatile[f]	Gas chromatography/ mass spectroscopy (GC/MS)	8270C (SOP A-28)	Soxhlet	3541, 3545 (SOP A-28)	GPC	3640
PCBs[f] (Aroclor-Specific)	GC/ECD	8082 (SOPs A-24 and A-37)	Sonication	3550A (SOPs A-24 and A-37)	Florisil GPC Sulfuric Acid Sulfur	3620 3640 3665 3660
Chlorinated Pesticides[f]	Gas chromatography/ electron capture detector (GC/ECD)	8081A (SOP A-23)	Soxhlet	3541, 3545 (SOP A-23)	Florisil GPC Sulfur	3620 3640 3660
Chlorinated Herbicides[f]	GC/ECD	8150B (SOP A-26)	Wrist shaker/sep. funnel	8150B (SOP A-26)	Hydrolysis esterification	8150B
Organophosphorus[f] Pesticides	GC/NPD	8141A (SOP A-25)	Soxhlet	3541, 3545 (SOP A-25)	Florisil Sulfur	3620 3660
PCDDs/PCDFs[f] Congener-Specific)	GC/MS	8290 (SOP A-36)	Soxhlet and Dean Stark	8290 (SOP A-36)	Acid/Base Silica gel Alumina Carbon	8290
Metals[f]	Inductively coupled plasma/atomic absorption (ICP)	6010B (SOP A-20)	Acid digestion	3050B (SOP A-19)	NA	NA
Mercury[f]	Cold vapor	7471A (SOP A-22)	Acid digestion	7471A (SOP A-22)	NA	NA
% Solids[f]	NA	(SOP A-17)	NA	NA	NA	NA

Table 7-2

Soil/Sediment and DNAPL/LNAPL Analytical Protocols (Continued)

Parameter	Analysis		Extraction		Cleanup[b]	
	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified)
Vegetation/Sediment						
PCBs (Homolog-Specific)	GC/MS SIM	EPA 680 (SOP A-85)	Pressurized Fluid Extraction (PFE)	3545 (SOP A-84)	GPC	3640

Notes:

[a] The standard Appendix IX list of 40 CFR Part 264 plus two additional constituents (2-chloroethyl vinyl ether [VOC] and diphenylhydrazine [SVOC]), as specified in Tables 7-4 and 7-5.

[b] Cleanup performed as necessary.

[c] Volatile organic analyses for soil/sediment matrices will be established with each specific Work Plan.

[d] Additional sediment fractionation samples were run by this method. (See SOP A-68)

[e] The waste dilution will be performed for all applicable methods.

[f] These NAPL analyses pertain to SSERC-EE/CA sampling events only.

Table 7-3

Water and Air Analytical Protocols

Parameter	Analysis		Extraction		Cleanup[a]	
	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified)
Appendix IX + 2[b]						
Volatiles	GC/MS	8260B (SOP A-34)	Purge & trap	5030B (SOP A-27)	NA	NA
Semivolatiles	GC/MS	8270C (SOP A-28)	Sep. funnel or continuous liquid-liquid	3510B 3520B (SOP A-28)	NA	NA
Chlorinated Pesticides	GC/ECD	8081A (SOP A-23)	Sep. funnel	3510B 3520B (SOP A-23)	Florisil Sulfur	3620 3660
PCBs (Aroclor-Specific)[d,g]	GC/ECD	8082 (MOD[e]) (SOPs A-24, A-37, A-49, A-50, A-75, and A-79)	Sep. funnel	3510B 3520B (SOPs A-24, A-37, A-49, A-50, A-74, and A-79)	Florisil Sulfuric Acid Sulfur	3620 3665 3660
Chlorinated Herbicides	GC/ECD	8150B (SOP A-26)	Sep. funnel	8150B (SOP A-26)	Hydrolysis Esterification	8150B
Organophosphorus Pesticides	GC/NPD	8141A (SOP A-25)	Sep. funnel	3510B 3520B (SOP A-25)	Florisil Sulfur	3620 3660
PCDDs/PCDFs (Congener-Specific)	GC/MS	8290 (SOPs A-36 and A-52)	Sep. funnel	8290 (SOPs A-36 and A-52)	Acid/base Silica gel Alumina Carbon	8290
Polynuclear Aromatic Hydrocarbons	Gas chromatography/ mass spectroscopy (GC/MS)	SIM (SOP A-29)	Sep. funnel	3510B 3520B (SOP A-29)	NA	NA
PCBs (Congener/Homolog-Specific)[g]	Gas chromatography/ mass spectroscopy (GC/MS)	Modified EPA 1668 (SOPs A-38 and A-47)	Sep. funnel	EPA 1668 (SOPs A-38 and A-47)	Acid/base Silica gel Alumina Carbon	NA
Metals[f,g]	ICP/AA	6010B (SOP A-20)	Acid digestion	3010A (SOP A-18)	NA	NA
Mercury[g]	Cold vapor	7470A (SOP A-21)	Acid digestion	7470A (SOP A-21)	NA	NA
Cyanide	Spectrometric	9010B (SOP A-5)	Distillation	9010B (SOP A-5)	NA	NA
Sulfide	Titrimetric	9030B (SOP A-12)	Distillation	9030B (SOP A-12)	NA	NA

Table 7-3

Water and Air Analytical Protocols (Continued)

Parameter	Analysis		Extraction		Cleanup[a]	
	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified)
Water Quality						
TSS	Gravimetric	EPA 160.2 (SOP A-3)	NA	NA	NA	NA
TDS	Gravimetric	EPA 160.1 (SOP A-2)	Filtration	NA	NA	NA
Chlorophyll-A	Fluorometric	EPA 10200 (SOP A-39)	Filtration	NA	NA	NA
BOD_5	5 day, 20°C	EPA 405.1 (SOPs A-14 and A-62)	NA	NA	NA	NA
DOC	Combustion or oxidation	EPA 415.1 (SOP A-15)	NA	NA	NA	NA
Hardness[g]	Titrimetric	EPA 130.2 (SOP A-1)	NA	NA	NA	NA
Orthophosphate as P	Colorimetric	EPA 365.2 (SOP A-11)	NA	NA	NA	NA
TKN	Potentiometric	EPA 351.3 (SOP A-7)	NA	NA	NA	NA
NH_3	Potentiometric	EPA 350.2 (SOP A-6)	NA	NA	NA	NA
NO_3/NO_2 as N	Colorimetric	EPA 353.2 (SOP A-8)	NA	NA	NA	NA
NO_2 as N	Colorimetric	EPA 354.1 (SOP A-9)	NA	NA	NA	NA
Total Phosphate as P Hydrolyzable Phosphate as P Organic Phosphate as P (Calculation)	Colorimetric	EPA 365.2 (SOP A-10)	NA	NA	NA	NA
COD	Titrimetric	EPA 410.1	NA	NA	NA	NA
Alkalinity	Titrimetric	EPA 310.1 (SOP A-4)	NA	NA	NA	NA
Turbidity	Nephelometric	EPA 180.1 (See FSP)	NA	NA	NA	NA
Dissolved Oxygen	NA	SM 45001-OC (See FSP)	NA	NA	NA	NA
pH	NA	9040B (SOP A-33)	NA	NA	NA	NA

Table 7-3

Water and Air Analytical Protocols (Continued)

Parameter	Analysis		Extraction		Cleanup[a]	
	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified) (SOP Reference)	Type	Method (SW-846 unless specified)
TOC[e]/POC	Combustion or oxidation	EPA 415.1 (SOPs A-15 A-63, A-65, and A-77)	NA	NA	NA	NA
Conductivity	NA	9050A (See FSP)	NA	NA	NA	NA
Waste Disposal (Water)						
TPH	Spectrophoto-metric	EPA 418.1 (SOP A-30)	NA	NA	NA	NA
Ignitability	NA	1010 (SOP A-31)	NA	NA	NA	NA
Reactive Cyanide	Spectrometric	9014 (SOP A-32)	NA	NA	NA	NA
Reactive Sulfide	Titrimetric	9034 (SOP A-32)	NA	NA	NA	NA
Corrosivity by pH	NA	9040B (SOP A-33)	NA	NA	NA	NA
TCLP Extracts (Water)						
TCLP Semivolatiles	GC/MS	8270C (SOP A-28)	Sep. funnel	3510B 3520B (SOP A-28)	NA	NA
TCLP OC Pesticides	GC/ECD	8081A (SOP A-44)	Sep. funnel	3510B 3520B (SOP A-44)	Florisil Sulfur	3620 3660
TCLP Herbicides	GC/ECD	8150B (SOP A-45)	Sep. funnel	8150B (SOP A-45)	Hydrolysis Esterification	8150B
TCLP Metals	ICP	6010B (SOP A-46)	Acid Digestion	3010A (SOP A-18)	NA	NA
TCLP Mercury	Cold Vapor	7470A (SOP A-21)	Acid Digestion	7470A (SOP A-21)	NA	NA
Air						
PCBs	GC/ECD	EPA TO-4 (SOP A-42)	Soxhlet, PFE	EPA TO-4 (SOP A-42)	Sulfuric Acid	EPA TO-4 (SOP A-42)

Notes:
[a]Cleanup performed as necessary.
[b]The standard Appendix IX list of 40 CFR Part 264 plus two additional constituents (2-chloroethyl vinyl ether [VOC] and diphenylhydrazine [SVOC]), as specified in Tables 7-4 and 7-5.
[c]Modified Surface and Groundwater Method 8082 will extract 2 liters of initial volume to a concentration of ½ mL in order to meet ambient water quality requirements.
[d]Additional water samples run by this method include: Pore water, SBLT, Elutriate and DRET. (See SOPs A-67, A-69, A-70, A-71, and A-72.)
[e]Additional water samples run by this method include: Pore water, SBLT, and Elutriate. (See SOPs A-69, A-70, A-71, and A-72.)
[f]Additional SBLT samples were run by this method. (See SOP A-72.)
[g]These analyses may be performed on total (unfiltered) and/or filtered samples, as prescribed by the scope of work.

Table 7-4

Appendix IX +2* Volatile Organic Compound Reporting Limits (SW-846 8260B) (SOPs A-27 and A-34)

Analytical Parameter	CAS Number	Soil/Sediment Reporting Limit (µg/kg)	Soil/Sediment Medium Level Reporting Limit (µg/kg)	Water Reporting Limit (µg/L)
1,1-Dichloroethane	75-34-3	5	625	0.5
1,1-Dichloroethene	75-35-4	5	625	0.5
1,1,1-Trichloroethane	71-55-6	5	625	0.5
1,1,1,2-Tetrachloroethane	630-20-6	5	625	0.5
1,1,2-Trichloroethane	79-00-5	5	625	0.5
1,1,2,2-Tetrachloroethane	79-34-5	5	625	0.5
1,2-Dibromo-3-chloropropane	96-12-8	5	625	0.5
1,2-Dibromoethane	106-93-4	5	625	0.5
1,2-Dichloroethane	107-06-2	5	625	0.5
1,2-Dichloropropane	78-87-5	5	625	0.5
1,2,3-Trichloropropane	96-18-4	5	625	0.5
2-Chloroethyl vinyl ether*	110-75-8	5	625	0.5
2-Hexanone	591-78-6	5	625	2.5
4-Methyl-2-pentanone	108-10-1	5	625	2.5
Acetone	67-64-1	5	625	2.5
Acrolein	107-02-8	5	625	2.5
Acrylonitrile	107-13-1	5	625	0.5
3-Chloropropene	107-05-1	5	625	0.5
Benzene	71-43-2	5	625	0.5
Bromodichloromethane	75-27-4	5	625	0.5
Bromoform	75-25-2	5	625	0.5
Carbon disulfide	75-15-0	5	625	0.5
Carbon tetrachloride	56-23-5	5	625	0.5
Chlorobenzene	108-90-7	5	625	0.5
Chloroethane	75-00-3	5	625	0.5
Chloroform	67-66-3	5	625	0.5
2-Chloro-1,3-Butadiene	126-99-8	5	625	0.5
cis-1,3-Dichloropropene	10061-01-5	5	625	0.5
Dibromochloromethane	124-48-1	5	625	0.5
Dichlorodifluoromethane	75-71-8	5	625	0.5
Ethyl methacrylate	97-63-2	5	625	0.5

Table 7-4

Appendix IX +2* Volatile Organic Compound Reporting Limits (SW-846 8260B) (SOPs A-27 and A-34) (Continued)

Analytical Parameter	CAS Number	Soil/Sediment Reporting Limit (µg/kg)	Soil/Sediment Medium Level Reporting Limit (µg/kg)	Water Reporting Limit (µg/L)
Ethylbenzene	100-41-4	5	625	0.5
Isobutanol	78-83-1	250	31250	50
Methacrylonitrile	126-98-7	5	625	2
Bromomethane	74-83-9	5	625	0.5
Chloromethane	74-87-3	5	625	0.5
2-Butanone	78-93-3	5	625	2.5
Iodomethane	74-88-4	5	625	0.5
Methyl methacrylate	80-62-6	5	625	0.5
Dibromomethane	74-95-3	5	625	0.5
Methylene Chloride	75-09-2	5	625	0.5
Propionitrile	107-12-0	20	2500	2
Styrene	100-42-5	5	625	0.5
Tetrachloroethene	127-18-4	5	625	0.5
Toluene	108-88-3	5	625	0.5
trans-1,2-Dichloroethene	156-60-5	5	625	0.5
trans-1,3-Dichloropropene	10061-02-6	5	625	0.5
trans-1,4-Dichloro-2-butene	110-57-6	5	625	0.5
Trichloroethene	79-01-6	5	625	0.5
Trichlorofluoromethane	75-69-4	5	625	0.5
Vinyl acetate	108-05-4	5	625	0.5
Vinyl chloride	75-01-4	5	625	0.5
Xylene (total)	1330-20-7	5	625	0.5
1,4-Dioxane	123-91-1	250	31250	50

Notes:

The following chemicals have synonyms:

3-Chloropropene = 3-Chloro-1-propane = Allyl Chloride
2-Chloro-1,3-Butadiene = Chloroprene
Isobutanol = Isobutyl Alcohol

Table 7-5

Appendix IX +2* Semivolatile Organic Compound Reporting Limits (SW-846 8270C) (SOP A-28 and A-78)

Analytical Parameter	CAS Number	Soil/Sediment and NAPL[a] Reporting Limit (µg/kg)	Water Reporting Limit (µg/L)
Acenaphthene	83-32-9	330	10
Acenaphthylene	208-96-8	330	10
Acetophenone	98-86-2	330	10
2-Acetylaminofluorene	53-96-3	330	10
Alpha, alpha-Dimethylphenethylamine	122-09-8	330	10
4-Aminobiphenyl	92-67-1	330	10
Aniline	62-53-3	800	25
Anthracene	120-12-7	330	10
Aramite	140-57-8	330	10
Benzo(a)anthracene	56-55-3	330	10
Benzo(b)fluoranthene	205-99-2	330	10
Benzo(k)fluoranthene	207-08-9	330	10
Benzo(g,h,i)perylene	191-24-2	330	10
Benzo(a)pyrene	50-32-8	330	10
Benzyl Alcohol	100-51-6	330	10
bis(2-Chloroethoxy)methane	111-91-1	330	10
bis(2-Chloroethyl)ether	111-44-4	330	10
2,2'-oxybis(1-chloropropane)	108-60-1	330	10
bis(2-Ethylhexyl)phthalate	117-81-7	330	10
4-Bromophenyl phenyl ether	101-55-3	330	10
Butylbenzylphthalate	85-68-7	330	10
Chlorobenzilate	510-15-6	330	10
2-Chloronaphthalene	91-58-7	330	10
2-Chlorophenol	95-57-8	330	10
4-Chlorophenyl phenyl ether	7005-72-3	330	10
Chrysene	218-01-9	330	10
Diallate	2303-16-4	330	10
Dibenzofuran	132-64-9	330	10
Dibenz(a,h)anthracene	53-70-3	330	10
3,3'-Dichlorobenzidine	91-94-1	330	10

Table 7-5

Appendix IX +2* Semivolatile Organic Compound Reporting Limits (SW-846 8270C) (SOP A-28 and A-78) (Continued)

Analytical Parameter	CAS Number	Soil/Sediment and NAPL[a] Reporting Limit (µg/kg)	Water Reporting Limit (µg/L)
2,4-Dichlorophenol	120-83-2	330	10
2,6-Dichlorophenol	87-65-0	330	10
2,4-Dimethylphenol	105-67-9	330	10
Diethyl phthalate	84-66-2	330	10
Dimethyl phthalate	131-11-3	330	10
4,6-Dinitro-2-methylphenol	534-52-1	800	25
2,4-Dinitrophenol	51-28-5	800	25
7,12-Dimethylbenz(a)anthracene	57-97-6	330	10
3,3'-Dimethylbenzidine	119-93-7	330	10
Di-n-butyl phthalate	84-74-2	330	10
Di-n-octyl phthalate	117-84-0	330	10
Dinoseb; DNBP	88-85-7	330	10
2,4-Dinitrotoluene	121-14-2	330	10
2,6-Dinitrotoluene	606-20-2	330	10
Azobenzene*	103-33-3	330	10
Ethyl methanesulfonate	62-50-0	330	10
Fluoranthene	206-44-0	330	10
Fluorene	86-73-7	330	10
Hexachlorobenzene	118-74-1	330	10
Hexachlorobutadiene	87-68-3	330	10
Hexachlorocyclopentadiene	77-47-4	330	10
Hexachloroethane	67-72-1	330	10
Hexachloropropene	1888-71-7	330	10
Indeno(1,2,3-cd)pyrene	193-39-5	330	10
Isophorone	78-59-1	330	10
Isosafrole	120-58-1	330	10
1,3-Dichlorobenzene	541-73-1	330	10
1,3-Dinitrobenzene	99-65-0	330	10
Methapyrilene	91-80-5	330	10

Table 7-5

Appendix IX +2* Semivolatile Organic Compound Reporting Limits (SW-846 8270C) (SOP A-28 and A-78) (Continued)

Analytical Parameter	CAS Number	Soil/Sediment and NAPL[a] Reporting Limit (µg/kg)	Water Reporting Limit (µg/L)
3-Methylcholanthrene	56-49-5	330	10
Methyl methanesulfonate	66-27-3	330	10
2-Methylnaphthalene	91-57-6	330	10
3-Nitroaniline	99-09-2	800	25
Naphthalene	91-20-3	330	10
1,4-Naphthoquinone	130-15-4	330	10
1-Naphthylamine	134-32-7	330	10
2-Naphthylamine	91-59-8	330	10
5-Nitro-o-toluidine	99-55-8	330	10
Nitrobenzene	98-95-3	330	10
N-Nitrosodiethylamine	55-18-5	330	10
N-Nitrosodimethylamine	62-75-9	330	10
N-Nitrosodi-n-butylamine	924-16-3	330	10
N-Nitrosodi-n-propylamine	621-64-7	330	10
N-Nitrosodiphenylamine	86-30-6	330	10
N-Nitrosomethylethylamine	10595-95-6	330	10
N-Nitrosomorpholine	59-89-2	330	10
N-Nitrosopiperidine	100-75-4	330	10
N-Nitrosopyrrolidine	930-55-2	330	10
2-Methylphenol	95-48-7	330	10
1,2-Dichlorobenzene	95-50-1	330	10
2-Nitroaniline	88-74-4	800	25
2-Nitrophenol	88-75-5	330	10
4-Nitrophenol	100-02-7	800	25
4-Nitroquinoline 1-oxide	56-57-5	330	10
o-Toluidine	95-53-4	330	10
4-Chloroaniline	106-47-8	330	10
4-Chloro-3-Methylphenol	59-50-7	330	10
4-Methylphenol	106-44-5	330	10
1,4-Dichlorobenzene	106-46-7	330	10

Table 7-5

Appendix IX +2* Semivolatile Organic Compound Reporting Limits (SW-846 8270C) (SOP A-28 and A-78) (Continued)

Analytical Parameter	CAS Number	Soil/Sediment and NAPL[a] Reporting Limit (µg/kg)	Water Reporting Limit (µg/L)
Pentachlorobenzene	608-93-5	330	10
Pentachloronitrobenzene	82-68-8	330	10
Pentachlorophenol	87-86-5	800	25
Phenacetin	62-44-2	330	10
Phenanthrene	85-01-8	330	10
Phenol	108-95-2	330	10
4-Nitroaniline	100-01-6	800	25
4-Phenylenediamine	106-50-3	330	10
2-Picoline	109-06-8	330	10
Pronamide	23950-58-5	330	10
Pyrene	129-00-0	330	10
Pyridine	110-86-1	330	10
4-(Dimethylamino)azobenzene	60-11-7	330	10
Safrole	94-59-7	330	10
1,2,4-Trichlorobenzene	120-82-1	330	10
2,4,5-Trichlorophenol	95-95-4	800	25
2,4,6-Trichlorophenol	88-06-2	330	10
1,2,4,5-Tetrachlorobenzene	95-94-3	330	10
2,3,4,6-Tetrachlorophenol	58-90-2	330	10
1,3,5-Trinitrobenzene	99-35-4	330	10
Pentachloroethane	76-01-7	330	10

[a]NAPL reporting limits will reflect these levels whenever achievable.

Note:

The following chemicals have synonyms:

2,2'-oxybis(1-chloropropane) = bis(2-chloro-1-methyl)ethylether
Dinoseb; DNBP = 2-sec-butyl-4,6-Dinitrophenol

Semivolatile organic results (SW-846 8270C) will be evaluated by the WESTON project team on an individual basis to determine if further SIM analysis is warranted. The WESTON Analytical Manager will be responsible for coordination of all SIM analyses, as well as any associated interdisciplinary team communications.

Table 7-6

Appendix IX Pesticide Compound Reporting Limits (SW-846 8081A) (SOP A-23)

Analytical Parameter	CAS Number	Soil/Sediment and NAPL[a] Reporting Limit (µg/kg)	Water Reporting Limit (µg/L)
4,4'-DDD	72-54-8	3.4	0.1
4,4'-DDE	72-55-9	3.4	0.1
4,4'-DDT	50-29-3	3.4	0.1
Aldrin	309-00-2	1.7	0.05
alpha-BHC	319-84-6	1.7	0.05
beta-BHC	319-85-7	1.7	0.05
Technical Chlordane	57-74-9	17	0.5
delta-BHC	319-86-6	1.7	0.05
Dieldrin	60-57-1	3.4	0.1
Endosulfan I	959-98-8	1.7	0.05
Endosulfan II	33213-65-9	3.4	0.1
Endosulfan sulfate	1031-07-8	3.4	0.1
Endrin	72-20-8	3.4	0.1
Endrin aldehyde	7421-36-3	3.4	0.1
gamma-BHC	58-89-9	1.7	0.05
Heptachlor	76-44-8	1.7	0.05
Heptachlor epoxide	1024-57-3	1.7	0.05
Isodrin	465-73-6	1.7	0.05
Kepone	143-50-0	1.7	0.05
Methoxychlor	72-43-5	17	0.5
Toxaphene	8001-35-2	170	5

[a]NAPL reporting limits will reflect these levels whenever achievable.

Note:

The following chemicals have synonyms:

Endosulfan I = alpha-Endosulfan
Endosulfan II = beta-Endosulfan

Table 7-7

PCB Compound Reporting Limits (SW-846 8082)

Analytical Parameter	CAS Number	Soil/Sediment and NAPL[a] Reporting Limit (µg/kg)	Water[b] Reporting Limit (µg/L)
SW-846 8082 (SOPs A-24, A-37, A-48, A-49, A-50, A-73, A-74, A-75, and A-79)			
PCB - Aroclor 1016	12674-11-2	17	0.014
PCB - Aroclor 1221	11104-28-2	17	0.014
PCB - Aroclor 1232	11141-16-5	17	0.014
PCB - Aroclor 1242	53469-21-9	17	0.014
PCB - Aroclor 1248[c]	12672-29-6	17	0.014
PCB - Aroclor 1254[c]	11097-69-1	17	0.014
PCB - Aroclor 1260[c]	11096-82-5	17	0.014
1,2,4-Trichlorobenzene[c,d]	120-82-1	3.3	0.1
SW-846 Modified 8082 (FLD MTHD) (SOP A-37)			
PCB - Aroclor 1248	12672-29-6	500	20
PCB - Aroclor 1254	11097-69-1	500	20
PCB - Aroclor 1260	11096-82-5	500	20
1,2,4-Trichlorobenzene[d]	120-82-1	10	5

[a]NAPL reporting limits will reflect these levels whenever achievable.

[b]Aroclor reporting limits are 0.5 µg/L, and the 1,2,4-TCB reporting limit is 0.1 µg/L for field blanks associated with soil/sediment sample.

[c]These compounds comprise the short-list for off-site PCB analyses.

[d]This compound has been removed from the analyte list as a result of potential volatilization during the extended 12-hour drying procedure that was established in April 1999, and due to documented poor chromatographic performance by this GC/ECD method (see SOP A-37, Revision 5).

Table 7-8

PCB Congener/Homolog Reporting Limits [HRGC/HRMS] (Modified EPA 1668) (SOP A-38)

CAS Number	Soil/Sediment Reporting Limits (µg/kg)	Water Reporting Limits (ng/L)
PCB-1	0.05	0.50
PCB-3	0.05	0.50
PCB-8	0.05	0.50
PCB-15	0.05	0.50
PCB-18	0.05	0.50
PCB-28	0.05	0.50
PCB-37	0.05	0.50
PCB-44	0.05	0.50
PCB-49	0.05	0.50
PCB-52	0.05	0.50
PCB-66	0.05	0.50
PCB-70	0.05	0.50
PCB-74	0.05	0.50
PCB-77	0.05	0.50
PCB-81	0.05	0.50
PCB-87/115	0.05	0.50
PCB-90/101	0.05	0.50
PCB-99	0.05	0.50
PCB-110	0.05	0.50
PCB-119	0.05	0.50
PCB-118	0.05	0.50
PCB-123	0.05	0.50
PCB-105	0.05	0.50
PCB-114	0.05	0.50
PCB-126	0.05	0.50
PCB-151	0.05	0.50
PCB-128/167	0.05	0.50
PCB-138/158	0.05	0.50
PCB-149	0.05	0.50

Table 7-8

PCB Congener/Homolog Reporting Limits [HRGC/HRMS] (Modified EPA 1668) (SOP A-38) (Continued)

CAS Number	Soil/Sediment Reporting Limits (µg/kg)	Water Reporting Limits (ng/L)
PCB-153/168	0.05	0.50
PCB-156	0.05	0.50
PCB-157	0.05	0.50
PCB-169	0.05	0.50
PCB-170	0.05	0.50
PCB-177	0.05	0.50
PCB-180	0.05	0.50
PCB-183	0.05	0.50
PCB-184	0.05	0.50
PCB-187	0.05	0.50
PCB-189	0.05	0.50
PCB-201	0.05	0.50
PCB-202	0.05	0.50
PCB-194	0.05	0.50
PCB-195	0.05	0.50
PCB-206	0.05	0.50
PCB-207	0.05	0.50
PCB-209	0.05	0.50
Total monochlorobiphenyl	0.05	0.50
Total dichlorobiphenyl	0.05	0.50
Total trichlorobiphenyl	0.05	0.50
Total tetrachlorobiphenyl	0.05	0.50
Total pentachlorobiphenyl	0.05	0.50
Total hexachlorobiphenyl	0.05	0.50
Total heptachlorobiphenyl	0.05	0.50
Total octachlorobiphenyl	0.05	0.50
Total nonachlorobiphenyl	0.05	0.50
Total decachlorobiphenyl	0.05	0.50

Table 7-9
Organophosphorus Pesticide Compound Reporting Limits (SW-846 8141A) (SOP A-25)

Analytical Parameter	CAS Number	Soil/Sediment and NAPL[a] Reporting Limit (µg/kg)	Water Reporting Limit (µg/L)
Dimethoate	60-51-5	33	1.0
Disulfoton	298-04-4	33	1.0
Famphur	52-85-7	33	1.0
Methyl parathion	298-00-0	33	1.0
o,o,o-Triethyl phosphorothioate	126-68-1	33	1.0
Parathion	56-38-2	33	1.0
Phorate	298-02-2	33	1.0
Sulfotepp	3689-24-5	33	1.0
Thionazin	297-97-2	33	1.0

[a]NAPL reporting limits will reflect these levels whenever achievable.

Note:

The following chemical has a synonym:

Parathion = Ethyl Parathion

Table 7-10

Appendix IX Herbicide Compound Reporting Limits (SW-846 8150B) (SOP A-26)

Analytical Parameter	CAS Number	Soil/Sediment and NAPL[a] Reporting Limit (µg/kg)	Water Reporting Limit (µg/L)
2,4-D	94-75-7	47	0.94
2,4,5-T	93-76-5	4.8	0.095
2,4,5-TP	93-72-1	4.8	0.095

[a]NAPL reporting limits will reflect these levels whenever achievable.

Table 7-11

PCDD/PCDF Compound Reporting Limits (SW-846 8290) (SOP A-36, A-51, and A-52)

Analytical Parameter	CAS Number	Soil/Sediment and NAPL[a] Reporting Limit (pg/g)	Water Reporting Limit (pg/L)
2,3,7,8-TCDD	1746-01-6	0.1	1.0
1,2,3,7,8-PeCDD	40321-76-4	0.1	1.0
1,2,3,6,7,8-HxCDD	57653-85-7	0.1	1.0
1,2,3,4,7,8-HxCDD	39227-28-6	0.1	1.0
1,2,3,7,8,9-HxCDD	19408-74-3	0.1	1.0
1,2,3,4,6,7,8-HpCDD	35822-46-9	0.1	1.0
1,2,3,4,6,7,8,9-OCDD	3268-87-9	0.5	5.0
2,3,7,8-TCDF	51207-31-9	0.1	1.0
1,2,3,7,8-PeCDF	57117-41-6	0.1	1.0
2,3,4,7,8-PeCDF	57117-31-4	0.1	1.0
1,2,3,6,7,8-HxCDF	57117-44-9	0.1	1.0
1,2,3,7,8,9-HxCDF	72918-21-9	0.1	1.0
1,2,3,4,7,8-HxCDF	70648-26-9	0.1	1.0
2,3,4,6,7,8-HxCDF	60851-34-5	0.1	1.0
1,2,3,4,6,7,8-HpCDF	67562-39-4	0.1	1.0
1,2,3,4,7,8,9-HpCDF	55673-89-7	0.1	1.0
1,2,3,4,6,7,8,9-OCDF	39001-02-0	0.5	5.0
Total TCDD	41903-57-5	0.1	1.0
Total PeCDD	36088-22-9	0.1	1.0
Total HxCDD	34465-46-8	0.1	1.0
Total HpCDD	37871-00-4	0.1	1.0
Total TCDF	55722-27-5	0.1	1.0
Total PeCDF	30402-15-4	0.1	1.0
Total HxCDF	55684-94-1	0.1	1.0
Total HpCDF	38998-75-3	0.1	1.0

[a]NAPL reporting limits will reflect these levels whenever achievable.

Table 7-12

Polynuclear Aromatic Hydrocarbon Reporting Limits (SIM*) (SOP A-29)

Analytical Parameter	CAS Number	Soil/Sediment Reporting Limit (µg/kg)	Water Reporting Limit (µg/L)
Acenaphthene	83-32-9	10	0.02
Acenaphthylene	208-96-8	10	0.02
Anthracene	120-12-7	10	0.02
Benzo(a)anthracene	56-55-3	10	0.02
Benzo(a)pyrene	50-32-8	10	0.02
Benzo(b)fluoranthene	205-99-2	10	0.02
Benzo(g,h,i)perylene	191-24-2	10	0.02
Benzo(k)fluoranthene	207-08-9	10	0.02
Chrysene	218-01-9	10	0.02
Dibenz(a,h)anthracene	53-70-3	10	0.02
Fluoranthene	206-44-0	10	0.02
Fluorene	86-73-7	10	0.02
Indeno(1,2,3-cd)pyrene	193-39-5	10	0.02
Naphthalene	91-20-3	10	0.02
Phenanthrene	85-01-8	10	0.02
Pyrene	129-00-0	10	0.02

*SIM - selected ion monitoring

Table 7-13

Appendix IX Metal and Inorganic Analyte Reporting Limits

Analytical Parameter (SOP Reference)	CAS Number	Soil/Sediment and NAPL[a] Reporting Limit[b] (mg/kg)	Water Reporting Limit[b] (µg/L unless specified otherwise)
Total Metals (SOPs A-18, A-19, A-20, A-21, and A-22)			
Antimony	7440-36-0	0.37 – 1.0	3.7 – 10.0
Arsenic	7440-38-2	0.49 – 0.6	4.9 – 6.0
Barium	7440-39-3	0.33 – 0.99	3.3 – 9.9
Beryllium	7440-41-7	0.01 – 0.04	0.1 – 0.4
Cadmium	7440-43-9	0.04 – 0.09	0.4 – 0.9
Calcium[c]	7440-70-2	NA	218.6 – 269.8
Chromium	7440-47-3	0.12 – 0.29	1.2 – 2.9
Cobalt	7440-48-8	0.22 – 0.39	2.2 – 3.9
Copper	7440-50-8	0.24 – 0.37	2.4 – 3.7
Lead	7439-92-1	0.19 – 0.28	1.9 – 2.8
Magnesium[c]	7439-95-4	NA	298.5 – 445.9
Mercury	7439-97-6	0.05	0.1
Nickel	7440-02-0	0.31 – 0.38	3.1 – 3.8
Selenium	7782-49-2	0.38 – 0.49	3.8 – 4.9
Silver	7440-22-4	0.15 – 0.31	1.5 – 3.1
Thallium	7440-28-0	0.47 – 0.65	4.7 – 6.5
Tin	7440-31-5	0.40 – 0.52	4.0 – 5.2
Vanadium	7440-62-2	0.24 – 0.4	2.4 – 4.0
Zinc	7440-66-6	0.21 – 0.41	2.1 – 4.1

Other Inorganic Analytes (SOP Reference)	CAS Number	Soil/Sediment and NAPL[a] Reporting Limit (mg/kg)	Water Reporting Limit (mg/L unless specified otherwise)
Cyanide (SOP A-5)	57-12-5	0.5	5.0 µg/L
Sulfide (SOPs A-12 and A-13)	18496-25-8	5.0	0.5
Total Organic Carbon (TOC) (SOPs A-15, A-16, A-63, A-64, A-65, A-76, and A-77)	7440-44-0	100	1.0[d]
Grain Size Distribution (Standard Sieve Series and Hydrometer) (SOPs A-35, A-58, and A-66)	NA	NA	NA

Table 7-13

Appendix IX Metal and Inorganic Analyte Reporting Limits (Continued)

Other Inorganic Analytes (SOP Reference)	CAS Number	Soil/Sediment and NAPL[a] Reporting Limit (mg/kg)	Water Reporting Limit (mg/L unless specified otherwise)
Atterberg Limits (SOP A-40 and A-55)	NA	NA	NA
Porosity (SOP A-41)	NA	NA	NA
Bulk Density (SOP A-59)	NA	NA	NA
BOD_5 (SOPs A-14 and A-62)	NA	NA	0.2
DOC (SOP A-15)	7440-44-0	NA	0.5
Hardness (SOP A-1)	NA	NA	2.0
Orthophosphate as P (SOP A-11)	NA	NA	0.01
TKN (SOP A-7)	7727-37-9	NA	0.2
NH_3 (SOP A-6)	7664-41-7	NA	0.02
NO_2 as N (SOP A-9)	14797-65-0	NA	0.005
NO_3/NO_2 as N (SOP A-8)	14797-55-8	NA	0.01
Total Phosphate as P (SOP A-10)	NA	NA	0.01
Hydrolyzable Phosphate as P	NA	NA	0.01
Organic Phosphate as P (Calculation)	NA	NA	0.01
Alkalinity (SOP A-4)	NA	NA	1.0
Turbidity (See FSP)	NA	NA	0.2 NTU
Dissolved Oxygen (See FSP)	7782-44-7	NA	0.2
TSS (SOP A-3)	NA	NA	0.5
TDS (SOP A-2)	NA	NA	5.0
Chlorophyll-A (SOP A-39)	NA	NA	0.1
pH (SOP A-33)	NA	NA	0.2 pH units
Conductivity (See FSP)	NA	NA	1.0 µS/cm
Total Petroleum Hydrocarbons (TPH) (SOP A-30)	NA	NA	0.4
Ignitability (SOP A-31)	NA	NA	150°F
Reactive Cyanide (SOP A-32)	57-12-5	NA	2.9
Reactive Sulfide (SOP A-32)	18496-25-8	NA	2.0
COD (SOP A-80)	NA	NA	0.5

[a]NAPL reporting limits will reflect these levels whenever achievable.
[b]The metals reporting limits, except for mercury, are represented as a range, from the IDLS of the three ICPs utilized for the analyses.
[c]These analytes are provided only for the water quality sample analysis.
[d]On May 1, 2000, as a result of a laboratory reporting protocol modification, the reporting limit of 0.5 mg/L was increased.

Table 7-14

PCB Compound Reporting Limits (EPA TO-4) (SOPs A-42 and A-43)

Analytical Parameter	CAS Number	Air (µg)
PCB - Aroclor 1016	12674-11-2	1.0
PCB - Aroclor 1221	11104-28-2	1.0
PCB - Aroclor 1232	11141-16-5	1.0
PCB - Aroclor 1242	53469-21-9	1.0
PCB - Aroclor 1248	12672-29-6	1.0
PCB - Aroclor 1254	11097-69-1	1.0
PCB - Aroclor 1260	11096-82-5	1.0

Table 7-15

TCLP Pesticide Compound Reporting Limits (SW-846 8081A) (SOPs A-44 and A-43)

Analytical Parameter	CAS Number	Water Reporting Limit (µg/L)
Technical Chlordane	57-74-9	10
Endrin	72-20-8	5
gamma-BHC	58-89-9	100
Heptachlor	76-44-8	3
Heptachlor epoxide	1024-57-3	3
Methoxychlor	72-43-5	1000
Toxaphene	8001-35-2	100

Table 7-16

TCLP Herbicide Compound Reporting Limits (SW-846 8150B) (SOPs A-45 and A-43)

Analytical Parameter	CAS Number	Water Reporting Limit (µg/L)
2,4-D	94-75-7	1000
2,4,5-TP	93-72-1	100

Table 7-17

TCLP Semivolatile Organic Compound Reporting Limits (SW-846 8270C) (SOPs A-28 and A-43)

Analytical Parameter	CAS Number	Water Reporting Limit (µg/L)
2,4-Dinitrotoluene	121-14-2	10
Hexachlorobenzene	118-74-1	10
Hexachlorobutadiene	87-68-3	10
Hexachloroethane	67-72-1	10
Nitrobenzene	98-95-3	10
2-Methylphenol	95-48-7	10
3/4-Methylphenol	106-44-5	20
1,4-Dichlorobenzene	106-46-7	10
Pentachlorophenol	87-86-5	20
Pyridine	110-86-1	10
2,4,5-Trichlorophenol	95-95-4	10
2,4,6-Trichlorophenol	88-06-2	10

Table 7-18

TCLP Metal Analyte Reporting Limits

Analytical Parameter (SOP Reference)	CAS Number	Water Reporting Limit[a] (µg/L unless specified otherwise)
TCLP Metals (SOPs A-18, A-21, A-43, and A-46)		
Arsenic	7440-38-2	1000
Barium	7440-39-3	10000
Cadmium	7440-43-9	100
Chromium	7440-47-3	1000
Copper	7440-50-8	1000
Lead	7439-92-1	1000
Mercury	7439-97-6	40
Nickel	7440-02-0	1000
Selenium	7782-49-2	100
Silver	7440-22-4	1000
Tin	7440-31-5	1000
Zinc	7440-66-6	1000

Table 7-19

PCB Congener/Homolog Reporting Limits (Modified EPA 1668) (SOP A-47) HRGC/LRMS

Analytical Parameter	Soil/Sediment and NAPL[a] Reporting Limits (µg/kg)	Water Reporting Limits (ng/L)	Large Volume Water[b] Reporting Limits (µg/L)
PCB-1	0.016667	0.5	0.000042
PCB-3	0.016667	0.5	0.000042
PCB-8	0.016667	0.5	0.000042
PCB-15	0.016667	0.5	0.000042
PCB-18	0.016667	0.5	0.000042
PCB-28	0.016667	0.5	0.000042
PCB-37	0.016667	0.5	0.000042
PCB-44	0.033333	1.0	0.000083
PCB-49	0.033333	1.0	0.000083
PCB-52	0.033333	1.0	0.000083
PCB-66	0.033333	1.0	0.000083
PCB-70/74	0.033333	1.0	0.000083
PCB-77	0.033333	1.0	0.000083
PCB-81	0.033333	1.0	0.000083
PCB-87/119	0.100000	3.0	0.000250
PCB-90/101	0.100000	3.0	0.000250
PCB-99	0.100000	3.0	0.000250
PCB-110/115	0.100000	3.0	0.000250
PCB-158	0.133333	4.0	0.000333
PCB-119	0.100000	3.0	0.000250
PCB-118	0.100000	3.0	0.000250
PCB-123	0.100000	3.0	0.000250
PCB-105	0.100000	3.0	0.000250
PCB-114	0.100000	3.0	0.000250
PCB-126	0.100000	3.0	0.000250
PCB-151	0.133333	4.0	0.000333
PCB-128	0.133333	4.0	0.000333
PCB-138	0.133333	4.0	0.000333
PCB-149	0.133333	4.0	0.000333

Table 7-19

PCB Congener/Homolog Reporting Limits (Modified EPA 1668) (SOP A-47) HRGC/LRMS (Continued)

Analytical Parameter	Soil/Sediment and NAPL[a] Reporting Limits (µg/kg)	Water Reporting Limits (ng/L)	Large Volume Water[b] Reporting Limits (µg/L)
PCB-153/168	0.133333	4.0	0.000333
PCB-156/157	0.133333	4.0	0.000333
PCB-167	0.133333	4.0	0.000333
PCB-169	0.133333	4.0	0.000333
PCB-170	0.166667	5.0	0.000417
PCB-177	0.166667	5.0	0.000417
PCB-180	0.166667	5.0	0.000417
PCB-183	0.166667	5.0	0.000417
PCB-184	0.166667	5.0	0.000417
PCB-187	0.166667	5.0	0.000417
PCB-189	0.166667	5.0	0.000417
PCB-194	0.200000	6.0	0.000500
PCB-195	0.200000	6.0	0.000500
PCB-201	0.200000	6.0	0.000500
PCB-202	0.200000	6.0	0.000500
PCB-206	0.333333	10.0	0.000833
PCB-207	0.333333	10.0	0.000833
PCB-209	0.333333	10.0	0.000833
Total monochlorobiphenyl	0.016667	0.5	0.000042
Total dichlorobiphenyl	0.016667	0.5	0.000042
Total trichlorobiphenyl	0.016667	0.5	0.000042
Total tetrachlorobiphenyl	0.333333	1.0	0.000083
Total pentachlorobiphenyl	0.100000	3.0	0.000250
Total hexachlorobiphenyl	0.133333	4.0	0.000333
Total heptachlorobiphenyl	0.166667	5.0	0.000417
Total octachlorobiphenyl	0.200000	6.0	0.000500
Total nonachlorobiphenyl	0.333333	10.0	0.000833
Total decachlorobiphenyl	0.333333	10.0	0.000833

[a]NAPL reporting limits will reflect these levels whenever achievable.
[b]As described in Table 6-1, large volume (12 liter) sampling will be performed at several surface water locations.

Table 7-20

Core Dating Analyte Reporting Limits (SOPs A-60, A-61)

Analytical Parameter	CAS Number	Soil/Sediment Reporting Limit (dpm/g)
Cesium-137	10045-97-3	0.01-0.1
Beryllium-7	13966-02-4	0.01-0.1
Lead-210	14255-04-0	0.01-0.1

Table 7-21

PCB Homolog Reporting Limits (EPA 680) (SOP A-85)

CAS Number	Vegetation/Sediment Reporting Limits (µg/kg)
Total Monochlorobiphenyl	5.0
Total Dichlorobiphenyl	5.0
Total Trichlorobiphenyl	5.0
Total Tetrachlorobiphenyl	10.0
Total Pentachlorobiphenyl	10.0
Total Hexachlorobiphenyl	10.0
Total Heptachlorobiphenyl	15.0
Total Octachlorobiphenyl	15.0
Total Nonachlorobiphenyl	15.0
Total Decachlorobiphenyl	25.0

Section 8

8. QUALITY CONTROL REQUIREMENTS

The daily quality of analytical data is controlled by the implementation of a laboratory-specific QA/QC Plan. A quality control program is a systematic process that controls the validity of analytical results by measuring the accuracy and precision of each method and matrix, developing expected control limits, using these limits to detect errors or out-of-control events, and requiring corrective action techniques to prevent or minimize the recurrence of these events.

This section defines common quality control checks and the quality control checks specified in Section 4 (Table 4-2). The inclusion of a definition in this section does not necessarily mean the quality control check is required for this sampling event. The required quality control checks, the frequency for the checks, and the acceptance criteria for the checks are listed in Section 4. The purpose of preparing and analyzing quality control samples is to demonstrate, through the known entities, how accurate and precise the investigative sample data are. The types of internal QC checks are described in the following subsections; for high resolution and complicated analytical protocols, more rigorous QC checks and cleanup procedures will be performed. In addition, the DQI designation is indicated for each of these quality control analyses. See Section 15 for overall description of the data quality indicators: accuracy/bias, precision, representativeness, completeness, comparability, sensitivity, and selectivity.

8.1 ANALYTICAL QUALITY CONTROL REQUIREMENTS

8.1.1 Method Blank

The method blank is an artificial sample designed to monitor artifacts that may be introduced into the sample during sample preparation or analysis. For analyses of aqueous samples, reagent water is generally used as the method blank matrix. For analyses other than radiological analyses of solid samples, a purified solid matrix is used. The method blank is carried through the entire analytical scheme (extraction, concentration, and analysis). For metals analyses, the method blank is referred to as the preparation blank. The volume or weight of the blank must be approximately equal to the sample volume or weight processed. A method blank is performed

with each batch of samples or one with every 20 field samples, whichever is more frequent. Analysis of the blank verifies that method interferences caused by contaminants in solvents, reagents, glassware, and other sample processing hardware are known and minimized. Optimally, a method blank should contain no greater than five times (5x) the practical quantitation limit for common laboratory solvents and phthalate esters; less than one-half the practical quantitation limit (PQL) for all other parameters, unless otherwise specified in the method or QAPP. DQI–Accuracy/Bias-Contamination.

8.1.2 Trip Blank

The trip blank is an artificial sample designed to monitor volatile artifacts that may be introduced into the sample during sample transportation. Reagent water is generally used as the trip blank matrix. The trip blank is treated as field sample and is carried through the analytical scheme. A trip blank should accompany every cooler containing field samples for volatile organic analysis. DQI–Accuracy/Bias-Contamination.

8.1.3 Equipment/Rinsate Blank

The equipment blank is an artificial sample designed to monitor artifacts that may be introduced into the sample during sample collection. Reagent water is generally used as the equipment blank matrix and the equipment blank can be analyzed for all required parameters. (Hexane blanks may be collected, in lieu of aqueous equipment blanks, for PCB analysis at the on-site laboratory facility.) The equipment blank is treated as field sample and is carried through the analytical scheme. At least one equipment blank will be collected during the sample equipment decontamination procedure, per sampling event, and submitted with the associated samples for analyses. DQI–Accuracy/Bias-Contamination.

8.1.4 Sulfur/Sulfuric Acid/GPC Cleanup Blanks

When sample extracts for pesticide/PCB analyses require a sulfur cleanup, sulfuric acid cleanup, and/or gel permeation chromatography (GPC) cleanup, associated blanks are performed. These

method blanks monitor for contamination from the various cleanup steps. DQI–Accuracy/Bias-Contamination.

8.1.5 Matrix Spike

Predetermined quantities of specific analytes are added to a sample matrix prior to sample extraction or digestion. Percent recoveries are calculated for each analyte to assess the accuracy of the analyses. Matrix spikes monitor the effects of the sample matrix on the analytical results as well as assess the accuracy of the analytical method. One matrix spike for every 20 samples collected will be performed for all applicable methods. The field samples to be spiked will be selected by field personnel and will not include field blank samples (trip blanks and equipment blanks). This will ensure that a sample matrix with possible analyte detections will be spiked to obtain representative results of analytical accuracy. DQI– Accuracy/Bias (LAB).

8.1.6 Matrix Spike Duplicate

Primary and duplicate matrix spikes will be performed on the same field sample. The matrix spike duplicate will assess the analytical and sampling precision by calculating a relative percent difference between the primary and duplicate spike recoveries. If poor precision is demonstrated between sets of results, it is probably an indication of laboratory performance problems. DQI-Precision (LAB).

8.1.7 Surrogate Spike

Surrogate compounds are organic compounds that are similar to analytes of interest in terms of their chemical composition and extraction and chromatographic properties, but that are not normally found in environmental samples. These compounds are spiked into all field and laboratory quality control samples (blanks, standards, and matrix spikes) for volatile organic, semivolatile organic, PCDD/PCDFs, herbicides, and pesticide/PCB analyses. (Refer to SW-846 Methods 8260B, 8270C, 8082, 8081A, 8141A, 8150B, and 8290.) Percent recoveries are calculated for each surrogate compound in each sample. These recoveries give an indication of

the performance and estimate accuracy of the analytical method by incorporating sample matrix effects and field conditions. DQI-Accuracy/Bias.

8.1.8 Replicate Sample (Laboratory Duplicate)

To assess the precision of the analytical method for given analyses, a replicate sample is analyzed by taking aliquots from a sample container, and an RPD is calculated for the results of the analyses of the primary sample and the replicate sample from the same container. Such replicate samples will be analyzed for metals. A replicate sample measures sample precision associated with the preparation through analysis and is prepared and analyzed at a rate of one per batch or one per 20 samples (if a batch is less than 20 samples). Field personnel will select the metals sample to be analyzed as a replicate. DQI-Precision (LAB).

8.1.9 Instrument Performance Check (Tuning)

GC/MS analyses require that the mass spectrometer be tuned prior to calibration and sample analysis. (Refer to SW846 Methods 8260B, 8270C, 8290, and Modified EPA Method 1668.) This is accomplished with analysis of a compound with properties similar to analytes of interest but that is not commonly found in the environment. For tunings and mass calibration, BFB and decafluorotriphenyl/phosphine (DFTPP) will be used for volatile organic and semivolatile organic GC/MS analyses, respectively; refer to SOPs A-36, A-38, A-47, A-51, and A-52 for PCDD/PCDF and PCB congener/homolog analyses. Specific ion abundance criteria must be met, as defined in the appropriate method, before analyses begin. DQI-Accuracy/Bias.

8.1.10 Initial Calibration

An instrument is calibrated initially with a series of standards at predetermined concentrations to identify the response factor of the instrument over the given concentration range. (Refer to SW-846 Organic Methods 8260B, 8270C, 8081A, 8082, 8141A, 8150B, and 8290.) This calibration is performed for most instruments when there has been a change in instrument conditions or when the continuing calibration check result is outside a defined acceptance criterion. DQI-Precision.

8.1.11 Calibration Check (Calibration Verification)

The initial instrument calibration is verified at regular intervals, for all SW-846 organic analyses, to account for potential instrument drift or other changes in instrument conditions. A standard with a concentration within the calibration range is analyzed after every 10 sample analyses or at a frequency defined in the analytical method. The standard result is compared to the initial calibration, and a percent difference or RPD is calculated. If the result is not within the established acceptance criterion range, then the analytical system is evaluated and recalibrated before resumption of sample analyses. DQI-Precision.

8.1.12 Retention Time Window (RTW)

Retention times of target analytes for GC and GC/MS analyses must be monitored for shifts during sample analyses. The allowed shift of retention time for a given analyte is called the retention time window. Retention time windows are established according to the analytical method. The retention time windows should be collected for three standards run over the course of 72 hours. Acceptance criteria are expressed as an established range, or, for pesticides analyses, as plus or minus three times the standard deviation of three retention times of the same analyte. Shifts that occur outside the acceptance criteria indicate a change in the chromatographic system or an instrument problem, and could lead to misidentifications unless corrective action is taken. DQI-Accuracy/Bias

8.1.13 Internal Standards

Internal standards and/or isotopically labeled standards are performed for volatile, semivolatile, PCB congener, and/or dioxin/furan analyses and are used to ensure that system sensitivity and response are stable throughout all analyses. It corrects for bias or change in instrument performance from sample to sample, incorporating effects associated with the analytical process only. Internal standards are compounds similar in analytical behavior to the analytes that are added to the calibration standards. Response factors of these standards are used to quantitate sample results. Criteria for internal standard responses and retention times are defined in the analytical methods. DQI-Sensitivity, Accuracy/Bias.

8.1.14 Initial and Continuing Calibration Blanks (ICB, CCB)

A blank consisting of reagent water is analyzed immediately after every initial and continuing calibration verification for metal analyses, and after completing every 10% of the sample analyses to be performed for each batch of samples or after every 2 hours, whichever is more frequent. (Refer to SW-846 Methods 6010B, 7470, and 7471A.) DQI-Accuracy/Bias-Contamination.

8.1.15 Laboratory Control Sample

An LCS is a standard solution of a certified concentration prepared by a source external to the laboratory performing the analysis that is used to measure analytical accuracy. This quality control check is performed for metals, volatiles, semivolatiles, PCDD/PCDFs, pesticides/PCBs, herbicides, and total dissolved and suspended solids analyses for every batch of analytical samples. The recovery of the LCS analysis for metals must be within 80 to 120%. Acceptance criteria for the other LCS analyses are outlined in Table 4-4. LCS provides evidence that the laboratory is performing the method within accepted guidelines, generally in the absence of matrix interferences. They are prepared at a rate of one per batch of 20 or fewer samples. DQI-Sensitivity.

8.1.16 Initial Calibration Verification (ICV)

After the ICP, atomic absorption (AA), and cyanide systems are calibrated, the accuracies of their initial calibrations are verified with analyses of calibration verification standards. (Refer to SW-846 Methods 6010B, 9010B, 7470, and 7471A.) Control limits have been established for each system (ICP and AA: 90 to 110% of the true value; AA-cold vapor for mercury: 80 to 120% of true value; and cyanide: 85 to 115% of true value). If a control limit is exceeded, then the problem causing this deviation must be identified and corrected, and the instrument recalibrated.

In addition, SW-846 Organic Methods 8260B, 8270C, 8081A, 8082, 8141A, and 8150B have an initial calibration verification performed daily prior to sample analysis. It is usually a midpoint

and low-level standard purchased from a second source vendor used to verify the accuracy curve for all target analytes. (Refer to the SW-846 method for specific protocol.) DQI-Accuracy/Bias.

8.1.17 Continuing Calibration Verification (CCV)

The initial calibrations of ICP, AA, and cyanide systems must be verified after completing every 10 analyses or after every 2 hours, whichever is more frequent. (Refer to SW-846 Methods 6010B, 9010B, 7470, and 7471A.) The standard solutions to be used for such continuing calibrations will be either EPA solutions, National Bureau of Standards SRM1643a solutions, or contractor-prepared standards according to the analytical method. Control limits for these analyses are the same as for ICV analyses. DQI-Precision.

8.1.18 Interference Check Sample (ICS)

An interference check sample (ICS) is analyzed for the ICP analysis at a frequency defined in the SW-846 (6010B) to verify interelement and background correction factors. The ICS consists of one solution containing interferents, and a second containing analytes mixed with the interferents. The second solution must fall within ±20% of the true value. Corrective action must be taken if this criterion is not met. DQI-Precision.

8.1.19 Secondary Column Confirmation

For gas chromatographic analyses, a GC column with a different coating or packing is used as a second analysis for all samples with detections in the primary analysis. This second analysis confirms the presence or absence of the detected analyte. DQI-Precision.

8.1.20 Performance Evaluation Sample

Performance evaluation (PE) samples are prepared externally to the laboratory to assess the ability of the laboratory to accurately perform the relevant analyses. The samples are fortified with known concentrations of analytes of interest, and submitted to the laboratory with field sample delivery groups. PE samples will be supplied by USACE throughout this project. WESTON's Laboratory QA/QC Coordinator will have the PE sample results scored by the

Office of Environmental Measurement Evaluation (OEME) QA office and subsequently will distribute PE result scores to both USACE and EPA. In addition, *Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses* (99-0100) will be used for evaluation/validation of the PE scores. DQI-Accuracy/Bias.

8.1.21 System Performance Check Compounds (SPCCs)

SPCCs are specific compounds used to monitor the relative response factors (RRFs) of continuing calibration checks as compared to the initial calibration for GC/MS analyses of volatile (SW-846 8260B) and semivolatile (SW-846 8270C) organic compounds. A minimum RRF for each of the SPCCs must be achieved in order for the initial calibration to be valid. DQI-Accuracy/Bias.

8.1.22 Calibration Check Compounds (CCCs)

CCCs are specific compounds used to monitor the RRFs of continuing calibration checks as compared to the initial calibration for GC/MS analyses for volatile and semivolatile organic compounds. The percent difference of the RRFs for each CCC must be less than or equal to 20% in order for the initial calibration to be valid, as defined in SW-846, Methods 8260B and 8270C. DQI-Accuracy/Bias.

8.2 STANDARDS AND TRACEABILITY

Analytical standards are prepared from pure compounds or are purchased-prepared from reputable vendors. These standards provide the stock used to prepare serial dilutions for calibration and spiking standards. Each laboratory section is responsible for the preparation, storage, and disposal of its standards. Pertinent standards preparation information is recorded into section-specific standard logbooks to document traceability of prepared standards to their source material(s).

Each standard is given an internal identification number. The preparation of all stock standards shall be documented in a standards notebook, which is used to record the date of preparation, analyst's initials, source of the reference material, standard components, amounts used, final

volume, final concentration(s), solvent used, expiration date of prepared standard, and the assigned serial reference number (internal identification number) of the stock solution. All standards shall be labeled, at minimum, with the standard serial reference number and expiration date, and, if space permits, the name of the standard, concentration, date of preparation, and initials of the preparer. All diluted working standards not consumed during an analytical session shall be labeled fully, including the serial reference number of any stock standard used in its preparation.

If no expiration date has been assigned by the manufacturer, then an expiration date of 1 year from the date of preparation is generally reported, unless degradation prior to this date is observed. The expiration date assigned to a prepared standard shall not exceed the expiration date of any individual component in the solution. To help determine if a standard has degraded, one must note inconsistencies. For instance, very poor recoveries from newly prepared quality control spikes or abnormally low instrument response to a specific standard are indications of possible standard degradation. However, for some standards, degradation is more easily noted. If degradation is observed before the default expiration date, it should be noted in the standards notebook for that standard entry and the standard removed from service.

Reference standards must be traceable to national standards of measurement (e.g., National Institute of Standards and Technology [NIST]), whenever possible. Standards used for calibration must be traceable, when possible, to national standards of measurement, either directly through supplier documentation or by verification against a second source, traceable reference standard.

8.3 PREVENTIVE MAINTENANCE

To minimize downtime and interruption of analytical work, preventive maintenance is routinely performed on each analytical instrument. Designated laboratory personnel are trained in routine maintenance procedures for all major instrumentation. When repairs are necessary, they are performed by either trained staff or instrument manufacturer service personnel.

8.3.1 Field Equipment Maintenance

Field equipment will be properly calibrated, properly charged, and in good working condition before the beginning of each working day. Any piece of equipment that is not operational will be removed from service and tagged or segregated. The segregated piece of equipment will be evaluated to determine whether to replace or to repair the equipment. If the equipment is repaired, it will be repaired by a qualified technician or qualified repair service. Table 8-1 provides a summary guideline for field preventive maintenance.

Table 8-1
Field Preventive Maintenance Summary

Maintenance	Frequency
Photoionization Detector	
Store in protective casing	D
Inspect equipment after use	D
Check and recharge batteries	D
Clean UV lamp and ion chamber	M or X
Keep logbook on instrument	D
Have replacement meter available	D
Return to manufacturer for service	X
Calibration	D
Conductivity and pH Meter	
Store in protective casing	D
Inspect equipment after use	D
Clean probe	D
Keep logbook on instrument	D
Have replacement meter available	D
Replace probes	X
Return to manufacturer for service	X
Calibration	D
Turbidimeter	
Store in protective case	D
Inspect after use	D
Check and recharge batteries	D
Keep logbook on instrument	D
Have replacement available	X
Return to manufacturer for service	X
Calibration	D
Thermometer	
Store in protective casing	D
Inspect equipment after use	D
Have a replacement meter available	D

Notes:
D = daily M = monthly X = operator's discretion

8.3.2 Laboratory Equipment Maintenance

All laboratories are required to have SOPs in place regarding equipment maintenance procedures. SOPs that cover basic operation and maintenance shall be written for each instrument. Detailed logbooks documenting preventive maintenance, nonroutine maintenance, and repairs shall also be maintained for each instrument. The following table summarizes minimum recommended maintenance protocols established by WESTON.

Table 8-2

Laboratory Routine Maintenance Procedures and Schedules

Instrument in Stock	Maintenance Procedures/Schedule	Spare Parts
Gas Chromatograph	1. Change septa weekly or as often as needed. 2. Change gas line dryers as needed. 3. Replace GC injector glass liner weekly or as needed. 4. Replace GC column as needed. 5. Clean/replace GC detector as needed. 6. Check to ensure the gas supply is sufficient for the day's activity and that the delivery pressures are set, as described in the SOP. 7. Check to ensure the pressure on the primary regulator never runs below 100 psi.	1. Septa 2. Detectors 3. Glass Liner 4. Column 5. Syringes
Gas Chromatograph (Dual Tower) On-Site Laboratory	1. Change septa weekly or as often as needed. 2. Change gas line dryers as needed. 3. Replace GC injector glass liner weekly or as needed. 4. Replace GC column as needed. 5. Clean/Replace GC detector as needed. 6. Check to ensure the gas supply is sufficient for the day's activity and that the delivery pressures are set, as described in the SOP. 7. Check to ensure the pressure on the primary regulator never runs below 100 psi.	1. Septa 2. Detectors 3. Glass Liner 4. Column 5. Syringes

Table 8-2
Laboratory Routine Maintenance Procedures and Schedules
(continued)

Instrument in Stock	Maintenance Procedures/Schedule	Spare Parts
Gas Chromatograph/Mass Spectrometry (GC/MS)	1. Replace pump oil as needed. 2. Change septa weekly or as often as needed. 3. Change gas line dryers as needed. 4. Replace electron multiplier as often as needed. 5. Replace glass jet splitter as needed. 6. Replace GC injector glass liner weekly or as often as needed. 7. Cut off front end of the guard or column or replace GC column, as needed. 8. Check to ensure the gas supply is sufficient for the day's activity and is described in the SOP. 9. Check to ensure the pressure on the primary regulator never runs below 100 psi. 10. Clean the MSD (ion source) as needed or when the tune criteria are not met.	1. Syringes 2. Septa 3. Various electronic components 4. Glass jet splitter 5. GC column 6. Glass liner
Inductively Coupled & Plasma Spectrometer (ICP)	1. Clean torch assembly and mixing chamber when discolored or after 8 hours of running high dissolved solid samples. 2. Clean nebulizer as needed. 3. Check to ensure the gas supply is sufficient for the day's activity, and the delivery pressures are set as described in the SOP.	1. Spare torch mixing chamber 2. Spare nebulizer
Mercury Analyzer	1. Clean tubing and quartz cell weekly or as often as needed. 2. Clean aspirator as necessary. 3. Check to ensure the gas supply is sufficient for the day's activity, and the delivery pressures are set as described in the SOP.	1. Quartz cells 2. Aspirator
pH Meter	1. Check battery (if used in field) and replace if discharged. 2. After use in samples containing free oil, wash the electrode in soap and rinse thoroughly with water. Immerse the lower third of the electrode in diluted HCL (1:9) solution for 10 minutes to remove any film formed. Rinse thoroughly with water. 3. Keep electrode properly filled with appropriate electrolyte solution.	1. Standard buffer solutions 2. Filling electrolyte solution 3. Spare electrode

Section 9

9. INSTRUMENT CALIBRATION AND FREQUENCY

Before any instrument is used as a measuring device, the instrument's response to known reference materials must be determined. As appropriate, the reference material will be traceable to an agency standard such as NIST, NBS, or American Society for Testing and Materials (ASTM). The manner in which various instruments are calibrated is dependent upon the particular type of instrument and its intended use. If possible, all sample measurements are made within the calibrated range of the instrument. For laboratory analyses, appropriate sample dilution is performed if the instrument response is greater than the upper end of the calibration range.

Calibration standards for each parameter are chosen to bracket the expected concentrations of those parameters in the sample and to operate within the linear response range of the instrument. Sample concentrations that fall above calibration range are diluted and reanalyzed until they are within the calibration range. Calibration standards are prepared typically at a minimum of three concentration levels, plus a calibration blank, with the exception of most organic analyses, which do not require a calibration blank. Organic analyses are quantitated from five-point curves, unless otherwise directed in the method. General chemistry methods use three- or five-point curves, depending on the method. Metals are quantitated from five-point curves for atomic absorption methods and two-point curves (blank and standard) for ICP methods. Either an internal standard or external standard quantification technique can be utilized. The reporting limit is verified by analysis of a standard at the reporting limit.

Instrumental responses to calibration standards for each parameter are subjected to an appropriate statistical test of fitness (least squares linear regression, quadratic equation, or relative standard deviation of response factors) or as required by the method or QAPP. The calibration must reflect an acceptable correlation of data points or linearity to be acceptable. In cases where the calibration data are outside these criteria, the analyst must rerun the calibration standards (meeting the same criteria), changing instrumental conditions as necessary until appropriate acceptance limits for the method are achieved.

For analyses that are performed frequently and for which substantial calibration data are available, a complete recalibration is not required each time an analysis is performed, provided that the following criterion is met: one calibration standard is analyzed at the beginning of the analysis, which may vary from the expected response (based on the most recent initial calibration curve) by no more than ±25%, or as specified by the method, SOP, or QAPP, whichever is more stringent. If this criterion is not met, a complete recalibration is necessary. Controlled versions of the subcontractor laboratory's QAPP and SOPs will be stored in a secured area on the laboratory's premises, and will be made available upon request.

During the course of analysis, calibration standards are routinely analyzed to ensure that the instrumental response has not exceeded the method acceptance limits. The continuing calibration criteria stipulated in each method or SOP are used by the analyst to determine whether the instrument must be recalibrated or the instrument conditions further optimized. The accuracy of working standards is verified by comparison with a standard from an independent source. All organic standards are refrigerated or frozen, as specified in the applicable analytical methods. Inorganic standards are refrigerated as necessary. All calibration techniques outlined in the following subsections pertain to both the on-site field laboratory and the fixed laboratory, as applicable.

9.1 FIELD INSTRUMENT CALIBRATION

Field instruments will be calibrated at least once per day during field use. Section 4 briefly summarizes the calibration frequency and acceptance criteria for the field instruments that will be used during this project. For specific details on field instrument calibration, refer to Appendix C in the *Field Sampling Plan* (00-0476). Other specialized sampling techniques required for this program are presented in the FSP as appendices.

Records will be maintained for each field instrument used as part of this program to ensure instrument capability to provide accurate and precise measurements. Records will be maintained on instrument maintenance and calibration during the field effort.

9.2 LABORATORY INSTRUMENT CALIBRATION

Laboratory instrument calibrations typically consist of two types: initial calibration and continuing calibration. Initial calibration procedures establish the calibration range of the instrument and determine instrument response over that range. Typically, three to five analyte concentrations are used to establish instrument response over a concentration range. The instrument response over that range is commonly expressed as a correlation coefficient (e.g., UV-visible/infrared spectrophotometry) or by a response factor, amount/response (e.g., for GC, GC/MS, or high-performance liquid chromatography).

Continuing calibration usually includes measurement of one or more calibration standards. The response is compared to the initial measured instrument response. Continuing calibration is performed at least once per operating shift for laboratory analyses.

Calibration procedures will be performed as described in the referenced analytical method identified in Section 7 of this plan and as described in the approved laboratory's SOPs. Calibration procedures for all laboratory analyses, along with frequency and acceptance criteria, are summarized in Section 4. The following subsections discuss the general calibration procedures for each type of instrumentation.

9.2.1 Analytical Balances

Every 12 months, calibration of the entire analytical range shall be checked by a qualified service technician. The calibration of each balance is checked each day of use using weights traceable to the NIST. Calibration weights are certified to ASTM Class 1 and are recertified every 5 years. If balances are calibrated by an external agency, verification of their weights will be provided. All information pertaining to balance maintenance and calibration is found in the individual balance logbook and/or is maintained by the QA Department.

9.2.2 Thermometers

Certified, or reference, thermometers are maintained for checking calibration of working thermometers. Reference thermometers are provided with NIST traceability for initial calibration and are recertified every 5 years with equipment directly traceable to the NIST.

Each thermometer is individually numbered and tagged with the identification number. Working thermometers are compared with the reference thermometers on an annual basis; digital working thermometers are verified for accuracy on a quarterly frequency. In addition, working thermometers are visually inspected by laboratory personnel prior to use. Calibration temperatures and acceptance criteria are based on the working range of the thermometer and the accuracy required for its use. An inventory of thermometers, their identification, calibration status, and due date of next calibration is maintained by the QA Department or designated area.

9.2.3 pH/Electrometers

The meter is calibrated using buffer solutions (pH @ 4, 7, and 10) before use each day, and once after each 4 hours of use.

9.2.4 Ovens

Oven temperatures are monitored using a mercury thermometer, which is placed in a beaker of sand and kept inside the oven. This thermometer is compared annually to a NIST traceable thermometer. Oven temperature is checked every day of use and recorded in the appropriate logbook.

9.2.5 GC/MS Calibration Procedures

Calibration procedures and acceptance criteria are method specific. Refer to the individual methods or the laboratory SOPs (Appendix A) for method-specific requirements in addition to the generic procedures outlined here.

The following are general minimum operations necessary to satisfy analytical requirements associated with the determination of organic compounds in water and soil/sediment samples. These operations should be performed routinely in the laboratory:

- Documentation of GC/MS mass calibration and abundance pattern.
- Documentation of GC/MS response factor stability.
- Internal standard response and retention time.

Prior to initiating data collection, it is necessary to establish that a given GC/MS meets the standard mass spectral abundance criteria. This is accomplished through the analysis of DFTPP for semivolatile organic compounds and p-bromofluorobenzene (BFB) for volatile compounds. Each GC/MS system used for the analysis of semivolatile organic compounds or volatile organic compounds must be tuned to meet method-specific ion abundance criteria before analysis of standards, blanks, or samples can proceed.

Prior to the analysis of samples and after tuning criteria have been met in all SW-846 organic methods, the GC/MS system must be initially calibrated with the method-specified number (typically five or more) of concentrations of each compound being analyzed to determine the linearity of response. EPA methods typically specify the concentration levels to be used for initial calibration and the specific internal standard to be used on a compound-by-compound basis for quantification. The response factor (RF) for each compound at each concentration level is calculated using the following Equation 9.1:

$$RF = \frac{A_x}{A_{is}} * \frac{C_{is}}{C_x} \qquad (9.1)$$

where: A_X = Area of the characteristic ion for the compound to be measured.
A_{IS} = Area of the characteristic ion for the specific internal standards.
C_{IS} = Concentration of the internal standard.
C_X = Concentration of the compound to be measured.

Using the RF from the initial calibration, the percent relative standard deviation (%RSD) for compounds identified as Calibration Check Compounds (CCCs) is calculated using Equation 9.2:

$$\%\,RSD = \frac{S}{X} \times 100 \qquad (9.2)$$

where: RSD = Relative standard deviation.
S = Std. deviation of initial 5 response factors (per compound).
X = Mean of initial five response factors (per compound).

The %RSD for each individual CCC should be less than 25%, or as specified by the method. These criteria must be met for the initial calibration to be valid.

A calibration check standard containing all compounds of interest, as well as all required internal standards and surrogates, is performed each day of analysis. The RF data from the standard are compared each day against the average RF from the initial calibration for a specific instrument. If the response to a calibration check standard differs from the initial calibration by more than ±25%, or as specified by the method, then investigation and corrective action must be performed, including a complete recalibration, if necessary.

9.2.6 Non-GC/MS Chromatography Calibration Procedures

Calibration procedures and acceptance criteria are method specific. Refer to the individual methods or the laboratory SOPs for method-specific requirements in addition to the generic procedures outlined here.

Initially, a three- or five-point calibration curve, consisting of all compounds of interest plus a calibration blank, is established to define the usable range of the instrument. Calibration may be accomplished as best-fit line, quadratic equation, or average response factor in accordance with the applicable method. The curve is determined to be linear if the correlation coefficient is ≥ 0.995. Linearity may also be determined using response factors. Response factors are calculated for each compound at each concentration level. These RFs will be averaged to generate the mean RF for each compound over the range of the standard curve. The curve is determined to be linear if the RSD of the response factors is $\leq 25\%$, or as specified in the method. The mean response factor will be used to calculate the sample concentration of the compound of interest. When sample responses exceed the range of the standard curve, the

sample must be diluted to fall within the range of the standard curve and be reanalyzed. The results of the daily GC standardization are tabulated and filed with the corresponding sample analyses. Daily full calibration is not necessary if a calibration check standard verifies the initial calibration curve. If the response to a calibration check standard differs from the initial calibration by more than ±15% for any analyte being quantitated, or as specified by the method, then investigation and corrective action will be performed, including complete recalibration, if necessary.

Continuing calibration is checked as described in the laboratory SOPs or methods.

9.2.7 Calibration of Inductively Coupled Argon Plasma Spectrophotometer (ICP) and Atomic Absorption Spectrophotometer (AAS)

Calibration procedures and acceptance criteria are method specific. Refer to the individual methods or the laboratory SOPs for method-specific requirements in addition to the generic procedures outlined here.

ICP and AAS instruments are standardized for the metal of interest by the analysis of a set of calibration standards prepared by diluting a stock solution of known concentration. For the AAS, the concentration of the calibration standards is chosen to cover the working range of the instrument. For ICP analysis, a linearity range standard (LRS) is run at the time of calibration to establish the upper limit of quantitation. Subsequently, all sample measurements are made within this working range. Once the working standards are prepared, they are analyzed on the ICP or AAS and the instrument response is calibrated to provide a direct readout in concentration.

The calibration is accomplished by entering the metal concentration equivalent to the readout in absorbance units (or emission intensity) during analysis of the working standards.

Once the instrument has been initially calibrated, the analysis of the working standards is repeated during sample analysis to verify calibration. A typical analysis sequence is presented below.

- Working standards are prepared by dilution of a stock standard solution of the metal of interest.
- A calibration curve within the working range of the instrument is established by analysis of three to five working standards.
- An independent standard is analyzed to confirm the calibration. If the calibration is not within acceptance limits, the instrument is recalibrated.
- The samples are analyzed for the metal of interest.
- During sample analysis, a check standard (Continuing Calibration Verification [CCV] is analyzed to monitor instrument stability. If the CCV indicates that instrument calibration has changed by more than $\pm$10% for ICP or AAS, the instrument is recalibrated and the analysis is repeated.
- Following completion of the sample analyses, the check standard is reanalyzed to confirm calibration. If calibration is verified, the analysis is completed; however, if the calibration is not verified, appropriate corrective action is taken and affected samples are reanalyzed.

Written records of all calibrations shall be kept with the raw data.

9.2.8 Classical (Wet) Chemistry Calibration Procedures

The minimum operations necessary to satisfy analytical requirements associated with the determination of classical wet chemistry parameters in water and soil/sediment samples are method dependent. Refer to individual methods or the laboratory SOPs for specific requirements.

Wet chemistry instruments are standardized for the parameter of interest by the analysis of a set of calibration standards prepared by diluting a stock solution of known concentration. The concentration of the calibration standards is chosen to cover the working range of the instrument. Subsequently, all sample measurements are made within this working range.

Once the instrument has been initially calibrated, the analysis of the working standards is repeated during sample analysis to verify calibration. A typical analysis sequence is presented below.

- Working standards are prepared by dilution of a stock standard solution of the parameter of interest.

- A calibration curve within the working range of the instrument is established by analysis of one to five working standards.
- An independent standard is analyzed to confirm the calibration. If the calibration is not within acceptance limits, the instrument is recalibrated.
- The samples are analyzed for the analyte of interest.
- During sample analysis, a check standard CCV is analyzed to monitor instrument stability. If the CCV indicates that instrument calibration has changed by more than the method-specified acceptance limits, the instrument is recalibrated and the analysis is repeated.
- Following completion of the sample analyses, the check standard is reanalyzed to confirm calibration. If calibration is verified, the analysis is completed; however, if the calibration is not verified, appropriate corrective action is taken and affected samples are reanalyzed.

A calibration curve is not prepared for titration. Titrants are purchased or are prepared as standards and their use is recorded in the appropriate standards logbook.

Written records of all calibrations shall be kept with the raw data.

Section 10

10. DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

During the life cycle of a project, significant volumes of technical information are collected, reviewed, analyzed, and reported. The data management objective is to capture, manage, and maintain the data in a manner consistent with overall project objectives.

The site and facility data have been acquired by specialists in a variety of disciplines. Appropriate measures, as outlined in the *Environmental Information Management Systems Data Management Plan*, will be undertaken to integrate these various data collection activities (environmental, geologic, water, biota, and socioeconomic) (00-0336). The system will:

- Assess availability and value of the historical data.
- Determine the nature and extent of past sampling activities.
- Identify data gaps.
- Predict the necessity of additional sampling and sampling locations.
- Integrate data tables, maps, and graphics to support remediation decisions.

Seventeen years of data are stored in approximately 100 hard copy reports produced by numerous contractors. In addition, extensive data, including more than 1,000 groundwater monitoring wells, have also been managed by MADEP. To date, most of these historical data have been in the form of analytical laboratory reports, engineering summary reports, monthly status reports, maps, and a GIS database (00-0336).

The assessment of these historical results consists of a review process that examines the general usability of the results. Items to be considered during the overall review of the historical record are: documentation completeness, associated QA/QC results, level of data evaluation/validation performed, validity of source, and comparability to current results. It is not meant to be an extensive evaluation of the historical data usability, but rather as a guide to potential support documentation and/or knowledge that may strengthen the validity of the historical value (see procedure outlined in Appendix F).

Section 11

11. DATA MANAGEMENT

11.1 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 data collected at the site, and data generated at the laboratory, are valid.

11.1.1 Field Data Reduction

For field measurement data that require calculations to obtain final concentrations/values (e.g., alkalinity), 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. If after this check, the value remains the same, it is considered a valid measurement. If the value is determined invalid, the other measurements will be used.

11.1.2 Laboratory Data Reduction

For both on-site and fixed laboratories, data reduction is performed by the 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, as specified in this QAPP.

Calculations and data reduction steps for various methods are summarized in the respective laboratory SOPs (see Appendix A) or program requirements.

11.2 FIELD DATA REVIEW

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 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 notebook page or form.

11.3 LABORATORY DATA REVIEW

The individual analyst continually reviews the quality of data through calibration checks, quality control sample results, and performance evaluation samples. The analyst initiates data review during, immediately following, and after the completed analysis. The Laboratory Supervisor, analyst, or data specialist performs a secondary review of the data. The peer reviewer is trained by the QA Section, Section Manager, or Unit Leader to perform the data review.

11.4 ELECTRONIC DATA VERIFICATION

Electronic data will be compared to the hard copy data received from the laboratory by the WESTON Data Management Coordinator, as discussed in Subsection 14.2 of this QAPP. WESTON will perform a cursory review of the electronic data results. If a discrepancy is identified, the laboratory will be requested to correct the error, or WESTON will use the result reported in the hard copy data by the laboratory.

Section 12

C. ASSESSMENT/OVERSIGHT

12. ASSESSMENT AND RESPONSE ACTIONS

There are two types of audits (assessments) that may be performed by WESTON: a technical system audit (TSA) or a performance assessment. A system audit is a planned and documented evaluation of a system or process to determine whether the system or process is capable of complying with specific requirements. For example, a system audit may be performed to determine whether a laboratory can meet the QA/QC Plan requirements for a specific analysis. A performance assessment is a planned and documented evaluation of an item, system, process, or results to determine the adequacy of and the compliance with established procedures, instructions, drawings, project plans, and other documents. For example, a performance assessment may be performed to determine how well a field team is complying with contract and Chemical QA/QC Plan specifications.

12.1 TECHNICAL SYSTEM AUDITS (TSA)

12.1.1 Field Laboratory (On-Site) Performance Assessments

One TSA will be performed at the on-site laboratory immediately following mobilization. If the project continues for more than 6 months, or laboratory performance does not meet QAPP requirements, or the field laboratory changes (more than 30% of the team members are replaced), then additional audits may be performed. The audit will be performed by the WESTON Laboratory QA/QC Representative and by the EPA and the USACE Representatives using checklists derived from reviewing the contractual and regulatory requirements specified in the Health and Safety Plan, this QAPP, and/or agency specifications.

At the completion of each audit, the Laboratory QA/QC Coordinator will submit a report to the Analytical Manager, the project file, and the Division Quality Assurance Manager. The report will be included as a quality record with the final report. If a problem is identified during the audit that impacts the usability of the data, then the problem will be documented. If only minor

problems are identified, the audit report will serve as documentation of the problems, and a memo describing the corrective actions taken for these problems will be submitted to the project file and included in the final report. In addition, a follow-up visit will be conducted 4 to 6 weeks after the initial TSA to confirm compliance to all audit action items.

12.1.2 Subcontractor Audits (Fixed Laboratory)

A subcontractor audit will be performed at least once during this program. In the event that laboratory performance does not meet QAPP requirements and/or significant data quality issues arise, WESTON reserves the right to perform additional system/project audits at any time throughout the program.

Checklists are to be used to ensure that all salient points are addressed and documented. The checklists are filled out legibly and reproducibly, in ink, by the auditor, and are signed and dated by the auditor when completed. The audit checklist is based on EPA laboratory evaluation criteria, the provisions of the Laboratory Quality Assurance Manual, and the laboratory SOPs. Audit checklists will cover at least the following areas:

- Systems Audit
  - Personnel qualifications and training records.
  - Adequacy of laboratory facilities, including work space, lighting, ventilation, and supplies.
  - Maintenance and calibration recordkeeping for analytical equipment.
  - Safety (facility configuration and practices).
  - General operations, including glassware cleaning, inventory and checking of reagents and standards, and storage procedures.
  - Recordkeeping, including sample log-in and tracking; traceability of standards, control charts; and raw data recording and tracking.

- Project Audit
  - Sample log-in and chain-of-custody records.
  - Sample storage procedures and records.
  - Sample preparation and analysis procedures.
  - Method validation (where applicable).
  - Conformance to QAPP.
  - Control charts (if applicable).
  - Precision and accuracy assessment.
  - Method blanks, reagent blanks, duplicates, check samples, fortifications, surrogates, etc.
  - Calibration.
  - Data packages.
  - Analyst qualifications.
  - Data validation and reporting.

Each system audit is immediately followed by a debriefing in which the auditor discusses his/her findings with the laboratory representatives. The debriefing serves a twofold purpose: (1) laboratory management is afforded an early summary of findings, which allows them to begin formulating corrective strategies; and (2) the auditor has a chance to test preliminary conclusions and to correct any misconceptions before drafting his/her report.

The records from these assessments will be included in the project file. An abbreviated summary of the audits, including the name of the laboratory, the project for which the audit was performed, and the overall rating of the laboratory (acceptable or unacceptable), will be submitted to procurement for tracking. If a laboratory is assessed unacceptable, corrective actions will be implemented.

12.2 PERFORMANCE EVALUATION AUDITS

Performance evaluation (PE) samples are submitted blind to both the on-site laboratory and the subcontracted laboratory (off-site) as a normal laboratory sample. The laboratory results for the samples are then compared to the known values and acceptance ranges to assess the laboratory's performance for a specific analysis method. If the laboratory fails to properly quantitate the target analytes, then corrective action will be implemented. For this sampling event, PE sample submission will be initiated by the USACE; these PE samples will routinely be sent with the actual field samples at varying frequency (see Subsection 8.1.20 for PE sample evaluation procedure reference).

Section 13

13. REPORTS TO MANAGEMENT

The deliverables associated with the individual task orders will contain separate QA sections in which data quality information will be summarized. Those reports will include accuracy, precision, and completeness of the data as well as the results of the performance and system audits, and any corrective action needed or taken during the project.

Also, the evaluation of the off-site PCB confirmation analyses (confirmation analyses at 10% frequency) will be included in monthly project QA reports. The confirmation analysis evaluation will conform to the criteria established in Section 15. Conclusions obtained from these confirmation analyses, in conjunction with field laboratory audits, will be used to verify on-site laboratory performance. Any corrective actions generated during this process will be forwarded to the WESTON Project/Field Operations Managers and the USACE and the EPA agency representatives, who will determine the appropriate action responses.

In addition, the project QA reports should contain all results of field and laboratory audits, all information generated during the preceding month reflecting on the achievement of specific data quality objectives, and a summary of the corrective action implemented and its immediate effect on the project. Whenever necessary, the following information will be reported: changes in key personnel, anticipated problems in the field or laboratory for the coming reporting period that could affect the data quality, as well as proposed solutions. All QA reports will be submitted in written final format.

Section 14

D. DATA VALIDATION AND USABILITY

14. DATA VERIFICATION, EVALUATION, AND VALIDATION REQUIREMENTS

Data quality assessment is performed by evaluating the results of data verification, data evaluation, and/or data validation to determine the usability of the data for the original project objectives defined in Section 1 of this plan. Data verification, data evaluation, 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 in the subsections below with the requirements for this project. 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 analyses.

14.1 DATA VERIFICATION

Initially, data are received at WESTON in both hard copy and electronic data deliverable formats, as discussed previously. Upon receipt of either the on-site or fixed laboratory deliverables, a data management staff member will verify that:

- Results were received for each requested analysis for each sample. If a result is missing, the staff member will determine whether the laboratory submitted a deficiency report that accounts for the missing data.
- The data deliverable will be inspected for completeness based on the requirements specified in this plan. Inspection will verify only that the report sections are present, not that the data within the report sections are complete. A Region I EPA-NE Complete SDG File Inventory Sheet (DC-2 form) will be completed to document package completeness. This form will be maintained in the individual analytical batch file.

WESTON will perform data verification on every report submitted by a laboratory. Field results will be reviewed for completeness. In addition, once the EDD is verified, it will be loaded into the electronic database management system as "unvalidated" for user access on the network.

Subsequent data management logistics and implementation are discussed in detail in the *Environmental Information Management Systems Data Management Plan* (00-0336).

14.2 DATA EVALUATION

Data evaluation is performed 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.

If quality control outliers are observed in the evaluated data, the qualifications described in Table 14-1 may be applied to the data.

Table 14-1

Data Evaluation Qualifiers

Qualifier	Application
U	Sample results that are less than 5x times the blank contaminant level will be qualified nondetect (U). If the affected analyte is a common laboratory contaminant, as defined in the EPA Functional Guidelines, then 10x will be used instead of 5x.
J	Positive sample results associated with quality control recoveries outside acceptance limits will be qualified estimated (J).
UJ	Nondetect sample results associated with quality control recoveries below acceptance limits will be qualified estimated (UJ).
R	Sample results associated with extremely poor quality control recoveries or which are suspected of being extremely biased, as determined by the person performing the evaluation, will be rejected (R).

Data evaluation will be performed on 100% of both the on-site and fixed laboratory deliverables generated during this program. (The automated data evaluation system originally presented as Appendix B in the October 1998 Publication was not implemented.) In addition, some technical review will be performed by WESTON's Data Evaluator/Chemist.

The manual evaluation process for on-site data can proceed following the load process (Section 5.4.4). "Evaluation" is performed on distinct QC criteria established in this QAPP: holding time, surrogate, method blank, field and/or trip blank, matrix spike/matrix spike duplicate, MS/MSD

unspiked compounds, LCS, laboratory duplicate, field duplicate, and percent solids (refer to the following subsection).

14.2.1 Additional On-Site Data Evaluation

The on-site data will also undergo manual evaluation for case narrative content, calibration performance, PE, and verification sample results. The report forms for the on-site PCB analyses have been modified from a CLP-type deliverable; however, the critical information for data evaluation will be presented in an organized format, as outlined in Subsection 5.4.1.1 of this QAPP. The Chemist will examine these parameters, which are outlined in Table 14-2. The PE samples will be evaluated against criteria established in *Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses (99-0100)* for "Action" items only, and the verification samples will use the criteria set forth in Figure 15-1. The worksheet (see Figure 14-1) will be completed for these items, and any flagging will be documented and made in the system, at which point, the analytical batch evaluation will be considered complete. In addition to the previously discussed evaluation process, the fixed laboratory data will undergo a more rigorous data validation process, as discussed in the following subsection.

Table 14-2

PCB Data Evaluation/Validation Protocol

QC	Criteria	Qualification/Action
1. Holding Time	a. If the 14-day extraction and/or 40-day analysis holding time requirement was exceeded.	a. Estimate (J) all positive detects in the affected sample Estimate (UJ) all non-detects in the affected sample
2. Field Duplicates	If the RPD >30% for water matrix or RPD >50% for soil matrix, and: a. Both results are ≥2x SQL b. If one result is non-detect and one result ≥2x SQL	a. Estimate (J) all positive results in the field set b. Estimate (J/UJ) the associated positive results and non-detects in the field set

Table 14-2

PCB Data Evaluation/Validation Protocol (Continued)

QC	Criteria	Qualification/Action
3. Surrogates	a. If one recovery was outside of the 30-150% QC limits	a. No action
	b. If the two %R are above the QC limits	b. Estimate (J) positive detects only
	c. If the two %R are below the QC limits	c. Estimate (J/UJ) all associated results
	d. If one %R is low and one %R is high	d. Estimate (J/UJ) both positive detects and non-detects
	e. Surrogates diluted out	e. No qualification
4. Spike Recoveries	a. If field sample conc. >4x spike conc.	a. No action required
	b. If %R <10%	b. Reject (R) the non-detect or estimate (J) the positive detect in the unspiked sample (MS) or samples (LCS)
	c. If 10% ≤% R or <50%	c. Estimate (J/UJ) either the positive detect or non-detect in the unspiked sample (MS) or samples (LCS)
	d. If %R >130%	d. Estimate (J) the positive detects only
	e. RPD >40%	e. Estimate (J/UJ) either the positive detect or non-detect in the unspiked sample (MS) or samples (LCS)
5. Column Percent Differences (Fixed Off-Site Lab)	a. If 25% <%D ≥500	a. Estimate (J) the positive detect
	b. If %>500	b. Reject (R) the positive detect
6. Method Blank	If the method blank contains a target compound >1/2 PQL	a. If contamination in blank but not in sample or if sample has >5x blank concentration, no action is taken If positive result is less than or equal to 5x the blank concentration, but >PQL, elevate the PQL to the concentration in the sample
7. Initial Calibration	a. If %RSD > 20%	a. Estimate (J/UJ) all positive and non-detected results in affected samples for associated analyte.
	b. If %RSD >50%	b. Estimate (J) all positive results, Reject (R) the non-detects for affected analyte in associated samples.
8. Continuing Calibration	a. If %D > 25%	a. Estimate (J/UJ) all results in affected samples for associated analyte.
	b. If %D >50%	b. Estimate (J) all positive results, Reject (R) the non-detects in associated samples for affected analyte.
9. % Solids	a. 10% ≤ % Solids <30%	a. Estimate (J) the positive results and reject (R) the non-detects.
	b. % Solids <10%	b. Reject (R) all positive results and non-detects.

Figure 14-1 Data Evaluation Worksheet On-Site PCB Analyses

COC#_____
LAB SDG#:_____

	YES	NO
1. Holding time evaluation was performed and qualifiers were applied as necessary.	_____	_____
Comments_____		
2. Field Duplicate evaluation was performed and qualifiers were applied as required.	_____	_____
Comments_____		
3. Surrogate recovery evaluation was performed and qualifiers were applied as required.	_____	_____
Comments_____		
4. Matrix Spike/Matrix Spike Duplicate Recovery and RPD evaluation were performed and qualifiers were applied as required.	_____	_____
Comments_____		
5. LCS Recovery evaluation was performed and qualifiers were applied as necessary.	_____	_____
Comments_____		
6. Method Blank evaluation was performed and qualifiers were applied as necessary.	_____	_____
Comments_____		
7. Field Blank evaluation was performed and flags were applied as required.	_____	_____
Comments_____		
8. % Solids evaluation was performed and qualifiers were applied as necessary.	_____	_____
Comments_____		
9. Initial Calibration(s) present.	_____	_____
10. Initial Calibration criteria met: $r \geq 0.995$	_____	_____

If no, Calibration outliers are as follows:

Figure 14-1 Data Evaluation Worksheet On-Site PCB Analyses (Continued)

Compound	Corr. Coef	Date/Time	Affected Samples	Action

	YES	NO
11. Continuing Calibration(s) present		
12. Continuing Calibration criteria met, %D≤25%.		

If no, Calibration outliers are as follows:

Compound	%D	Date/Time	Affected Samples	Action

	YES	NO
13. Verification Samples Analyzed.		
14. Verification criteria met: %D≤75% and both results >2x SQL, or Both results ≤2x SQL, or One >2x SQL and one ≤2X SQL and %D≤ 75%		

If no, Verification result outliers are as follows

Compound	On-site Result	Verification Result	%D	Flag (if applicable)

	YES	NO
15. PE Analyzed: Sample #_____		
16. PE criteria met (See Region I Functional Guidelines)		

If no, PE result outliers are as follows

Compound	Conc.	Reg I PES Score	Samples Affected	Action

Comments:_____

_____

_____

_____

Validator:_____ Date:_____

14.3 DATA VALIDATION OF ANALYTICAL DATA

Data validation is performed to confirm that the data were collected following the proper analytical procedures, that all calibration requirements were met, that the results were properly calculated, that all of the quality control requirements were within acceptance limits, and that the data package is complete. This level of quality assurance is applied to data that may be used in litigation or that are likely to be used to make high-risk decisions. For this sampling event, it is anticipated that the data validation will be performed on 100% (15% tissue residue samples as of November 1999) of the CLP-type data deliverables (verification samples discussed in Subsection 3.2), in accordance with *Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses* (99-0100) per Table 14-3.

Table 14-3

Proposed Validation Matrices and Levels

Matrix	Validation Level
Biological	Tier III
Groundwater	Tier II + chromatograms
Surface Water	Tier II
Soil	Tier II
Sediment	Tier II
Air	Tier II + chromatograms
Dioxin/Furan and PCBs (Congener/Homolog-Specific)	Tier III

Tier I: The data package is checked for completeness. The DC-2 Form is completed and signed. This ensures that the data set is complete for potential use in court. The PE sample results are evaluated to assess potential usability issues. For Tier I validations, the validator produces a Tier I Validation Cover Letter.

Tier II: The results of the QC checks, analytical procedures, and PE sample results are assessed and applied to the data set. This will result in the proper qualifiers being applied to the data. For

Tier II validations, a Data Validation Report is produced by the validator. As in Table 14-3, several Tier II validations will also include examination of the chromatograms.

Tier III: The raw data are examined in detail to check for calculation, compound identification, and/or transcription errors. For Tier III validations, a Data Validation Report is produced by the validator.

The CLP data validation elements contained within the *Laboratory Data Validation Functional Guidelines for Evaluating Environmental Analyses* (99-0100) will be modified by the data validator to be applicable to SW-846 method results.

The data validation of the verification samples will be used to supplement the previously discussed automated data evaluation process. Region I EPA-NE Data Validation Worksheets will be provided, as necessary, for those QC parameters not evaluated by the automated system. The data validation Tier levels will be presented as detailed, with the exception of volatile and semivolatile (SW-846 8260B and 8270C) Tentatively Identified Compounds (TICs), which will not be validated under this program. Upon completion, the data validation package will be distributed to Region I EPA NE document control officer for historical maintenance. The data validation package will also be retained in the analytical batch file within WESTON's data management section.

14.3.1 Corrective Action During Data Validation

The need for corrective action during either data evaluation or data validation may be identified. Potential types of corrective action may include resampling by the field team or reinjection/reanalysis of samples by the laboratory.

These actions depend on the ability to mobilize the field team and whether the data to be collected are necessary to meet the required quality assurance objectives (e.g., exceeded holding time). When the data validator/reviewer identifies a corrective action situation, the Project Manager is responsible for approving the implementation of the corrective action, including resampling, during data assessment. All corrective actions of this type will be documented.

Section 15

15. RECONCILIATION WITH DATA QUALITY OBJECTIVES

Data quality indicators, such as precision, accuracy, completeness, representativeness, and comparability measurements, aid in the evaluation process (see Subsection 15.6) and are discussed in the following subsections.

15.1 PRECISION

Precision is the level of agreement among repeated independent measurements of the same characteristic, usually under a prescribed set of conditions (e.g., under the same analytical protocol). The most commonly used estimates of precision are the relative percent difference (RPD) for cases in which only two measurements are available, and the percent relative standard deviation (%RSD) when three or more measurements are available. In both cases, the quantitative measure of the variability of the group of measurements is compared with their average value. 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 concentration indigenous to samples.

Precision is represented as the RPD between measurement of an analyte in duplicate samples or in duplicate spikes. RPD is defined as follows, Equation 15.1:

Where:

$$RPD = \frac{|C_1 - C_2|}{\frac{C_1 + C_2}{2}} \times 100 \qquad (15.1)$$

C_1 = First measurement value
C_2 = Second measurement value

The % RSD is calculated by the standard deviation of the analytical results of the replicate determinations relative to the average of those results for a given analyte. This method of precision measurement can be expressed by the formula, Equation 15.2:

Where:

$$\%RSD = \frac{\sqrt{\sum_{I=1}^{N}\left(\frac{RF_i - RF}{N-1}\right)}}{RF} \times 100 \qquad (15.2)$$

RF = Response factor
N = Number of measurements

Precision control limits for evaluation of sample results are established by the analysis of control samples. The control samples can be method blanks fortified with surrogates (e.g., for organics), or laboratory control samples (LCS) purchased commercially or prepared at the laboratory. The LCS is typically identified as blank spikes (BS) for organic analyses. For multi-analyte methods, the LCS or BS may contain only a representative number of target analytes rather than the full list.

The RPD for duplicate investigative sample analysis provides a tool for evaluating how well the method performed for the respective matrix. The quality control samples determined to be necessary to meet the precision data quality objectives (DQOs) of this project are listed in Section 4. Depending on the specific data quality objectives, there may be instances where none or only some of the types of quality control samples discussed in this section will be included in the tables in Section 4.

15.2 ACCURACY/BIAS

Accuracy is the degree of agreement of an analytical measurement with the true or expected concentration. When applied to a set of observed values, accuracy will be a measure of both random error and systematic error (bias).

Bias is systematic error inherent in an analysis caused by some artifact of the measurement system or by deviation from protocol. Temperature effects and extraction inefficiencies are examples of the first type of systematic error; contamination, mechanical losses, and calibration errors are examples of the latter type of error.

Accuracy control limits are established by the analysis of control samples, which are water and/or solid/waste matrices.

For organic analyses, the LCS may be a surrogate compound in the blank or a select number of target analytes in the blank spike. The LCS is subjected to all sample preparation steps. When available, a solid LCS may be analyzed to demonstrate control of the analysis for soil. The amount of each analyte recovered in an LCS analysis is recorded and entered into a database to generate statistical control limits. These empirical data are compared with available method reference criteria and available databases to establish control criteria.

The percent recovery (% R) for spiked investigative sample analysis (e.g., matrix spike) provides a tool for evaluating how well the method worked for the respective matrix. These values are used by the client to assess a reported result within the context of the project data quality objectives. For results that are outside control limits provided as requirements in the QAPP, corrective action appropriate to the project will be taken and the deviation will be noted in the case narrative accompanying the sample results. Percent recovery is defined as follows, Equation 15.3:

Where:

$$\%\,\text{Recovery} = \frac{(A_T - A_0)}{A_F} \times 100 \qquad (15.3)$$

A_T = Total amount recovered in fortified sample
A_0 = Amount recovered in unfortified sample
A_F = Amount added to sample

Accuracy for some procedures is evaluated as the degree of agreement between a new set of results and a historical database or a table of acceptable criteria for a given parameter. This is measured as percent difference (%D) from the reference value, and is primarily used by the laboratory as a means for documenting acceptability of continuing calibration.

The percent difference (%D) is calculated by expressing, as a percentage, the difference between the original value and new value relative to the original value. This method for precision measurement can be expressed by the formula, Equation 15.4:

Where:

$$\%D = \frac{C_1 - C_2}{C_1} \times 100 \qquad (15.4)$$

C_1 = Concentration of analyte in the initial aliquot of the sample.
C_2 = Concentration of analyte in replicate.

The quality control samples determined to be necessary to meet the accuracy DQOs of this project are listed in Section 4. Depending on the specific DQOs, there may be instances where none, or only some of the types, of the quality control samples discussed in this section will be included.

15.3 COMPLETENESS

Completeness is a measure of the percentage of planned samples collected or the percentage of data points per measurement, analyte, or analysis that were determined usable. Project-specific 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, as well as external problems, that prohibit collection of the sample. The following calculation is used for determining the percent complete, Equation 15.5:

Where:

$$\text{Completeness} = \frac{A}{B} \times 100 \qquad (15.5)$$

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

The formula for sampling completeness is, Equation 15.6:

$$\text{Sampling Completeness} = \frac{\text{Number of locations sampled}}{\text{Number of planned sample locations}} \times 100 \qquad (15.6)$$

For example, if 100 samples were planned for collection and 2 samples could not be collected due to the sample locations being inaccessible, the sampling percent completeness would be 98%.

An example formula for analytical completeness is, Equation 15.7:

$$\text{VOC Analytical Completeness} = \frac{\text{Number of Usable Date Points}}{\text{Expected Number of Usable Data Points}} \times 100 \qquad (15.7)$$

The completeness for a chemical analysis, such as volatile organics that consist of many target analytes, is determined by dividing the total number of usable volatile analyte results for the project by the total number of volatile results. For example, if 10 samples were submitted for volatile analysis, the volatile analysis consisted of 10 target analytes, and 1 analyte was rejected from every sample, the percent completeness would be 90%.

The ability to meet or exceed completeness objectives is dependent on the nature of samples submitted for analysis. For example, if the analytical methods proposed for use (particularly for organics analyses) are intended for analysis of environmental samples of low and medium hazard, the applicability of these methods to nonroutine matrices, such as drum samples, wipes, air samples, etc., may result in poor method performance and, therefore, adversely impact achievement of the data completeness goal.

Table 15-1 lists the completeness goals for this program. 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 is not met because of uncontrollable circumstances, such as inaccessible sample points, matrix interferences, etc., then the deficiency will be evaluated.

Table 15-1

Project Completeness Goals

Task	Subtask	Completeness Goal
Sampling	Sample Collection	95%
Field Measurements	Conductivity	100% of collected samples
	pH/Turbidity/DO	100% of collected samples
Analytical Measurements	All Laboratory Analyses	95% of collected analytes
		80% of each target analyte

15.4 REPRESENTATIVENESS

Representativeness expresses the degree to which data accurately and precisely represent characteristics of a population, parameter, and variation at a sample point, process condition, or environmental condition. Data representativeness for this project is accomplished by implementing approved sampling procedures and analytical methods that are appropriate for the intended data uses, and which are established within this QAPP and the *Field Sampling Plan* (00-0476).

15.5 COMPARABILITY

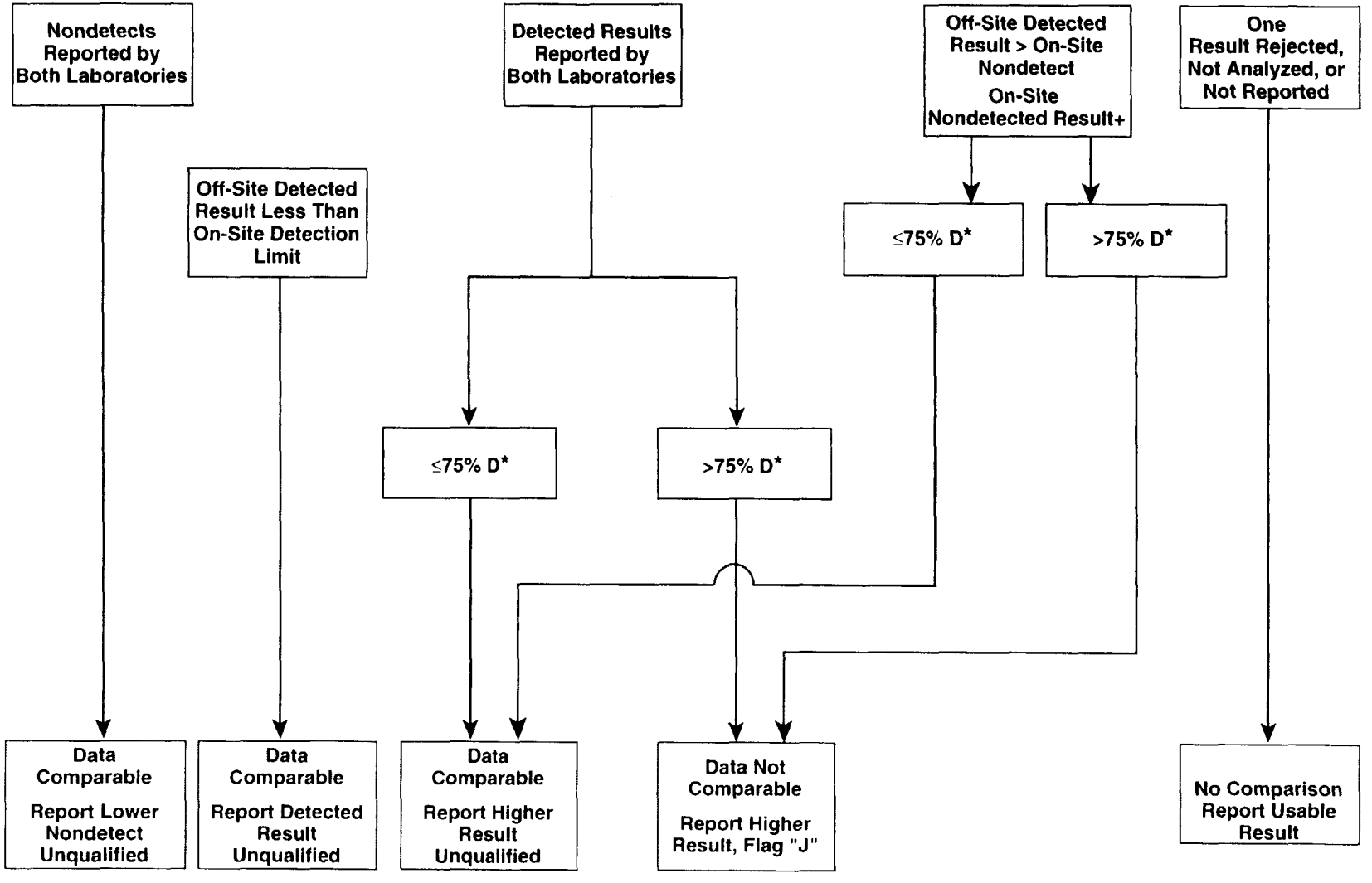
Comparability expresses the confidence with which one data set can be compared to another. Comparability of data sets generated for this project will be obtained through the implementation of standard sampling and analysis procedures, by the use of traceable reference materials for laboratory standards, and by expressing the results in comparable concentration units. One main comparability measurement will be obtained in the confirmation (WESTON) split sampling program as discussed in the following subsection. In addition, a system for evaluating comparability of historical data to current activities is under development and will be provided as a QAPP appendix at a later date.

15.5.1 Field Screening/Confirmatory Split Sampling Data Comparability

The frequency of the field confirmatory split sampling program is discussed in Section 7. The comparability of field screening data generated on-site versus split sample verification data obtained in a fixed laboratory is the most important factor for determining if the field screening data will be usable for project purposes. Figure 15-1 outlines the evaluation process for the Total PCB results only. Refer to Equation 15-4 for the comparability calculation. The individual sample result comparability criterion is established at a %D of 75%; however, for the overall project, at least 75% of these split results are to be within the 75% comparability criterion.

The results of the split sampling program will be monitored and reported to EPA and USACE personnel. This process will expedite the decision-making process so that field or laboratory protocol adjustments can be performed, if warranted.

FIGURE 15-1 DATA COMPARISON FLOW DIAGRAM AND CRITERIA



* %D = See Equation 15.4.
\+ = Use the Detection Limit Value in %D Calculation.

RL = Reporting Limit is the Quantitation Limit adjusted for any necessary sample dilutions, sample volume deviations, and/or extract/digestate volume deviations.

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During the removal/disposal phase of site operations, the data comparability results will be a vital concern because site actions will directly relate to the usability of the on-site laboratory results. Due to the obvious lag-time as a result of on-site laboratory (24-hr) versus fixed laboratory (7-day) turnaround times, statistical results from previous sampling events can be extrapolated to evaluate the current activity. Removal/disposal activity will establish the framework and drive the decision-making timeframe.

Corrective action can be initiated by any key project staff; however, WESTON will be primarily responsible for comparability communication/action via evaluation by the Laboratory QA/QC Coordinator and/or Data Validator. The interdisciplinary team will receive report distribution, and in extreme circumstances, immediate verbal actions can be discussed/implemented through the WESTON Analytical Manager.

15.6 SENSITIVITY

Sensitivity is the ability of the method or acceptable sensitivity instrument to detect the contaminant of concern and other target compounds at the level of interest. Quantitative measurement performance criteria need to be determined for acceptable sensitivity to ensure that the quantitation limits can be routinely achieved for each matrix, analytical parameter, and concentration level.

15.7 SELECTIVITY

Selectivity is the ability of the method or instrument to identify and differentiate between various compounds/analytes of interest and interferences.

15.8 ASSESSMENT OF DATA USABILITY

Data usability is defined as the ability of the final data set to address and satisfy the data quality objectives (DQOs) established in the planning phase of a study. Assessment of the data usability is an important component of each study conducted as part of the Housatonic River

Supplemental Investigation and will be performed as a preliminary step of the data interpretation phase of each study.

In addition, data assessment is considered the final step in the data evaluation process and can only be performed on data of known and documented quality. As described in Section 14, most data generated for this project will undergo a formalized evaluation/validation process, following USEPA-NE Region 1 protocol. For this project, all data will be assessed for usability, regardless of the data evaluation/validation process implemented. As mentioned previously, data usability goes beyond validation in that it evaluates the achievement of the DQOs based on the comparison of the project DQIs (previously defined in the QAPP) and individual study-specific workplans, with the obtained results. The results of the data usability assessment, and particularly any changes to the DQOs necessitated by the data not meeting usability criteria, will be included in each final report.

Primarily, the assessment of the usability will follow procedures described in appropriate EPA guidance documents, particularly *Guidance for Data Useability in Risk Assessment* (Publication No. 9285.7-05FS, September 1992) (99-0086), and will be conducted according to the process outlined below.

15.8.1 Sampling and Analysis Activities Evaluation

The first step of the data usability evaluation will include a review of the sampling and analysis activities in comparison to project-specific DQIs outlined in detail in Table 4-2 and study-specific workplans. Specific limitations to the data, i.e., results that are qualified as estimated (J/UJ), or rejected (R), will be determined and documented in the database. The data acquisition and evaluation process consists of a series of procedures that were designed to maximize final data quality as outlined in Figure 15-2.

15.8.2 Achievement of DQIs

The second part of data usability pertains to the achievement of the program-specific DQIs. Each investigator will compare the performance achieved for each data quality criterion against the

Figure 15-2 Data Acquisition/Evaluation Process

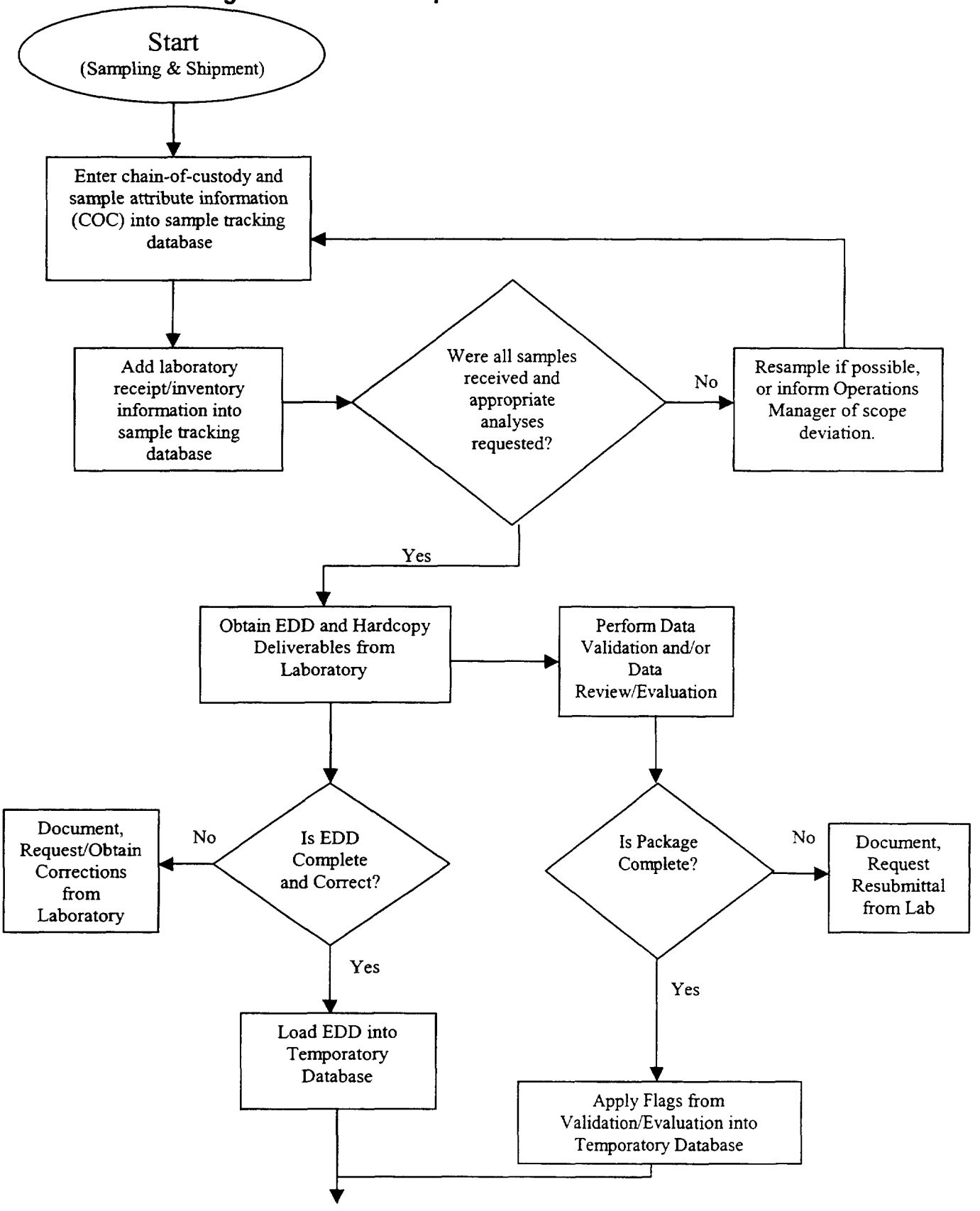
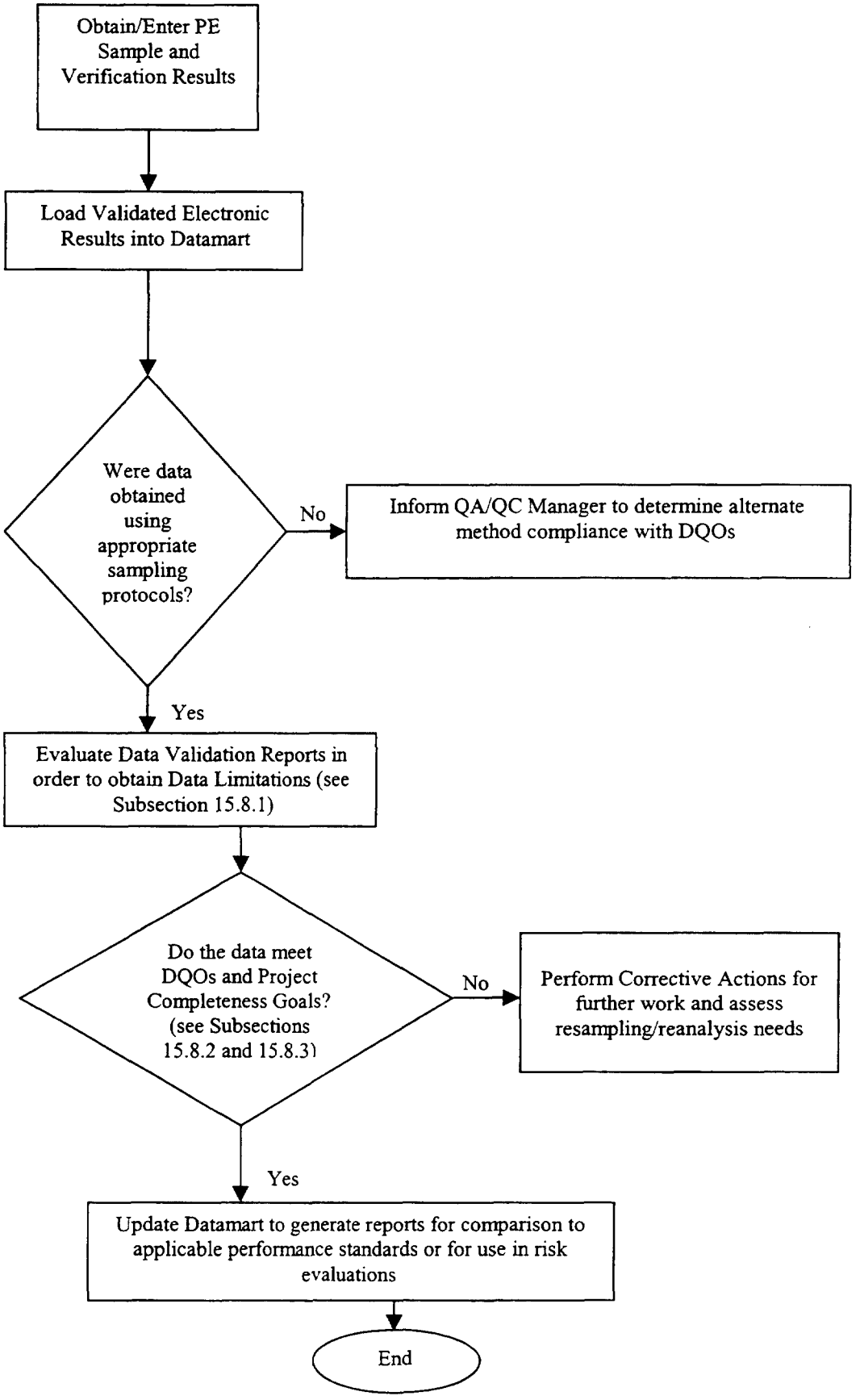


Figure 15-2 Data Acquisition/Evaluation Process (Continued)



expected and planned performance. In general, this comparison will follow from the DQIs used to define each DQO. This comparison is the most critical component of the assessment process. Any deviation from planned performance will be documented and evaluated to determine whether corrective action is advisable. Potential corrective actions will range from resampling and/or reanalysis of data, to qualification or exclusion of the data for use in the data interpretation. In the event that corrective action is not possible, the limitations, if any, of the data with regard to achieving the DQOs will be noted.

In conjunction with the DQI achievement review, the investigators will need to make decisions for the use of qualified values, which are a consequence of the formalized evaluation/validation process. Data qualifiers will be applied to individual data results as discussed in Section 14. Data usability decisions will be made based on the assessment of the usability of each of these results for the intended purpose. Evaluation will describe the uncertainty (bias, imprecision, etc.) of the qualified results. Cumulative QC exceedances from the DQIs 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 EPA document mentioned in Subsection 15.8, which allows for the use of estimated values. Finally, data users may choose to determine final data usability qualifiers as a result of this overall examination and decision process.

15.8.3 Achievement of DQOs

The third step in the data usability process concerns achievement of the 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 questions:

- Are the data adequate to determine the extent to which hazardous substances have migrated or to what extent they were 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 evaluate 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 study principal investigators, in conjunction with the project team, will need to formulate solutions if data gaps are found as a result of problems, biases, trends, etc., 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 address any limitations on the use of the data that may result from a failure to achieve the stipulated DQOs.

Section 16

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