QUALITY ASSURANCE PROJECT PLAN

PHASE I EMORY RIVER DREDGING

TENNESSEE VALLEY AUTHORITY

KINGSTON FOSSIL PLANT ASH RECOVERY PROJECT

March 18, 2009

Prepared for:
TENNESSEE VALLEY AUTHORITY

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4.0 INTRODUCTION

4.1 Problem Statement

On Monday, December 22, 2008, just before 1 a.m., a coal fly ash spill occurred at Tennessee Valley Authority's (TVA's) Kingston Fossil Plant site, allowing a large amount of fly ash to escape into the adjacent waters of the Emory River. Ash, a by-product of a coal-fired power plant, is stored in containment areas. Failure of the dredge cell dike caused about 60 acres of ash in the 84-acre containment area to be displaced. At the time of the slide, the area contained about 9.4 million cubic yards of ash. The dike failure released about 5.4 million cubic yards (cy) of coal ash that covered about 275 acres and affected about 40 area homes. In addition, a section of the Emory River channel is blocked by ash and the river is diverting around the blockage.

As part of overall remediation activities associated with the Kingston Ash Recovery Project, TVA will dredge the Emory River. The dredging will be conducted in three phases as described in the Phase I Emory River Dredging Plan, Kingston Fossil Plant Ash Recovery Project (Phase I Dredging Plan; Shaw Environmental, February 2009). The primary goal of Phase I dredging is to clear the Emory River channel to restore flow to the channel, to minimize flooding, and to prevent further migration of the ash. Later phases of dredging are being planned and are expected to focus on removing remaining ash from within and outside the Emory River channel.

The TVA Kingston Fossil Plant (KIF) Monitoring Plan for Phase I Dredging (TVA, March 2009) provides guidance for sampling design and execution as related to the Phase I dredging. This Quality Assurance Project Plan (QAPP) is limited to activities associated with the Phase I dredging; this QAPP may be revised or amended as Work Plans for the later phases of dredging are approved.

4.2 Project Description and Applicability

On behalf of TVA, Environmental Standards, Inc. (Environmental Standards) has prepared this Quality Assurance Project Plan (QAPP) that presents the project organization, objectives, procedures, functional activities, and specific quality assurance (QA) and quality control (QC) activities relative to the laboratory analyses associated with Phase I dredging of the Emory River in association with to the Kingston Fossil Plant Ash Recovery Project. The activities addressed in this QAPP are a subset of a wide variety of investigation, characterization, and monitoring activities that will support the Kingston Fossil Plant Ash Recovery Project; a comprehensive site-wide QAPP will be prepared that encompasses all activities at the site.

This QAPP includes the activities associated with the organization; laboratory, data management, and field activities; and data reporting and archiving for all field samples associated with Phase I dredging of the Emory River Channel. The requirements of this QAPP are applicable to affiliated project personnel, support groups, contractors, and subcontractors. This QAPP is intended to establish an overall QA plan to provide the framework for the Phase I dredging project; additional requirements will be described in the Phase I Dredging Plan, the KIF Monitoring Plan for Phase I Dredging, and other supporting documents such as laboratory Standard Operating Procedures (SOPs), Data Quality Objectives (DQOs), and general requirements associated with various analysis, data generation, data reduction, and reporting activities are stipulated herein. This

QAPP will be governed by the site-wide QAPP, which will present the comprehensive quality assurance program for the Kingston Ash Recovery Project.

4.3 Purpose and Scope

The purpose of this QAPP is to detail the requirements for the performance of activities relative to field sampling and laboratory analyses necessary to monitor remediation activities and to assess the potential health hazard and biological impact related to Phase I dredging operations.

The scope of this document is to provide the appropriate QA procedures and QC measures to be applied throughout the Phase I dredging and to address the following items:

- QA objectives.
- Laboratory procedures.
- Sample collection, handling, and preservation.
- Sample analysis, data reduction, validation, and reporting.
- Internal QC checks.
- QA performance and system audits.
- Preventive maintenance procedures and schedules.
- Data assessment procedures, including processing, interpretation, and presentation.
- Corrective actions.
- QA reports to management.

4.4 Data Objectives

The goals of data collection during sampling associated with Phase I dredging and subsequent analysis of project samples are to monitor remediation activities and to assess the potential health hazard and biological impact related to Phase I dredging operations with defensibly accurate analyses. Specifically, this will require meeting appropriate Data Objectives, which will allow TVA to utilize the analytical data to the fullest extent possible.

The Data Objectives for the project are established to ensure that the data generated are of known and acceptable quality. Primary Data Objectives of this project are to:

- To monitor remediation activities
- To assess the potential health hazard and biological impact from Phase I dredging
- To generate high-quality, defensible analytical data to support project decisions.
- To generate analytical data that meet the quality assurance and quality control objectives detailed in Section 6.0 and Tables 7 and 8.

To ensure that the data generated are of known and acceptable quality, the QAPP establishes or makes provisions for the following:

- Development of standards for performance related to various elements of the scope-of-work.

- Monitoring of performance to determine compliance with the established methods.
- Reporting of the monitored performance.
- Correction of performance not conforming to the established standards.

To achieve the Data Objectives, QA measures will be implemented throughout the Project to ensure that the data generated meet known and suitable data quality criteria such as accuracy, precision, representativeness, comparability, and completeness. The quality of sampling data will be controlled through the collection of field QC samples and the calibration of field and laboratory equipment following US EPA protocols. Implementation of QA/QC measures will allow project personnel to assess data quality relative to the Data Objectives.

Surface water, sediment, and toxicological (biological) samples will be collected in association with the Phase I dredging activities. The requested parameters and analytical methods for chemical parameters for each sample matrix are addressed in Tables 4 and 5. The toxicological assessments that will be conducted in association with dredging are described in the KIF Monitoring Plan for Phase I Dredging and in the associated toxicological laboratory SOPs.

Data quality from fixed-based laboratory chemical analyses (using US EPA, SW-846, and Standard Methods) will be assessed by performing full data validation for 100% of the data. Validation is discussed in greater detail in Section 11.2.4. Data quality for toxicological assessments will be evaluated in accordance with TVA's toxicological monitoring program.

4.5 Schedule

The overall schedule for Phase I dredging and sampling activities is provided in Section 1.5 of the Phase I Dredging Plan. The anticipated schedule of activities related to analytical data generated from chemical analyses is detailed below.

- The laboratory will provide analytical results to TVA within 5 business days from sample receipt (or sooner when expedited turn-around time is requested) and will report results on a weekly basis to US EPA Region IV and TDEC.
- The laboratory will provide full data deliverables packages and Electronic Data Deliverable (EDD) to TVA and Environmental Standards within 10 business days of sample receipt.
- Environmental Standards will screen the EDD for acceptability to the database and complete the initial completeness review (see Section 11.2.4) within 2 business days of EDD receipt.
- Environmental Standards will complete data validation and generate reports within 10 business days of receipt of the complete data package.
- Data validation qualifiers will be added to the database.
- Qualified data will be used to generate reports.
- Qualified data will be posted to the shared database within 2 business days of data validation completion.

Data generated from toxicological assessments will be reported and reviewed in accordance with TVA's toxicological monitoring program as described in the site-wide QAPP.

4.6 Special Training/Certification

All field personnel will have completed a training course of at least 40 hours that meets the requirements specified in 29 CFR Part 1910.120(e) on safety and health at hazardous waste operations and a refresher course of at least 8 hours that meets the requirements of 29 CFR Part 1910.120(e) on safety and health at hazardous waste operations within the last 12 months.

Field personnel performing sample collection activities will be properly trained in equipment use and procedures necessary for each task prior to entering the field. Training will be conducted by Environmental Standards, Jacobs, and/or other subcontractors. Any training not provided by Environmental Standards, will be reviewed by Environmental Standards. All field sampling personnel training will be fully documented; documentation will be maintained as part of the Project Record.

All individuals who plan to participate in field activities have current health and safety training prior to commencement of sample collection activities. The Field Team Leader will ensure all participants who arrive on-site have provided evidence of health and safety training. It will be the responsibility of the Field Team Leader to ensure that field personnel understand and comply with the applicable requirements for their individual tasks.

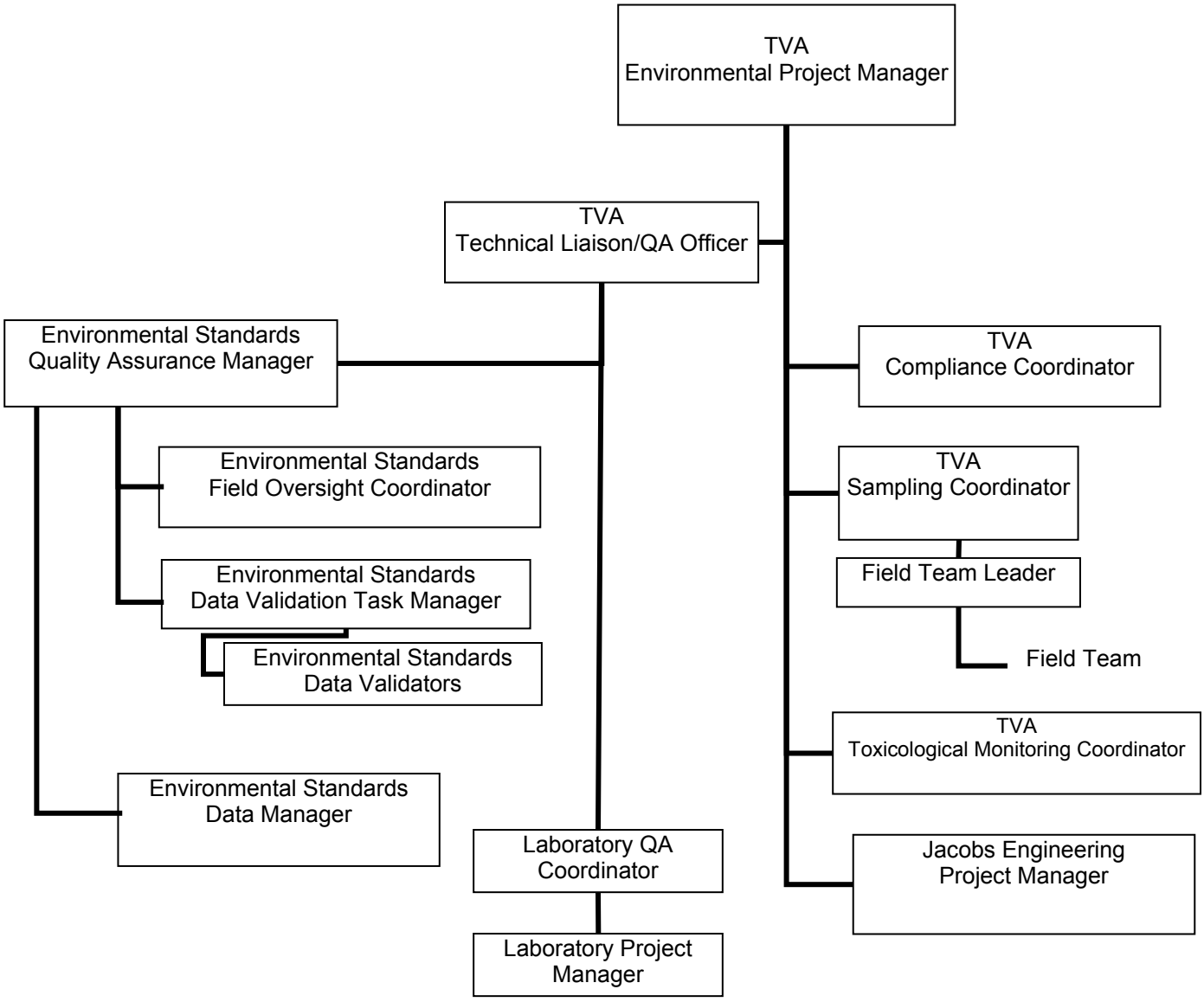
Personnel who are responsible for performing laboratory analyses will be properly trained by the Laboratory Director or her/his designee to conduct the various laboratory analyses described in this QAPP. The laboratories participating in this project will have training programs that are equivalent to those requirements in the National Environmental Laboratory Accreditation Conference (NELAC/NELAP) Standards, Section 5.0 Quality Systems. The laboratory shall have sufficient personnel with the necessary education, training, technical knowledge, and experience for their assigned functions. Data verification and validation will be under the direction of the Environmental Standards Data Validation Task Manager who is experienced with the production, reporting, verification and validation of analytical data.

5.0 PROJECT ORGANIZATION AND RESPONSIBILITY

5.1 Project Organization

This section describes the organizational structure, lines of authority, and responsibilities of key project individuals. Project activities will be performed within the framework of the organization and functions described in this section. Emphasis is placed on the organization and entities responsible for the implementation and administration of this QAPP. The organizational structure showing relationships of individuals with key responsibilities is presented in Figure 5-1. The organizational structure in Figure 5-1 represents a subsection of the overall organizational structure for the project as directly related to the Phase I dredging activities.

Figure 5-1: Organizational Structure



The organizational structure is designed to provide clear lines of responsibility and authority. This control structure encompasses the following activities:

- Identifying lines of communication and coordination.
- Monitoring project schedules and performance.
- Managing key technical resources.
- Providing periodic progress reports.
- Coordinating support functions such as laboratory analysis and data management.
- Rectifying deficiencies and issues.

Field and laboratory personnel providing services in support of Project efforts will perform work in strict compliance with the appropriate contract specifications for the activity.

Under the overall direction of the TVA Technical Liaison/Quality Officer, QA personnel will perform the following tasks:

- Identify QA problems.
- Initiate, recommend, or provide solutions to QA problems through designated channels.
- Ensure that project activities, including processing of information, delivery of deliverables, and installation or use of equipment, are reviewed in accordance with QA objectives.
- Ensure that deficiencies/non-conformances are corrected.
- Ensure that further processing, delivery, or use of data is controlled until the proper disposition of a non-conformance, deficiency, or unsatisfactory condition has occurred.

5.2 EPA Region IV Project Manager and TDEC Project Manager

The EPA Region IV Project Manager and TDEC Project Manager have regulatory oversight responsibilities for the development and approval of the documents and reports for this project. The responsibilities of the EPA Region IV Project Manager and TDEC Project Manager include:

- Schedule meetings, if necessary, between agency and representatives of TVA.
- Review and approve proposed schedules.
- Review and approve documents and reports.

5.3 TVA Environmental Project Manager

Neil Carriker, Ph.D. – Tennessee Valley Authority

The TVA Environmental Project Manager holds overall authority of project-related decisions and activities and management responsibility for the entire project. The responsibilities and duties of the TVA Environmental Project Manager include the following:

- Approve documents prior to submission to US EPA Region IV, TDEC, and other regulatory agencies.
- Represent TVA at meetings.
- Define objectives for the project as a whole.
- Approve reports prior to submission.
- Serve as point-of-contact for local government, US EPA Region IV, TDEC, other regulatory agencies, area residents, and environmental groups.
- Review and analyze overall task performance with respect to planned requirements and authorizations.
- Interact with Environmental Standards and other subcontractor personnel regarding standard project communications.

5.4 TVA Technical Liaison/Quality Officer
William Rogers, Ph.D. – Tennessee Valley Authority

The responsibilities and duties of the TVA Technical Liaison/Quality Officer include the following:

- Review and analyze overall task performance with respect to planned requirements.
- Submit project progress reports to TVA Environmental Project Manager.
- Serve as point-of-contact between Environmental Standards and project laboratories.
- Perform general oversight of corrective action process.
- Receive and review data validation reports.
- Provide support to the analytical laboratories for sample preparation and analysis issues.
- Provide day-to-day contact for project laboratories.

5.5 TVA Environmental Compliance Officer
Cynthia Anderson – Tennessee Valley Authority

The TVA Environmental Compliance Officer ensures environmental compliance with all dredging activities and is the liaison between TVA, TDEC, US EPA Region IV, and other regulatory agencies.

5.6 TVA Toxicological Monitoring Coordinator
Rick Sherrard, Ph.D. – Tennessee Valley Authority

The TVA Toxicological Monitoring Coordinator is responsible for coordinating and overseeing all toxicity testing associated with dredging, including whole sediment elutriate evaluation, elutriate toxicity evaluation, plume toxicity evaluation, and polymer toxicity evaluation. The TVA Toxicity Testing Coordinator schedules all toxicity sampling events; serves as the point of contact with the toxicity laboratory; receives analytical data; and coordinates with the TVA Technical Liaison/Quality Officer regarding quality control issues encountered.

5.7 TVA Sampling and Monitoring Coordinator

Robert Crawford – Tennessee Valley Authority

The responsibilities and duties of the TVA Sampling and Monitoring Coordinator include the following:

- Receive and review daily progress reports from Field Team Leader.
- Receive and review weekly compiled field data sets from the Field Team Leader.
- Oversee use of sample planning, including use of Sample Planning Module, and coordinate delivery of bottleware from the project laboratories for the dredging sampling events.
- Notify TVA Technical Liaison/Quality Officer and Environmental Standards Quality Assurance Program Manager about field QA situations that require corrective action.
- Maintain a database containing all environmental media sampling events.

5.7.1 Field Team Leader

The Field Team Leader will be the primary contact in the field and will be responsible for all field activities, as listed below.

- Coordination and management of all field personnel and subcontractors.
- Coordination of field sampling activities.
- Ensuring field procedures are followed to achieve the DQOs.
- Perform review of field notebooks/logs with respect to completeness, consistency, and accuracy.
- Coordinate delivery of samples to the project laboratories for analysis.

5.7.2 Field Teams

The Field Teams are responsible for the performance of field activities as required by the KIF Monitoring Plan for Phase I Dredging. Field teams will document compliance with project documents through recording activities/observation in the field in a field logbook. In addition, field teams will be responsible for collection of samples, submission of samples to the laboratory, and completion of Chain-of-Custody Records.

5.8 TVA Records Custodian

The TVA Records Custodian is responsible for maintaining all project files. The TVA Records Custodian will receive all reports for the project to be filed in the project file.

5.9 Jacobs Engineering Project Manager

Jeff Bale – Restoration Services, Inc.

The Jacobs Project Manager is responsible for oversight of the dredging and sampling efforts performed by Jacobs. The Jacobs Project Manager will serve as the liaison between operational aspects of dredging and the QA oversight personnel.

5.10 Environmental Standards Quality Assurance Manager

Rock J. Vitale; CEAC, CPC - Environmental Standards, Inc.

The Environmental Standards Quality Assurance Program Manager will oversee all quality assurance aspects of the Project. Specific tasks include:

- Review of project documents.
- Provide technical consulting on corrective action process.
- Provide technical consulting to TVA and project laboratories.
- Issue reports to TVA Environmental Project Manager and TVA Technical Liaison/Quality Officer.
- Initiate performance and on-site audits with the project laboratories.
- Provide oversight and approval of analytical data validation reports.
- Coordinate performance and on-site audits.
- Provide ongoing quality assurance reporting

5.10.1 Environmental Standards Data Validation Task Manager

Erin E. Rodgers – Environmental Standards, Inc.

The Environmental Standards Data Validation Task Manager will be responsible for assigning the validation of laboratory-produced data and issuing the data validation quality assurance report to the TVA Technical Liaison/Quality Officer and TVA Records Custodian. The Environmental Standards Data Validation Task Manager is responsible for notifying the Environmental Standards Quality Assurance Program Manager or Environmental Standards Project Manager of issues relating to the quality or validity of the data and reporting with respect to project objectives and requirements.

5.10.2 Environmental Standards Data Validator

The Environmental Standards Data Validator is responsible for performing review and validation of all project data generated by the laboratories in accordance with this QAPP, production of the data validation reports, and notification of issues to the Environmental Standards Data Validation Task Manager.

5.10.3 Environmental Standards Field Oversight Coordinator

Stephen D. Brower, P.G. – Environmental Standards, Inc.

The Environmental Standards Field Oversight Coordinator will be responsible for training and overseeing all field sampling activities, sampling handling procedures, and sample custody as required by the KIF Monitoring Plan for Phase I Dredging. The Environmental Standards Field Oversight Coordinator will work with the TVA Sampling Coordinator to ensure compliance with this QAPP and the KIF Monitoring Plan for Phase I Dredging. The Field Oversight Coordinator will perform field audits of the Field Teams during the collection of samples for this project and will assess the procedures and performance of the Field Teams relative to the requirements in this QAPP and the KIF Monitoring Plan for Phase I Dredging. The Field Oversight Officer will generate a report of findings to be distributed to the Environmental Standards Quality Assurance Program Manager, TVA Environmental Manager, and TVA Technical Liaison/Quality Officer.

5.10.4 Environmental Standards Data Manager

Dennis P. Callaghan – Environmental Standards, Inc.

The Environmental Standards Data Manager is responsible for managing all data from the project laboratories and is the main point-of-contact for data related issues. The Environmental Standards Data Manager prepares visual representation of the project data for public consumption and Agency review. The Environmental Standards Data Manager is responsible for loading EDDs containing validated/verified data received into the project database.

The Data Manager receives EDDs directly from the project laboratories after sample analysis and places them in the proper format so that they can be used during the validation/verification process. The Data Manager is also responsible for loading EDDs containing validated/verified data received into the project database.

5.11 Contract Laboratory Organization and Responsibilities

The functional roles for the laboratory are described in this subsection. From the Project perspective, the structure is designed to facilitate information exchange among the laboratory, Environmental Standards, and TVA personnel relative to planning, technical requirements, schedules, and QA/QC measures. Project information exchange specifically includes sample identification; preservation procedures; sample container requirements; sample collection procedures; decontamination protocols; and sample labeling, packing, holding times, and shipping.

Although the internal laboratory structure may differ depending on the specific contractor, key functional roles will include division management, technical direction, subcontracting coordination, data review, and data management.

5.11.1 Laboratory QA Coordinator

The Laboratory QA Coordinator will ensure conformance with authorized policies, procedures, and sound laboratory practices as necessary. The Laboratory QA Coordinator will inform the Laboratory Project Manager of any non-conformances, introduce control samples into the sample train, and establish testing lots. In addition, the Laboratory QA Coordinator will approve laboratory data before reporting or transmittal to permanent storage and will be responsible for retention of supporting information such as control charts and other performance indicators to demonstrate that the systems that produced the data were in control. The Laboratory QA Coordinator will also review results of internal QA audits and recommend corrective actions and schedules for their implementation.

The responsibilities of the Laboratory QA Coordinator will include, but not be limited to, the following:

- Administering the laboratory QA/QC program.
- Implementing QC procedures for each test parameter.
- Reviewing analytical results, including raw data, calculations, and laboratory log books.
- Monitoring proper documentation and maintenance of the records.

- Identifying and implementing training requirements for the laboratory analytical personnel.
- Overseeing QA/QC implementation at the laboratory on a daily basis.
- Identifying QA/QC problems and recommending appropriate corrective action.
- Preparing status reports (progress, problems, and recommended solutions).
- Preparing reports documenting completion of corrective actions.

5.11.2 Laboratory Project Manager

The Laboratory Project Manager will be the primary contact for the Project Team. The Laboratory Project Manager will primarily schedule project analytical requirements, monitor analytical status/deadlines, approve laboratory reports, coordinate data revisions/corrections and resubmittal of packages, and communicate sample preparation and analyses issues to the Environmental Standards Quality Assurance Program Manager and TVA Technical Liaison/Quality Officer on a real-time basis. The Laboratory Project Manager will provide direction/support for administrative and technical project staff, interface with laboratory project staff on technical issues, and QA oversight of analytical data. The Laboratory Project Manager will contact Environmental Standards Quality Assurance Program Manager if at any point there is a need to deviate from the QAPP or other sited published materials.

5.11.3 Laboratory Sample Custodian

The Laboratory Sample Custodian will receive samples from the field, sign and date Chain-of-Custody forms, record the date and time of receipt, and record the condition of shipping containers and sample containers.

The Sample Custodian will verify and record agreement or non-agreement of information on sample documents. If there is non-agreement, the Sample Custodian will record the problems/inconsistencies for the case file and will inform the Laboratory Project Manager.

The Sample Custodian will also label samples with laboratory sample numbers, place samples and spent samples into appropriate storage and/or secure areas, and monitor storage conditions.

5.11.4 Laboratory Analyst

The Laboratory Analyst is responsible for preparing and/or analyzing samples in accordance with this document and/or the applicable analytical methods. If there are problems encountered during sample preparation or analysis, the Laboratory Analyst will inform the Laboratory QA Coordinator and Laboratory Project Manager.

6.0 QUALITY ASSURANCE AND QUALITY CONTROL OBJECTIVES

This section describes the data quality objectives and associated data quality indicators used for the project. QA/QC procedures are designed to ensure high quality for all environmental data associated with this project.

6.1 General

The Data Quality Objectives (DQO) process is a series of planning steps based on a scientific method to ensure that the type, quantity, and quality of environmental data used in decision-making are appropriate for the intended application. In general, DQOs provide a qualitative and quantitative framework around which data collection programs can be designed. The qualitative aspect of DQOs seeks to encourage good planning for field investigations. The quantitative aspect of DQOs involves designing an efficient field investigation that reduces the possibility of making an incorrect decision.

Elements of the DQOs are incorporated into this QAPP, the Phase I Dredging Plan, and/or field or laboratory SOPs. There are four levels of DQOs that have been developed for this project.

- Level I: Field screening or analysis using portable instruments (*e.g.,* temperature probe). Results are often not compound specific but results are available in real time. Depending on the analysis being performed and the instrumentation used, the results may be considered qualitative, semi-quantitative, or quantitative.
- Level II: Field analysis using more sophisticated portable analytical instruments (*e.g.*, Hydrolab® instrument). There is a wide range in the quality of data that can be generated depending on the use of suitable calibration standards, reference materials, and sample preparation equipment. Results are available in real-time or typically within hours of sample collection.
- Level III: All analyses performed in an off-site analytical laboratory using USEPA approved analytical methods. These data generally do not include the level of formal documentation required under Level IV and are not subject to formal data validation. These data are typically used for engineering studies (*e.g.*, treatability testing), risk assessment (*e.g.*, toxicity testing), site investigations, and remedial design, and may be suitable for litigation/enforcement activities. Results are both qualitative and quantitative.
- Level IV: These data are generated using USEPA methods (*e.g.,* Water and Wastewater Methods and SW846 Methods) and are supported by a rigorous QA program, supporting documentation, and data validation procedures. These data are suitable for use in Site characterizations, risk assessments, enforcement/litigation activities, and design of remedial alternatives.

Level I data quality will be obtained for field screening data collected with portable instruments such as pH meters, temperature probes, which may be used for health and safety and field operational monitoring. In addition, these instruments or field test kits may be used to produce data for determining where to collect a sample to assess impacts and for field screening of samples to be designated for laboratory confirmation

analyses. A Level IV data QA program will be executed by the laboratory for the chemical analysis specified to meet the DQOs.

DQOs are assessed by monitoring QA measures, such as accuracy, precision, representativeness, comparability, and completeness, as discussed in Section 4.3. Specific qualitative DQOs for the chemical analyses to be performed in association with Phase I dredging are presented in detail in Section 14.0 and on Tables 7 and 8 of this QAPP. The objectives associated with accuracy and precision of laboratory results are assessed through an evaluation of the results of QC samples. The accuracy of field measurements for temperature and other field parameters will be assessed by calibration, as described in the sampling plan.

6.2 Field and Laboratory Quality Control Samples

The quality of data for chemical analyses will be controlled, monitored, and verified by maintaining site logs, by documenting field activities, and by collecting and analyzing of QC samples concurrently with investigative samples. Field and laboratory QC samples will be used to assess accuracy and precision to gauge both field and laboratory activities. QC samples will be used to assess laboratory performance and gauge the likelihood of cross-contamination associated with both field and laboratory activities.

The subsections below apply to chemical analyses performed on surface water and sediment (ash) samples associated with the Phase I dredging. The quality of toxicity testing data will be controlled in accordance with the laboratory QA/QC program, laboratory SOPs, and the methods developed for this project. The KIF Monitoring Plan for Phase I Dredging and the associated laboratory SOPs detail the toxicological evaluations that will be performed in association with Emory River dredging.

QC samples will be collected and analyzed in conjunction with samples designated for laboratory analysis using US EPA methods. Standard analytical QC checks that may be instituted by field and laboratory personnel will include, but not be limited to, the following:

- Equipment Rinsate Blanks
- Field Duplicate Samples
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples
- Laboratory Method Blanks
- Laboratory Control Samples
- Laboratory Duplicate Samples
- Temperature Blanks

These types of QC samples are discussed in the following subsections. Field QC samples will be submitted to the laboratory using the same information as the associated investigative samples.

6.2.1 Equipment Rinsate Blanks

Analyte-free reagent water will be poured into/through/over clean sampling equipment used in the collection of investigative samples and subsequently collected into prepared sample bottles. For vibracore sampling, analyte-free reagent water will be poured through Lexan® tubing. Preservatives or additives will be added as required and the

sample bottle will be sealed. The rinsate blanks will be collected at a rate of one blank/day. The rinsate blank will be analyzed for the same parameters as the investigative samples.

6.2.2 Field Duplicate Samples

Field duplicate samples are used to check for sampling and analytical error, reproducibility, and homogeneity. For Phase I dredging, one duplicate sample will be collected per 10 samples per sample matrix. For sediment samples, the duplicate will be obtained by collecting a sample from an area adjacent to the routine sample or by collecting a separate aliquot of sediment from within the same core (*i.e.*, co-located sample), whichever is more appropriate for the type of sample/sampling technique (*i.e.*, surface or subsurface sediment sample). Duplicates will be analyzed for the same parameters specified for the associated investigative samples.

6.2.3 Matrix Spike/Matrix Spike Duplicate Samples

Matrix spike/matrix spike duplicate (MS/MSD) samples are investigative samples to which known amounts of compounds are added in the laboratory before extraction/digestion and analysis. The recoveries for spiked analytes can be used to assess how well the method used for analysis recovers target analytes in the site-specific sample matrix. For Phase I dredging, at least one set of MS/MSD samples will be collected and analyzed for each 10 field samples collected. The laboratories will prepare and analyze one set of MS/MSD samples for every batch of 10 (or fewer) samples associated with Phase I dredging. The laboratories will utilize a project sample for the MS/MSD pair for every batch that includes a project sample. For metals analyses, a laboratory duplicate (described in Section 6.2.6) may be substituted for a MSD.

6.2.4 Laboratory Method Blanks

Method blanks consist of analyte-free materials (*e.g.,* reagent water) and reagents (*e.g.*, sodium sulfate) that are prepared in the same manner as the associated samples (*i.e.,* digested, extracted, *etc.*) and that are analyzed and reported in the same manner as the associated investigative samples. Laboratory method blanks will be performed as indicated in the analytical method and in Appendices C and D.

6.2.5 Laboratory Control Samples

A Laboratory Control Sample (LCS) is a sample of laboratory certified material that is fortified (spiked) with the analytes of interest or a certified reference material that is prepared and analyzed in the same manner as investigative samples. The LCS must be from a source that is different from the source of the initial calibration standards (*i.e.*, second-source). LCS data are used to monitor analytical accuracy and laboratory performance. LCSs are prepared and analyzed with each preparation batch of 20 (or less) field samples. LCS will be performed as indicated in the analytical method and in Appendices C and D.

6.2.6 Laboratory Duplicate Samples

A duplicate sample is obtained by splitting a field sample into two separate aliquots and performing separate preparation and analysis on the respective aliquots. The analysis of laboratory duplicate samples monitors precision; however, precision may be affected by sample homogeneity, particularly in the case of solid samples. Laboratory duplicates will be analyzed and reported with every batch of 20 (or fewer) field samples. The laboratory will utilize a project sample for the laboratory duplicate in every batch that includes project samples.

7.0 FIELD INVESTIGATION PROCEDURES

The information presented in this QAPP encompasses the work associated with Phase I dredging at the Kingston Fossil Plant site. The Phase I dredging activities are a subset of the site-wide investigation, characterization, and remediation activities at the Kingston Fossil Plant site and are subject to the requirements set forth in the site-wide QAPP and the site-wide FSP. The information provided below is intended as a general overview of internal QA/QC procedures as specifically related to Phase I dredging activities.

Descriptions of the procedures for the sampling, identification, packaging, and handling of project samples; the decontamination of sampling equipment; and the maintenance of sampling equipment are presented in the Phase I Dredging Plan, the KIF Monitoring Plan for Phase I Dredging, and the field SOPs associated with a particular activity. The Phase I Dredging Plan presents site maps, including sampling locations. A description of the field sampling process design and an overview of field sampling activities associated with the Phase I dredging, including sampling frequency, is provided in the KIF Monitoring Plan for Phase I Dredging.

Surface water and sediment (ash) samples will be collected to support monitoring activities and biological health impact assessment associated with the Phase I dredging. In addition to routine chemical analyses (as described in Section 10.0), sediment samples will be collected for toxicological testing as described in the KIF Monitoring Plan for Phase I Dredging. In addition, routine sampling activities (such as air monitoring) may be performed concurrently with dredging operations; where possible, data generated from ongoing sampling activities will be used to monitor the impact of dredging operations on the site. Routine sampling activities are addressed in the site-wide QAPP and FSP.

Field investigation and sampling procedures will be conducted such that samples are representative of the media sampled and the resultant data can be compared to other data sets. The sampling plan (as described in the KIF Monitoring Plan for Phase I Dredging) has been designed to provide a statistically meaningful number of field sampling points and the rationale for the collection of these samples. Where chemical levels may vary with location, a sufficient number of samples will be collected to characterize the area. The number of samples anticipated to be collected in association with Phase I dredging activities is addressed in the KIF Monitoring Plan for Phase I Dredging. The KIF Monitoring Plan for Phase I Dredging, in conjunction with the site-wide QAPP and FSP, will be employed to implement the field investigation and sampling methods, including equipment requirements and decontamination procedures, required for to meet the DQOs of the project.

7.1 KIF Monitoring Plan for Phase I Dredging and/or Field Standard Operating Procedures

The overall investigative rationale and specific sampling and analytical program associated with the Phase I dredging are addressed in the KIF Monitoring Plan for Phase I Dredging and/or the associated field SOPs. The SOPs required for all sample collection activities will be included in the site-wide FSP.

7.2 Sample Containers, Preservation, and Holding Times

Sediment samples intended for toxicological monitoring use will be collected and stored in accordance with the TVA toxicological monitoring program requirements, laboratory SOPs, and analytical methods currently under development for this project. Sufficient sample volume will be collected to allow the full suite of testing described in the KIF Monitoring Plan for Phase I Dredging. Detailed sample collection protocol, including specific sample volume and preservation requirements, will be provided as part of the site-wide QAPP.

Samples for chemical analyses will be contained and preserved in accordance with appropriate US EPA specifications. For each parameter, the required type of container, volume of sample, sample temperature, type and concentration of preservative, and analytical holding times are specified on Tables 1, 2, and 3. Sampling containers and preservatives will be provided by the laboratory. For chemical analyses, sample containers provided will be new, pre-cleaned I-Chem® Series 300 or equivalent. Any shipping container received at the laboratory with broken custody seals will be considered compromised and will not be used. Samples will be placed in individual pre-cleaned containers for shipment to the laboratory.

Sample container orders, when shipped by the laboratory, will include a packing list that details the number and type of bottles shipped, the bottle lot numbers, chemical preservatives, and the packer's signature. The Chain-of-Custody records will be completed by field sampling personnel and returned to the laboratory with the samples. After the cooler is sealed, sampling personnel will attach signed/dated custody seals to the outside of the cooler as described in the associated field SOPs.

Samples will be stored according to the applicable storage criteria from the time of collection until the time of analysis by the laboratory. Field personnel will keep samples cold using ice and coolers, in which samples will be stored until delivery to the analytical laboratory personnel. After receipt of the samples, it is the laboratory's responsibility to store the applicable samples (Tables 1, 2, and 3) at $\leq 6^{\circ}C$ until preparation and analysis has been initiated.

Samples have a finite holding time (the time between sample collection, sample digestion, and sample analysis) to limit the potential for degradation of the analytes. Sample holding times specified on Tables 1, 2, and 3 must be met unless otherwise dictated by the analytical method. The holding times for required analyses are measured from the verified time of sample collection. When possible, samples will be shipped by overnight carrier or delivered by same-day courier to minimize the time between collection and laboratory receipt.

7.3 Decontamination

Tools and equipment decontamination procedures are implemented to prevent cross-contamination of samples and to control potential inadvertent transport of hazardous constituents. Personnel decontamination procedures are designed to prevent personnel exposure to chemicals. Disposable sediment sampling equipment will be utilized to the extent possible in an effort to limit the potential for cross-contamination and to reduce labor/ disposal costs. The non-disposable equipment will be decontaminated using the procedures described in the associated field SOP.

8.0 SAMPLE IDENTIFICATION, DOCUMENTATION, AND CUSTODY

Field sampling personnel are responsible for the collection, description, documentation, labeling, packaging, storage, handling, and shipping of samples obtained in the field. These practices are necessary to ensure sample integrity from collection through laboratory analysis and data reporting. To meet the DQOs of this QAPP, all information relative to the collected project samples will be properly described, documented, labeled, packaged, preserved, and shipped to the laboratories for analysis in appropriate sample containers, under the recommended temperature conditions with a Chain-Of-Custody Record documenting the time and day of sample collection.

The sample naming convention for sediment and aqueous samples collected for chemical analyses is as follows.

Sample ID: [site]-[location]-[matrix code]-[date]
e.g, KIF-ERM 1.0-SW-010109

[site]	KIF = Kingston Fossil Plant
[location]	CRM = Clinch River Mile
	ERM = Emory River Mile
	TRM = Tennessee River Mile
[matrix code]	SW = surface water
	SD = sediment
[date]	date in DDMMYY format

Laboratory-supplied sample kits with custody seals, packing materials, and US EPA-recommended sample containers and preservation methods presented on Tables 1, 2, and 3 will be used for all Project samples during sample collection and transport to the fixed laboratory. In some instances, the laboratory may supply their own Chain-of-Custody Records in the sample kits.

8.1 Sample Chain-of-Custody

Laboratory evidentiary files will be maintained by the TVA Sampling and Monitoring Coordinator and will include information that defines the Project in its entirety, including but not limited to:

- Field logbooks
- Raw data
- QC information
- Chain of Custody (COC) Records
- Airbills (when used) for sample shipments
- Photographs

8.1.1 Chain-of-Custody Record

A primary consideration for environmental data is the ability to demonstrate that samples have been obtained from specific locations and have reached the laboratory without alteration. Evidence of collection, shipment, laboratory receipt, and laboratory custody

until disposal will be documented by maintaining a Chain-of-Custody that records each sample and the individuals responsible for sample collection, shipment, and receipt at the project laboratory. Samples that are collected will be accompanied by a Chain-of-Custody Record. The following information will be recorded to complete the Chain-of-Custody Record:

- Project name and number.
- Name or initials of sampler.
- Sample identifier/name, location, date and time collected, and sample type.
- Analyses requested.
- Special instructions and/or sample hazards, if applicable.
- Signature of sampler in the designated blocks, including date, time, and company.
- Sample condition (including temperature) upon receipt as reported by the analytical laboratory.

Chain of Custody Records will be initiated using the Earthsoft® EQuIS® Sample Planning Module (SPM). SPM procedures, including an example Chain of Custody Record, are addressed in the site-wide QAPP and FSP. Copies of all Chain of Custody Records are maintained onsite by the TVA Sampling and Monitoring Coordinator. Duplicates of all Chain of Custody Records are retained by the TVA Records Custodian as part of the Project File.

8.1.2 Sample Custody in the Field

The purpose of sample custody procedures is to document the history of samples (and sample extracts or digestates) from the time of sample collection through shipment, analysis, and disposal. A sample is considered to be in one's custody if one of the following conditions applies:

- The sample is in an individual's actual possession.
- The sample is in view after being in an individual's physical possession.
- The sample is in a tamper-evident container or locked storage after having been in an individual's physical possession.

Each individual field sampler is responsible for the care and custody of samples he/she collects until the samples are properly transferred to temporary storage or are shipped to the laboratory. The following Chain-of-Custody procedures will be followed for samples submitted to the laboratory for analyses:

- A Chain-of-Custody Record will be completed by the sampler for samples collected and submitted to the laboratory.
- Each time the samples are transferred, the signatures of the person relinquishing and the person receiving the samples, as well as the date and time of transfer, will be documented.
- Sample coolers will be sealed with custody seals (signature across seal) for shipment from field to laboratory.
- A copy of the carrier airbill (when applicable) will be retained as part of the permanent Chain-of-Custody documentation.
- The laboratory will record the condition of sample containers (including

custody seal condition) and sample temperature upon receipt.

Changes or corrections to the information documented by the Chain-of-Custody Record (including, but not limited to, field sample ID or requested analyses) must be changed, dated, and initialed by the person making the change. If the request for a change or correction comes from the Field Team after the COC Records have been relinquished to the laboratory, a copy of the Chain-of-Custody Record will be revised, initialed, and forwarded to the laboratory, where the revised version will supersede the original Chain-of-Custody Record. The original Chain-of-Custody Record and any documented changes to the original record will be included as part of the final analytical report to the TVA Technical Liaison/Quality Officer. This record will be used to document sample custody transfer from the sampler to the laboratory and will become a permanent part of the project file.

At the end of each day samples are collected or at the end of the sampling event, sample coolers with appropriate custodial seals will be shipped (over-night delivery) to the contract laboratory.

8.2 Sample Custody in the Laboratory

The following subsections describe the Chain-of-Custody procedures associated with sample receipt, storage, tracking, and documentation by the laboratory.

8.2.1 Sample Receipt

A designated Laboratory Sample Custodian will be responsible for samples received at the laboratory. The Laboratory Sample Custodian will be familiar with custody requirements and the potential hazards associated with environmental samples. In addition to receiving samples, the Laboratory Sample Custodian will also be responsible for documenting sample receipt, storage before and after sample analysis, and the proper disposal of samples. Upon sample receipt, the Sample Custodian will:

- Inspect the sample containers for integrity and ensure that custody seals are intact on the shipping coolers. The temperature of the samples upon receipt and the presence of leaking or broken containers will be noted on the Chain-of-Custody Record/sample receipt forms.
- Sign (with date and time of receipt) the Chain-of-Custody/sample analysis request forms, thereby assuming custody of the samples and assign the laboratory sample identification numbers.
- Compare the information of the Chain-of Custody Record/sample receipt with the sample labels to verify sample identity. Any inconsistencies will be resolved with the Field Team before sample analysis proceeds.
- Store samples in accordance with Section 8.2.2.

8.2.2 Sample Storage

Analytical samples will be stored in a refrigerator, in a locked facility, and maintained within the appropriate temperature range as specified in US EPA and/or 40 CFR sample storage guidelines. The temperature will be monitored and recorded daily in a bound logbook by laboratory personnel. The sample storage conditions for the various matrices are presented below.

Sample Matrix	Storage Temperature Acceptance Criterion
aqueous	≤6°C
solid	≤6°C

Following analysis, any unused sample weight for sediment samples will be returned to TVA for storage in an onsite sample archive. Samples may be retrieved from the archive for analysis in the event that data quality objectives are not met for a particular sample.

8.2.3 Sample Tracking

Each sample will receive a unique laboratory sample identification number at the laboratory when the sample is logged into the laboratory information management system.

A sample digestion record will be prepared. Laboratory data will be entered on the sample digestion form and permanently recorded in a laboratory logbook.

The laboratory will maintain a sample tracking system that documents the following:

- Organization/individual who performed sample analyses.
- Date of sample receipt, extraction or digestion, and analysis.
- Names of analysts.
- Sample preparation procedures.
- Analytical methods used to analyze the samples.
- Calibration and maintenance of instruments.
- Deviations from established analytical procedures, if applicable.
- QC procedures used to ensure that analyses were in control during data generation (instrument calibration, precision checks, method standards, method blanks, *etc.*).
- Procedures used for the calculation of precision and accuracy for the reported data.
- Statement of quality of analytical results.

8.2.4 Record-keeping

This QAPP will be distributed to each contractor responsible for the collection, generation, and interpretation of field and analytical data. The Environmental Standards QAM will be responsible for ensuring that necessary revisions are made so that the QAPP is up-to-date with actual practices. The TVA Document Management will ensure that QAPP revisions and updates are distributed. The document control format used in this QAPP will identify the QAPP revision number and revision date. A QAPP revision history will be maintained that identifies each revision and a summary of the revision.

Analytical data for this project will be reported in both an electronic data deliverable (EDD) and an analytical hardcopy package. To maintain uniformity and consistency among contract laboratories, TVA, and Environmental Standards, the EDD format for the transfer of all project related data will be EarthSoft's EQuIS®. The EQuIS data transfer parameters are discussed further in Appendix B. The EDD will be generated by the laboratories and will be used by the Environmental Standards Data Manager and the TVA Data Manager to facilitate loading the analytical data into the Project database.

Analytical data packages will be prepared by the laboratory for all sample analyses performed. A limited data deliverable (Appendix A) in Adobe® Acrobat® .pdf format and hardcopy and an EQuIS EDD (Appendix B) will be provided by the contract laboratory within 5 business days of sample receipt. Full deliverables (Appendix A) will be provided by the laboratory in EQuIS in an Adobe Acrobat .pdf electronic format and hardcopy for all analyses within 10 business days of sample receipt. The limited deliverable will be provided to the TVA Technical Liaison/QA Officer and Environmental Data Validation Task Manager. A complete hardcopy will also be provided to the Environmental Standards Data Validation Task Manager for data validation. A summary of results will be provided to other necessary personnel for us in checking the project analytical database against hardcopy results or other preliminary evaluation.

Appropriate records will be maintained to provide adequate documentation of the entire data generation process, including field sampling and laboratory analysis. Field sampling records will include maintaining field logs and sample Chain-of-Custody documentation. Field QA/QC samples will be documented on both the field log and sample Chain-of-Custody Records.

The final project file will be the central repository for documents relevant to sampling and analysis activities as described in this QAPP. The TVA Records Custodian will maintain the files for this Project, including all relevant records, correspondence, reports, logs, data, field records, pictures, subcontractor reports, analytical data, and data reviews. The file will include the following information if generated:

- Field records
- Field data and data deliverables
- Photographs
- Drawings
- Sample logs
- Laboratory data deliverables
- Data validation reports
- Field and laboratory audit reports
- Progress reports, QA reports
- Custody documentation

8.3 Sample Packaging and Shipment

Samples will be packed and shipped to the laboratory in accordance with applicable US Department of Transportation (US DOT) regulations, consulting corporate guidelines, and International Air Transport Association (IATA) standards (as detailed in the most current edition of *IATA Dangerous Goods Regulations* for hazardous materials shipments), as applicable.

8.4 Sample Archive

Unused portion of sediment samples collected in association with the Kingston Ash Recovery Project will be returned to TVA for onsite archive. Archiving procedures are described in detail in the site-wide QAPP.

9.0 CALIBRATION PROCEDURES

This section provides the requirements for calibration of measuring and test equipment/instruments used in field sampling and laboratory analysis. The calibration procedures stipulated in this QAPP are designed to ensure that field equipment and instrumentation are calibrated to operate within manufacturer specifications and that the required traceability, sensitivity, and precision of the equipment/instruments are maintained. Measurements that affect the quality of an item or activity will be taken only with instruments, tools, gauges, or other measuring devices that are accurate, controlled, calibrated, adjusted, and maintained at predetermined intervals to ensure the specified level of precision and accuracy.

9.1 Field Equipment Calibration and Procedures

Field instruments that may be used include, but are not limited to, the following:

- Hydrolab® Intstrument;
- Specific Conductance Meter/Temperature Probe;
- pH Meter;
- Turbidimeter;
- Oxidation Reduction Potential Meter;
- Dissolved Oxygen Meter;
- Water Flow Meter; and
- Water Level Meter.

All field analytical equipment will be calibrated immediately prior to each day's use or at the frequency specified by the instrument manufacturer. The calibration procedures of field instruments will conform to manufacturer's standard instructions to ensure that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. Personnel performing instrument calibrations shall be trained in its proper operation and calibration. Records of all instrument calibration will be maintained by the Field Team Leader in the field logbook and will be subject to audit by the Environmental Standards Field Oversight Coordinator. The Field Team Leader will maintain copies of all the instrument manuals on-site.

The daily calibration records will contain the following information in the field logbook:

- Instrument name and identification number;
- Name of person performing the calibration;
- Date of calibration;
- Calibration points;
- Results of the calibration;
- Manufacturer lot number of the calibration standards; and
- Expiration dates for the calibration standards, where applicable.

Field equipment will be properly inspected, charged, and in good working condition prior to the beginning of each working day. Prior to the start of each working day, the Field Team Leader will inspect equipment to ensure its proper working condition. Field equipment and instruments will be properly protected against inclement weather conditions during the field work. At the end of each working day, field equipment and

instruments will be properly decontaminated, taken out of the field, and appropriately placed for overnight storage and/or charging.

Calibration checks may suggest the need for maintenance or calibration by the manufacturer. Field instruments that do not meet the calibration requirements will be taken out-of-service until acceptable performance can be verified. Maintenance should be performed when the instrument will not adequately calibrate. Maintenance of field equipment should be noted in an instrument logbook or field notebook.

Field equipment calibration is addressed greater detail in the site-wide Field Sampling Plan and the SOPs associated with each field investigation or monitoring activity.

9.2 Laboratory Equipment Calibration

Instruments and equipment used in the laboratory will be controlled by a formal calibration program. The program will verify that the equipment has the proper calibration range, accuracy, and precision to generate data comparable with specific requirements. All calibration will be performed by laboratory personnel experienced in the referenced methods for the analysis of project samples for the constituents of concern.

The laboratory will provide all data and information to demonstrate that the analytical system was properly calibrated at the time of analysis, including calibration method, required frequency, and source of standards, response factors, linear range, check standards and applicable control limits, as part of the data deliverables.

Before any instrument is used as a measuring device, the instrument's response to reference materials must be determined. The manner in which various instruments are calibrated is dependent on the particular type of instrument and its intended use. Preparation of reference materials used for calibration will be documented in a laboratory notebook.

The two types of laboratory instrument calibration are initial calibration and continuing calibration verification. Initial calibration procedures establish the calibration range of the instrument. Typically, multiple analyte concentrations are used to establish the calibration range and calibration data. The laboratory evaluates the resulting calibration data as detailed in the associated SOP.

Continuing calibration verification usually measures the instrument's response to fewer calibration standards and requires instrument response to fall within certain limits of the initial measured instrument response. Continuing calibration verification may be used within an analytical sequence to verify stable calibration throughout the sequence and/or to demonstrate that instrument response did not drift during a period of non-use of the instrument.

The QA/QC measures in the associated SOP will be used for calibration, calibration verification, and subsequent sample analyses. In addition, the following procedures will be used for the calibration of balances and thermometers.

Laboratory balances will be calibrated and serviced annually by a certified external contractor. Balances will undergo a calibration check prior to use each day using multiple S-Class or equivalent class weights that bracket the usage range. A record of calibrations and daily checks will be maintained in the balance logbook.

Oven and refrigerator thermometers will be calibrated annually against a NIST-certified thermometer in the range of interest. Annual calibrations will be recorded in a calibration notebook. Daily oven and refrigerator readings will be recorded. Thermometers must be tagged with any applicable correction factors.

Records will be maintained as evidence of required calibration frequencies, and equipment will be marked suitably to indicate calibration status. If marking on the equipment is not possible, records traceable to the equipment will be readily available for reference.

10.0 ANALYTICAL PROCEDURES

Routine analytical services are performed using standard US EPA-approved methodology. Analytical methods cited in this QAPP reference *The Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (US EPA SW-846) and US EPA Office of Water Methods. For the chemical analyses associated with Phase I dredging, the analytical methods selected and the project-required reporting limits are presented on Tables 4, 5, and 6. Individual sample reporting limits may vary from the laboratory's routinely reported limits; this variance may be a result of dilution requirements, sample weight or volume used to perform the analysis, dry-weight adjustment for solid samples, the presence of analytical background contaminants, or other sample-related or analysis-related conditions.

10.1 Field Analysis

Surface water samples will be monitored for the following field parameters using Hydrolab® instruments as summarized below. Detailed descriptions of field monitoring activities are provided in the KIF Monitoring Plan for Phase I Dredging:

- Continuous monitoring of temperature, dissolved oxygen, conductance, pH, and turbidity by Hydrolab instruments deployed from five floating platforms in the river and intake channel.
- Daily field monitoring via boat using Hydrolab instruments to locate turbidity plumes.

10.2 Laboratory Analysis

The laboratory will perform a percent moisture analysis on each sediment sample in accordance with US EPA SW-846 procedures for determining dry sample weight. The analytical data for solid matrices will be reported on a dry-weight basis.

In some instances, results may be reported between the reporting limit and method detection limit (MDL). When results are reported between the reporting limit and MDL, those results will be reported as estimated values.

TVA has established a standard turn-around-time (TAT) of 5 business days from sample receipt at the laboratory for all parameters, with the exception of TSS (which will require 24 hour TAT). Sample analyses will be complete and results reported to TVA and Environmental Standards within the 5 business days. The full data package and EDD will be submitted to TVA and Environmental Standards within 10 business days from sample receipt at the laboratory.

10.2.1 Analytical Methods

As part of the evaluation of the potential presence of site-related constituents, the collected samples will be tested for the constituents listed on Tables 4, 5, and 6. Dissolved metals analysis of surface water samples shall be performed on field-filtered (0.45-μm filter) water samples. The laboratory SOPs for the performance of the analytical methodology associated with the Phase I dredging are included along with all other laboratory SOPs in the site-wide QAPP. These SOPs are intended for use on this

project and other uses are not permitted unless expressly permitted by the analytical laboratory.

10.3 Toxicological Analysis

As part of the evaluation of the potential biological impact of Emory River channel dredging and related activities, freshwater organisms will be used to conduct the following toxicity tests.

- Whole Sediment toxicity evaluation
- Elutriate toxicity evaluation
- Plume toxicity evaluation
- Polymer toxicity evaluation

A description of the toxicological assessment associated with dredging is presented in the KIF Monitoring Plan for Phase I Dredging. The laboratory SOPs for the performance of the toxicological analyses associated with dredging are included along with all other laboratory SOPs in the site-wide QAPP. These SOPs are intended for use on this project and other uses are not permitted unless expressly permitted by the analytical laboratory.

11.0 DATA REDUCTION, VALIDATION, AND REPORTING

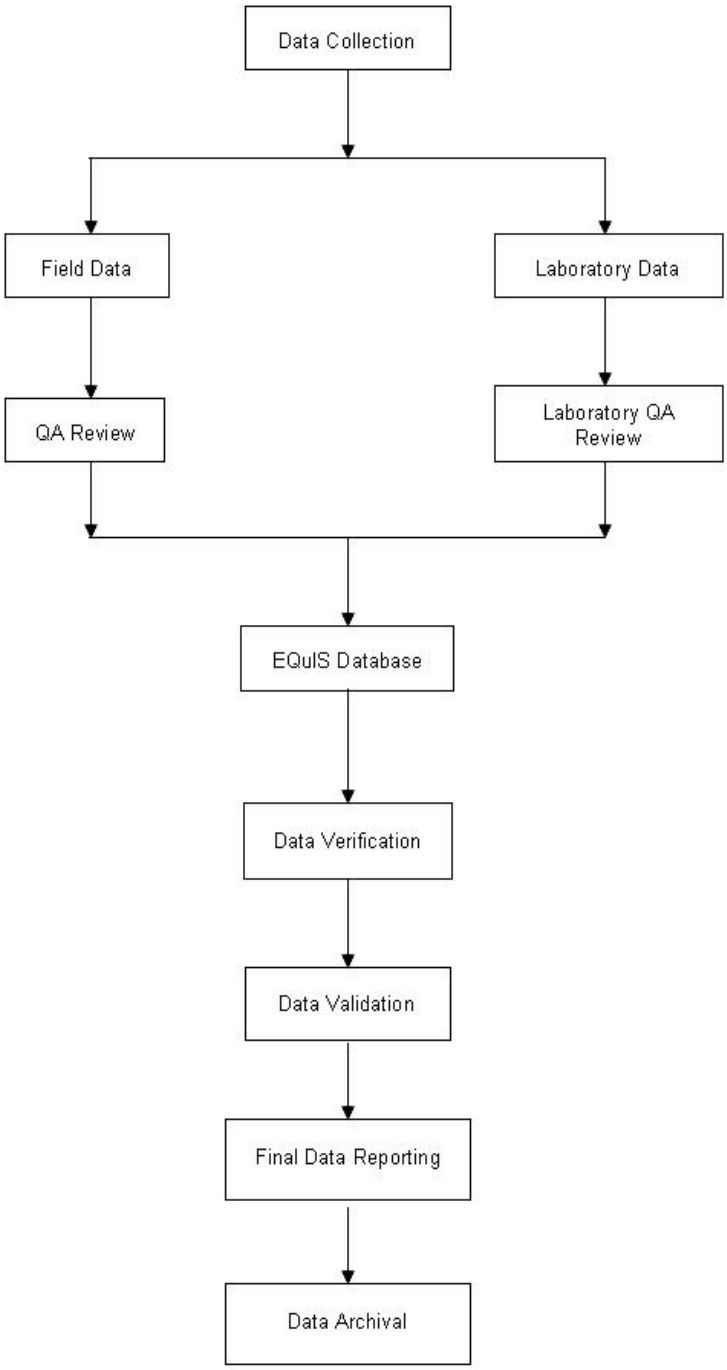
Data validation is a process used to determine if data are accurate, complete, and meet specified criteria (ANSI, 2000). Data validation objectives are as follow:

- Produce data with values that are validated and of a known quality.
- Evaluate the internal, spatial, temporal, and physical consistency of the data.
- Inter-compare data to identify errors, biases, or outliers. (US EPA, 2003)

The data validation process will consist of data generation, reduction, and review of both field data and laboratory analytical data. The results of the validation will be included with the original hardcopies of the data and will be maintained in the project file. The data will be recorded in the site database.

A flow diagram depicting the general relationship of data collection, reduction, validation, management, and reporting is shown in Figure 11-1.

FIGURE 11-1: DATA MANAGEMENT FLOW CHART



11.1 Field and Technical Data

The field (i.e. non-laboratory) data that will be collected during the field effort can generally be characterized as either “objective” or “subjective” data. Objective data include direct measurements of field data such as field screening/analytical parameters and water-level measurements. Subjective data include descriptions and observations such as descriptions of sampling locations and conditions and physical descriptions of samples.

Field data collected during the field activities will be evaluated for usability by conducting a QA review, which will consist of checking the procedures used and comparing the data to previous measurements. Field QC samples will be evaluated to ensure that field measurements and sampling protocols have been observed and followed. The field data will be reviewed by the TVA Sampling Coordinator for the following:

- Use of standard operating procedures (SOPs)
- Calibration method and frequency
- QC lot number
- Date and time sampled
- Preservation
- Samplers
- Comparisons to laboratory results
- Chain-of Custody records
- Date shipped

11.1.1 QA Data Review

The QA review for usability of objective field and technical data will be performed at two levels. For the first level, data will be reviewed at the time of collection by following standard procedures and QC checks. For the second level, after data reduction to table format or arrays, the data will be reviewed for anomalous values.

Any inconsistencies or anomalies identified during data review will be investigated by the TVA Sampling Coordinator. When possible, the TVA Sampling Coordinator will seek clarification from the field personnel responsible for collecting the data. Resolution of discrepancies will be documented using the corrective action process detailed in Section 15.0.

Field data will be reviewed for reasonableness and completeness. In addition, random checks of sampling and field conditions will be made to check recorded data at that time to confirm the recorded observations. Whenever possible, peer review will also be incorporated into the QA review process in order to maximize consistency among field personnel.

11.2 Laboratory Data Documentation

Analytical laboratories performing work on this project will retain records of the analytical data for a minimum of 10 years after project completion. Analytical data will not be disposed without TVA’s consent. In addition, all laboratory data will be provided to TVA in hardcopy form; TVA will retain hardcopy data indefinitely following project completion.

11.2.1 Data Reduction

Data reduction is performed by the individual analysts and consists of calculating concentrations in samples from the raw data obtained from the measuring instruments. The complexity of the data reduction is dependent upon the specific method and the number of discrete operations (*i.e*., extractions/ digestion, dilutions, and levels/concentrations) involved in obtaining a sample that can be measured.

For all analytical methods, sample response will be applied to the average response factor or the regression line to obtain an initial raw result, which will then be factored into equations to obtain the estimate of the concentration in the original sample. Rounding will not be performed until after the final result has been obtained to minimize rounding errors; results will not normally be expressed in more than three significant figures.

Copies of raw data and calculations used to generate the final results will be retained on file to allow reconstruction of the data reduction process at a later date.

11.2.2 Laboratory Data Review

System reviews are performed at all levels. The individual analyst constantly reviews the quality of data through calibration checks, QC sample results, and performance evaluation samples. These reviews will be performed prior to submission to the Laboratory Project Manager.

Criteria for analytical data review/verification include checks for internal consistency, transmittal errors, laboratory protocol, and laboratory QC. QC sample results and information documented in field notes will be used to interpret and evaluate laboratory data. The laboratory QA Department will independently conduct a complete review of selected reports to confirm analytical results.

The laboratory will complete data verification procedures, including:

- Verifying analyses requested were analyses performed.
- Preliminary data proofing for anomalies-investigation and corrections, where possible.
- Reviewing laboratory data sheets for reporting/detection limits, holding times, surrogate recovery performance, and spike recovery performance.
- Double-checking computerized data entry, if applicable.

The Laboratory Project Manager will review data for consistency and reasonableness with other generated data and determine whether project requirements have been satisfied. Selected hardcopy output of data (chromatograms, spectra, integrations, *etc.*) will be reviewed to ensure that results are interpreted correctly. Unusual or unexpected results will be reviewed, and a determination will be made as to whether the analyses should be repeated. In addition, the Laboratory Project Manager may recalculate selected results to verify the calculation procedure.

The Laboratory QAM will independently conduct a complete review of the Project data to determine whether laboratory and QAPP analytical requirements have been met. Discrepancies will be reported to the Laboratory Project Manager for resolution.

Prior to final review/signoff by the Laboratory Project Manager, the laboratory personnel will verify that the report deliverable is complete and in proper format, screen the report for compliance to laboratory and QAPP requirements, and ensure that the Case Narrative addresses any noted deficiencies. The Laboratory Project Manager will perform the final laboratory review prior to reporting the results to Environmental Standards and TVA. Any discrepancies noted during laboratory review that result in sample reanalysis or data correction must be documented using the corrective action procedure addressed in Section 15.0.

11.2.3 Data Reporting/Deliverable Package

The laboratory will be responsible for providing an approved electronic data deliverable (EDD, see Appendix B) as well as a hardcopy report (see Appendix A). The deliverable package will contain final results (uncorrected for blanks and recoveries), analytical methods, detection limits, surrogate recovery data, method blank data, and results of QC samples. In addition, special analytical problems and/or any modifications of referenced methods will be noted. The number of significant figures reported will be consistent with the limits of uncertainty inherent in the analytical method. Data are normally reported in units commonly used for the analyses performed. Concentrations for liquid samples are expressed in terms of weight per unit volume (*e.g.,* milligrams per liter [mg/L]). Concentrations for solid samples are expressed in terms of weight per unit weight of sample (*e.g.*, milligrams per kilogram [mg/kg]).

In addition, 100% of the data will be reported in full documentation data packages for independent data validation. The format for the data package is provided in Appendix A.

QC results reported will include a method blank, matrix spike/matrix spike duplicate (MS/MSD) samples, field QC samples, and laboratory control samples (LCSs). Sample data results (including QC sample results) will also be provided in the electronic format. The laboratory is responsible for reviewing the electronic data to ensure that these data are consistent with hardcopy CLP-like results. Data discrepancies between the EDD submission and hardcopy results, if any, will be reconciled at validation and the contract laboratory and TVA will be informed by the Environmental Standards QAM so that changes are made and the final hardcopy reports made consistent with the EDD and archived by TVA.

11.3 Data Review and Validation

The purpose of analytical data validation is to eliminate unacceptable data and to qualify data for any data quality limitations identified during validation. In addition to the laboratory QA review, the CLP-like reports will be evaluated and validated by Environmental Standards for the following:

- Compliance with requested testing requirements
- Completeness
- Reporting Accuracy (including hardcopy to EDD)
- Confirmation of receipt of requested items
- Traceability, sensibility, and usability of the data

In addition to the above criteria, the data will be validated with guidance from the National Functional Guidelines for Organic Data Review (US EPA, October 1999); the National Functional Guidelines for Inorganic Data Review (US EPA, October 2004); the US EPA Region IV Data Validation Standard Operating Procedures for Contract Laboratory Program Routine Analytical Services (Rev. 2.1; July 1999); and the US EPA Region IV Data Validation Standard Operating Procedure for Organic Analysis (Revision 3.1, June 2008); and the US EPA Region IV Data Validation Standard Operating Procedure. It should be noted that these guidelines are not completely applicable to the US EPA and SW-846 methods referenced herein; consequently, professional judgment will be used to evaluate data usability. A data validator with the appropriate experience and expertise, at the direction of the Environmental Standards Data Validation Task Manager, will have a completeness review performed within 5 business days of receipt of each data package. Complete data validation and generation of reports will be accomplished within 10 business days of the receipt of the complete data package. Analytical data from fixed laboratories will be rejected and otherwise qualified with guidance on the National Functional Guidelines referenced above. The data validation qualifiers listed below will be used for all project samples:

- Organic Data Validation Qualifiers

U*	This result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level.
R	Unusable result; compound may or may not be present in sample
J	Quantitation is approximate due to limitations identified during data validation.
UJ	This compound was not detected, but the reporting limit should be considered estimated due to a bias identified during data validation.

- Inorganic Data Validation Qualifiers

U*	This result should be considered “not detected” because it was detected in a rinsate blank or laboratory blank at a similar level.
R	Unusable result; analyte may or may not be present in sample
J	Quantitation is approximate due to limitations identified during data validation.
UJ	This analyte was not detected, but the reporting limit may or may not be higher due to a bias identified during data validation.

11.4 Data Management

A copy of the Chain-of-Custody Record will be delivered to the TVA QA Officer and TVA Records Custodian, for inclusion in the project files. Upon receipt and log-in of the samples at the laboratory, the remaining sections of the Chain-of Custody Record (*e.g.*, description of the sample condition at the time of receipt, assigned laboratory identification number, and any special conditions) will be completed. Discrepancies will be documented by the laboratory, and the Field Team Leader will be notified.

The field Chain-of-Custody Record information will be initially keyed into and maintained in the laboratory’s database. A copy of the laboratory’s Chain-of-Custody Record, referred to as sample receipt confirmation, will be sent to the TVA QA Officer following sample log-in for verification of properly entered and Chain-of-Custody Record requests and information such as sample identification numbers, analyses requested, and the

quantity of samples. In case of discrepancies between the Chain-of Custody Record and the sample receipt confirmation, the appropriate revisions will be communicated to the laboratory for the appropriate Chain-of-Custody Record corrections. Corrected information on the Chain-of-Custody Record will be recorded into the project data management system.

The samples received by the laboratory will be analyzed in accordance with internal laboratory QC procedures. The laboratory's hardcopies, on submission to Environmental Standards, will be validated by Environmental Standards validators with guidance from the National Functional Guidelines and US EPA Region IV SOPs referenced in Subsection 11.2.4. Data package completeness will be assessed and missing or incomplete information will be obtained from the laboratory. Any incorrect data will be corrected. Data usability will be evaluated and appropriate qualifiers will be added before submission to TVA. Any data rejected by data validation efforts due to imprecision, holding time exceedances, and failure of relevant QC measures will be qualified or not utilized for the project.

11.5 Data Archival

Applicable electronic field and laboratory data collected from the Site during sampling will be archived electronically. Backup tapes containing databases and programs or software utilities will be maintained in a secure location. All hardcopy data, including but not limited to field logs, laboratory data deliverables, and data validation reports, will be archived in accordance with TVA's document control protocols.

12.0 INTERNAL QUALITY ASSURANCE/QUALITY CONTROL

A detailed description of site Quality Assurance and Quality Control procedures is presented in the site-wide QAPP. The Phase I dredging activities are a subset of the site-wide investigation, characterization, and remediation activities at the Kingston Fossil Plant site and are subject to the requirements set forth in the site-wide QAPP and the site-wide FSP. The information provided below is intended as a general overview of internal QA/QC procedures as specifically related to Phase I dredging activities.

12.1 Field Activities

Field quality assurance will include (not limited to) the following:

- Instrument calibration.
- Documentation of sample collection and field conditions.
- Adherence to Chain-of-Custody procedures.
- Adherence to this QAPP, the Phase I Dredging Plan, and the field SOPs.
- Collection of field QC samples (discussed in Section 6.2 and the associated field SOPs).

12.2 Laboratory Analysis

Internal laboratory quality assurance will consist of the following:

- Instrument performance checks.
- Instrument calibration and calibration verification.
- Retrieval of documentation pertaining to instrument standards, samples, and data.
- Adherence to this QAPP and the associated laboratory SOPs.
- Documentation of sample preservation, transport and analytical methodology.
- Analysis of QC samples (discussed in Section 6.2).
- Meeting the specific method requirements presented in Appendix C.

12.3 Reporting Checks

After validated data have been made available, the data will be compiled into tables consistent with the requirement of the EDDs specified in Attachment B to facilitate the assessment of results. An independent check of the data entered into these tables will be performed for accuracy and completeness, and corrections will be made as addressed and discussed in Section 11.0 and Section 14.0.

12.4 Performance and System Audits

The primary objective of performance and system audits is to ensure that the established QA/QC procedures are properly implemented. Audit documentation will be maintained in the project file as described in the site-wide QAPP.

12.4.1 Performance Audits

Performance audits are quantitative evaluations of data quality produced by a particular activity or function. As specified in the site-wide QAPP, performance audits of the participating laboratories performing chemical analyses of project samples will be conducted through the submission and analysis of single- or double-blind performance evaluation samples. The Environmental Standards QAM will coordinate the manufacture and submission of performance audit samples to the laboratory. A NELAC-approved performance testing sample provider will be used to obtain the performance evaluation samples.

12.4.2 System Audits

System audits entail on-site observation and evaluation of participating laboratories and field sampling activities for compliance with the QAPP, SOPs, and/or Phase I Dredging Plan. System audits will be conducted as specified in the site-wide QAPP. Prior to conducting an on-site audit, the auditor will conduct a thorough examination of procedures and records. These on-site audits will also include verification of effectiveness of implemented corrective actions.

Systems audits of laboratories conducting chemical analyses of project samples will be performed by the Environmental Standards QAM. Systems audits of laboratories performing toxicological testing will be conducted in accordance with the TVA's toxicological monitoring program.

The system audits will address both field and laboratory activities, including a review of personnel qualifications, equipment, documentation, sampling techniques, analytical methods, and adherence to QA/QC procedures. Each laboratory has its own Quality Assurance Plan; therefore, the laboratory audit activities under this QAPP will entail a general review of laboratory quality assurance practices.

13.0 PREVENTIVE MAINTENANCE

13.1 Field Equipment

Equipment failure will be minimized by routinely inspecting all field equipment to ensure that it is operational and by performing preventative maintenance procedures. Field sampling equipment will be inspected prior to sample collection activities and all repairs will be made prior to decontamination and reuse of the sampling equipment. Routine preventative maintenance procedures at a minimum will include removal of foreign debris from exposed surfaces of the sampling equipment; storage of equipment in a cool dry place protected from the elements; inspections of the equipment each day prior to use; and verification of instrument calibrations as described in Section 9.

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedure based on the manufacturer's instructions or recommendations. Maintenance will be performed in accordance with the schedule specified by the manufacturer to minimize the downtime of the measurement system. Maintenance work will be performed by qualified personnel.

A list of critical spare parts will be developed prior to the initiation of fieldwork. Field personnel will have ready access to critical spare parts to minimize downtime while fieldwork is in progress. A service contract for rapid instrument repair or backup instruments may be substituted for the spare part inventory.

Non-routine maintenance procedures require field equipment to be inspected prior to initiation of fieldwork to determine whether or not it is operational. If it is not operational, it will be serviced or replaced. Batteries will be fully charged or fresh, as applicable.

The ability to collect valid samples requires that field equipment to be appropriately cleaned and maintained. The elements of an effective maintenance program are identified below:

- Pre-cleaned or certified clean equipment
- Spare parts
- Contingency plan
- Maintenance and repair of non-dedicated equipment

13.2 Laboratory Equipment

The ability to generate valid analytical data requires that an analytical instrumentation be properly maintained. The laboratory will be responsible for appropriate maintenance for major instruments. The elements of an effective maintenance program are identified below and discussed in the following subsection:

- Instrument maintenance logbooks
- Instrument maintenance and repair
- Available spare parts
- Contingency plans

Periodic preventive maintenance is required for all sensitive equipment. Instrument manuals will be kept on file for reference if equipment needs repair. The troubleshooting section of factory manuals may be used in assisting personnel in performing maintenance tasks.

Major instruments in the laboratory are covered by annual service contracts with manufacturers or other qualified personnel (internal or external). Under these agreements, regular preventive maintenance visits are made by trained service personnel. Maintenance is documented and maintained in permanent records by the individual responsible for each instrument.

Written procedures will establish the schedule for servicing critical items to minimize the downtime of the measurement system. The laboratory will adhere to the maintenance schedule, and arrange any necessary and prompt service. Qualified personnel will perform required service.

13.2.1 Instrument Maintenance Logbooks

Each analytical instrument will be assigned an instrument logbook. Maintenance activities will be recorded in the instrument logbook and the information entered will include:

- Date of service
- Person performing
- Type of service performed and reason for service
- Replacement parts installed (if applicable)
- Miscellaneous information

If service is performed by the manufacturer or its representative, a copy of the service record will be inserted into the page facing the logbook page where the above cited-information has been entered.

13.2.2 Instrument Calibration and Maintenance

An overview of the routine calibration procedures used for analytical instrumentation is presented in Section 9.0. Preventive maintenance and calibration by manufacturer service representatives will be provided on a routine basis.

In addition to maintenance by manufacturer service representatives, procedures for routine maintenance in accordance with manufacturer specifications for each analytical instrument will be followed by the laboratory. This will include maintaining inventories of spare parts used routinely (*e.g.*, spare torches for ICP/MS). Instrument operators have the responsibility to ensure that an acceptable inventory of spare parts is maintained.

14.0 DATA ASSESSMENT PROCEDURES

A detailed description of site Quality Assurance and Quality Control procedures is presented in the site-wide QAPP. The Phase I dredging activities are a subset of the site-wide investigation, characterization, and remediation activities at the Kingston Fossil Plant site and are subject to the requirements set forth in the site-wide QAPP and the site-wide FSP. The information provided below is intended as a general overview of data assessment as related to Phase I dredging activities.

The overall QA objective for field activities, data analyses, and laboratory analyses is to produce data of sufficient and known quality to support the comparison of background concentrations of specific analytes to the concentrations of same analytes off-site locations. Specifically, data will be developed using procedures appropriate for the intended use.

This data assessment activity is an on-going coordinated process with data production and is intended to assure that all data produced during the project are acceptable for use in subsequent evaluations. Both statistical and qualitative evaluations will be used to assess the quality of the data. The primary evaluation of the data will be based upon the control samples. The blank samples will be used to evaluate whether or not the laboratory and/or field sample handling represent a possible source of sample contamination. Duplicate sample results will be used to evaluate data precision.

The data produced during the sampling tasks included in the field investigation will be compared with the defined QA objectives and criteria for precision, accuracy, representativeness, completeness, and comparability (PARCC) and sensitivity. The primary goal of these procedures is to ensure that the data reported are representative of actual conditions at the Site.

Standard procedures are used so that known and acceptable levels of accuracy, precision, representativeness, completeness, and comparability are maintained for each data set. Descriptions of these criteria are presented in the following subsections.

The specific quantitative QA/QC objectives for chemical analyses associated with Phase I dredging are summarized on Tables 4, 5, and 6. QA/QC objectives associated with toxicological monitoring testing are presented in the KIF Monitoring Plan for Phase I Dredging and the associated laboratory SOPs.

14.1 Precision

The degree of agreement between the numerical values of a set of duplicate samples performed in an identical fashion constitutes the precision of the measurement.

During the collection of data using field methods and/or instruments, precision is checked by reporting measurements at one location and comparing results. For example, soil measurements are taken in pairs at a certain point and depth and the values compared. The measurements are considered sufficiently precise only if the values are within a specified percentage of each other.

Analytical precision is calculated by expressing, as a percentage, the relative percent difference between results of analyses of laboratory duplicate samples for a given analyte. Precision is calculated when both results are greater than 5× the reporting limit as is expressed by the following formula:

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

Where: C_1 = Value of original sample
C_2 = Value of duplicate sample

When at least one result is less than 5× the reporting limit, the difference between the results is calculated in lieu of precision.

Specific precision and difference objectives for field duplicate samples, laboratory duplicate samples, including MSDs, are presented on Tables 4, 5, and 6.

14.2 Accuracy

Accuracy is the degree of agreement of a measurement, X, with an accepted reference or true value, T. Accuracy is usually expressed as the difference between the two values, X-T, or the difference as a percentage of the reference or true value, 100(X-T)/T; accuracy is also sometimes expressed as a ratio X/T. Accuracy, which is a measure of the bias in a system, is assessed by means of reference samples and percent recoveries. Error may arise due to personal, instrumental, or method factors.

The two types of analytical check samples used are laboratory control samples and matrix spike samples. Analytical accuracy is expressed as the percent recovery of an analyte that has been added to the control sample or a standard matrix (*e.g.*, blank soil, *etc.*) at a known concentration prior to analysis.

The formula used to calculate accuracy for the laboratory control sample is:

$$\text{Accuracy} = \%\ \text{Recovery} = (A_T/A_F)\ X100$$

Where: A_T = The total concentration of the analyte measured or recovered
A_F = The concentration of the analyte spiked

When calculating accuracy in the matrix spike analysis, a correction for background concentration found in the unspiked sample must be made. The formula is:

$$\text{Accuracy} = \%\ \text{Recovery} = \frac{A_T - A_O}{A_F} X100$$

Where: A_T = The concentration of the analyte measured or recovered
A_O = The unspiked concentration of the analyte
A_F = The concentration of the analyte spiked.

In general, the accuracy objectives are based on what is specified in the analytical method and in Appendix C.

14.3 Completeness

Completeness is a measure of the degree to which the amount of sample data collected meets the needs of the sampling program and is quantified as the relative number of analytical data points that meet the acceptance criteria (including accuracy, precision, and any other criteria required by the specific analytical method used). Completeness is defined as a comparison between actual numbers of usable data points expressed as a percentage of expected number of points.

The QA objectives for completeness will be based upon QA protocols. The ability to meet or exceed this completeness objective is dependent on the nature of samples submitted for analysis. If data cannot be reported without qualifications, project completion goals may still be met if the qualified data (*i.e.,* data of known quality, even if not perfect) are suitable for specified project goals. Percent completeness will be expressed as the ratio of the total number of usable results relative to the total number of analytical results. The total number of usable analytical results will be total number of results minus any results deemed unusable at validation.

Difficulties encountered while handling samples in the laboratory, as well as unforeseen complications regarding analytical methods, may affect completeness during sample analysis. For example, the proposed analytical methods are intended to analyze "environmental samples" (low-level and medium-level concentrations). Using these methods to analyze unknown or hazard-level samples may result in poor performance, which would adversely impact the data completeness goal. The minimum goal for completeness is 90%; the ability to exceed this goal is dependent on the applicability of the analytical methods to the sample matrix analyzed.

14.4 Representativeness

Representativeness expresses the degree to which sample data are accurate and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter associated with the proper design of the sampling program. The representativeness criterion can, therefore, be met through the proper selection of sampling locations, the collection of a sufficient number of samples and by using US EPA-approved and standardized sampling procedures to describe sampling techniques and the rationale used to select sampling locations to ensure representativeness of the sample data.

Representativeness will also be measured by the collection of field duplicates, as appropriate (see Section 3.2.2). Comparison of the analytical results from field duplicates will provide a direct measure of individual sample representativeness.

14.5 Comparability

Comparability is a qualitative parameter used to express the confidence with which one data set can be compared with another. The comparability of the data, a relative measure, is influenced by sampling and analytical procedures. By providing specific protocols for obtaining and analyzing samples, data sets should be comparable regardless of who collects the sample or who performs the sample analysis.

The laboratory will be responsible providing the following controls to allow assessment of comparability:

- Adherence to current, standard US EPA-approved methodology for sample preservation.
- Compliance with holding times and analysis consistent with this QAPP.
- Consistent reporting units for each parameter of similar matrices.
- US EPA-traceable or NIST-traceable standards, when applicable.

14.6 Reconciliation with Data Quality Objectives

The Environmental Standards QAM, in conjunction with the TVA Technical Liaison/QA Officer and the TVA Toxicological Monitoring Coordinator, will determine whether field and validated analytical data or data sets meet the requirements necessary for decision-making. The results of measurements will be compared to the DQO requirements set forth in Section 6.0 of this QAPP. As data are evaluated, anomalies in the data or data gaps may become apparent to the data users. Data that do not meet the data users' needs will be identified and appropriately noted so that decision-makers are aware of data limitations. The process of reconciling project data with the DQOs will be addressed in the "Reconciliation with User Requirements" section of the site-wide QAPP and the Work Plan associated with a given field activity and will be performed with guidance from the Guidance for Data Quality Assessment, Practice Methods for Data Analysis (US EPA QA/G-9, July 2000).

15.0 FEEDBACK AND CORRECTIVE ACTION

A detailed description of site Feedback and Corrective Action procedures is presented in the site-wide QAPP. The Phase I dredging activities are a subset of the site-wide investigation, characterization, and remediation activities at the Kingston Fossil Plant site and are subject to the requirements set forth in the site-wide QAPP and the site-wide FSP. The information provided below is intended as a general overview of corrective action as related to Phase I dredging activities.

15.1 Feedback Mechanism

There are mechanisms within the project structure that allow for the identification, feedback, and control of any non-conformances or deficiencies. In general, the technical personnel involved with the project are responsible for reporting suspected technical non-conformances through standard communication channels established by the organizational structure. In the same manner, project personnel are responsible for reporting suspected QA non-conformances.

In general, non-conformances or deficiencies will be addressed in accordance with TVA's Corrective Action Program. TVA's Corrective Action Program includes various pathways depending on the nature and severity of the issue identified. Issues will be resolved using the lowest-level pathway that adequately identifies and addresses the cause of the non-conformance or deficiency and prevents recurrence. TVA's Corrective Action Program is detailed in the site-wide QAPP.

15.2 Corrective Action

15.2.1 Field Activities

Field personnel have the initial responsibility to monitor the quality of field measurements and observations. The Field Team Leader is responsible for verifying that QC procedures are followed. This responsibility requires the Field Team Leader to assess the correctness of field methods and the ability to meet QA objectives. If a problem occurs that might jeopardize the integrity of the project or that might cause a specific QA objective not to be met, the Field Team Leader will notify the TVA Sampling and Monitoring Coordinator and the TVA Technical Liaison/Quality Officer. An appropriate corrective action will then be determined and implemented. The Field Team Leader will document the problem, the corrective action, and the results. A copy of the documentation form will be provided to the TVA Field Coordinator.

Field auditing is a recognized technique for evaluating the performance of field sampling teams and assessing how team performance may affect data quality. A field audit during the collection of samples will be conducted by the Environmental Standards Field Oversight Coordinator to ensure that sampling, handling, and transportation to project laboratories provide assurance that such procedures meet quality assurance/quality control (QA/QC) protocols and that field documentation is sufficient to produce data of satisfactory quality; to provide a "defense" in the event that field procedures are called into question; and to identify ways to reduce sampling costs.

Environmental Standards Field Oversight Coordinator will, at a minimum, observe the first dredging event and ensure that all aspects of the dredging are compliant with site-specific SOPs and the site-wide FSP. Any items identified as non-compliant will be addressed and an appropriate corrective action will be determined and implemented.

15.2.2 Laboratory Corrective Action

The laboratory has the responsibility to monitor the quality of the analytical system and to provide a corrective action process adequate to address problems encountered in laboratory analysis of samples. The laboratory will verify that QC procedures are followed and that the analytical results of QC samples are within the acceptance criteria. The verification requires that the laboratory assess the correctness of the following items, as appropriate:

- Sample preparation procedure
- Initial calibration
- Calibration verification
- Method blank result
- Laboratory control sample
- Laboratory duplicate analysis
- Fortified sample result
- Internal standard performance

If the assessment reveals that the QC acceptance criteria are not met, the laboratory must immediately evaluate the analytical system and correct the problem. The analyst will notify the Laboratory Project Manager and Laboratory QA Coordinator of the problem and, if possible, will identify potential causes and suggest correct action. Figure 15-1 presents the pathway for corrective actions.

The nature of the corrective action obviously depends on the problem. For example, if a continuing calibration verification standard is determined to be out-of-control, the corrective action may require recalibration of the analytical system and reanalysis of all samples analyzed since the last acceptable continuing calibration standard.

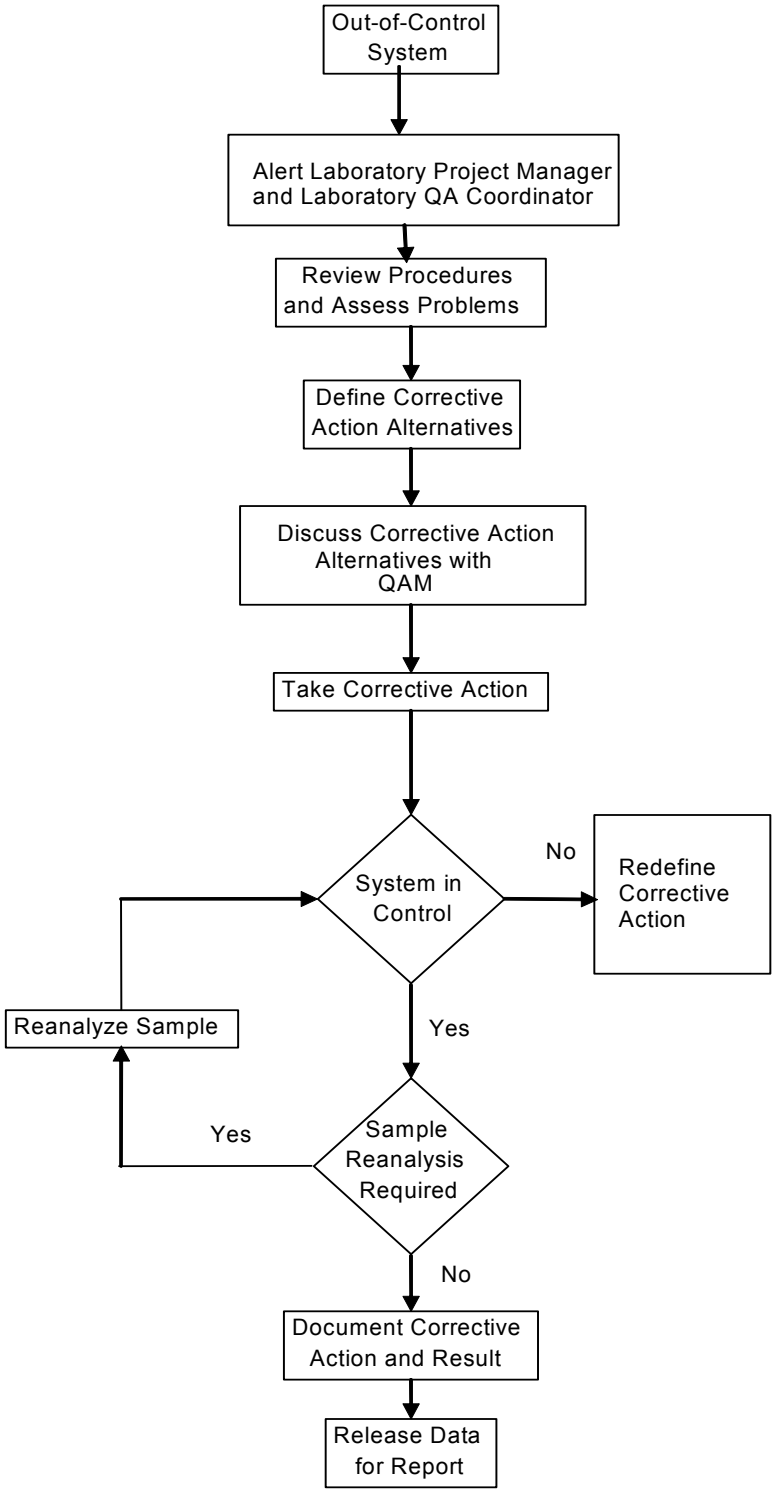
When the appropriate corrective action measures have been implemented and the analytical system is determined to be “in control,” the analyst will document the problem, the corrective action taken, and resultant data demonstrating that the analytical system is in control. Copies of the documentation will be provided to the Laboratory Project Manager and the Laboratory QA Coordinator.

Data generated concurrently with an out-of-control system will be evaluated for usability relative to the nature of the deficiency. If the deficiency does not impair the usability of the results, data will be reported and the deficiency will be addressed in the Case Narrative. If sample results are impaired, the Laboratory Project Manager will be notified and appropriate corrective action (*e.g.*, reanalysis) will be taken.

Environmental Standards Data Reviewer will verify or validate 100% of the data generated by the laboratories for all chemical analyses of project samples. Data generated for toxicological assessments will be reviewed by the TVA Toxicological Monitoring Coordinator in accordance with TVA’s toxicological monitoring program. Any issues observed during data validation will be brought to the attention of TVA personnel

and the Laboratory Project Manager and an appropriate corrective action will be determined and implemented.

FIGURE 15-1: CRITICAL PATH FOR LABORATORY CORRECTIVE ACTION



16.0 QUALITY ASSURANCE REPORTS

The QA activities performed by laboratories conducting chemical analyses of samples related to Phase I dredging will be monitored by the TVA Technical Liaison/QA Officer and the Environmental Standards QAM. The QA activities performed by the toxicological laboratory will be monitored by the TVA Toxicological Monitoring Coordinator in accordance with TVA's toxicological monitoring program.

Communication among TVA, Environmental Standards, and laboratory personnel is important to ensure that problems are remedied and that solutions are documented in an informed and timely manner.

Within 10 business days after the completion of a performance and systems audit, the Environmental QAM will submit an audit report to the TVA Technical Liaison/Quality Officer. This audit report should include a list of observed field activities, a list of reviewed documents, and any observed deficiencies. The TVA Technical Liaison/Quality Officer and Environmental Standards QAM will meet with the laboratory Project Managers of any area with observed deficiencies to review the audit findings, confirm the observations, and to resolve misunderstandings. In the event that inadequacies are identified, corrective actions will be undertaken as outlined in Section 15.0.

16.1 Field QA Reports

The Field Team Leader will provide the TVA Sampling and Monitoring Coordinator with daily field progress reports and weekly compiled field data sets. The TVA Technical Liaison/Quality Officer and Environmental Standards QAM will be immediately notified about field QA situations that require corrective action. Corrective action will be performed and documented in accordance with the protocol set forth in Section 15.0.

16.2 Laboratory QA Reports

The laboratory QA Coordinator will provide periodic, routine summary reports specific to the project to the Environmental Standards QAM. These reports will summarize QA activities for the reporting period, including results of performance audits (external and internal), results of system audits (external and internal), summaries of corrective action to remedy out-of-control situations, and recommendations for revisions of laboratory procedures to improve the analytical systems. The laboratory Project Manager will notify the Environmental Standards QAM and TVA Technical Liaison/Quality Officer about laboratory QA situations that appear to systematically impact data quality.

The laboratory QA Coordinator will immediately notify the Environmental Standards QAM and the TVA QA Officer of any laboratory QA situations that require corrective action and ascertain if such measures meet the DQOs of the project. Corrective action will be performed and documented in accordance with the protocol set forth in Section 15.0 or internal laboratory corrective action tracking system, as appropriate.

16.3 Data Submittals

The electronic data deliverable and full data packages for data generated from the chemical analysis of project samples will summarize the deviations from approved protocols and significant data findings in the Case Narratives. Analytical reports will be submitted to TVA and Environmental Standards as separate documents and will be transmitted in an electronic (.pdf and EDD) and hardcopy formats. Environmental Standards will maintain a database of TVA data for data validation and/or verification. Environmental Standards will complete data validation and generate project reports for TVA. Data validation and project reports will be submitted to the TVA Technical Liaison/QA Officer and the TVA Records Custodian. Electronic validated data will be submitted upon approval from the TVA Technical Liaison/QA Officer. Data generated from toxicological testing will be submitted, reviewed, and stored in accordance with TVA's toxicological monitoring program.

Electronic and hardcopy data will be archived for a minimum of 10 years from the date of report. The TVA Records Custodian will maintain a complete project file and will archive all hardcopy and electronic data indefinitely. Electronic or hardcopy data associated with the Kingston Ash Recovery Project will not be discarded, deleted, or destroyed by any party without the written consent of the TVA Records Custodian.

17.0 REFERENCES

Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual (Inland Testing Manual) http://www.epa.gov/waterscience/itm/itmpdf.html

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Quality Management Data Plan for EPA Region 4, Revision 2. US EPA Region IV; May 2003.

QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations – Chemical Evaluations. US EPA; 1995.

Test Methods for Evaluating Solid Waste, Physical and Chemical (SW-846), 3rd Edition including Final Update IV. US EPA; November 2000.

US EPA 40 CFR Part 136 Final Methods Update Rule. US EPA; March 2008.

US EPA Region IV Data Validation Standard Operating Procedures for Contract Laboratory Program Routine Analytical Services, Revision 2.1. US EPA Region IV; July 1999.

TABLES

Table 1: Sample Containers, Preservation, and Holding Times Surface Water Samples					
Parameter	**Method**	**Suggested Volume**	**Container**	**Preservative**	**Holding Time**
Total Metals	EPA 200.7/200.8 SW-846 6010B/6020	1 L	P, G	HNO_3 to pH < 2 Cool to ≤6°C	6 months
Dissolved Metals	EPA 200.7/200.8 SW-846 6010B/6020	1 L	P, G	HNO_3 to pH < 2 after filtration Cool to ≤6°C	6 months
Total Mercury	EPA 245.1 SW-846 7470A	1 L	P, G	HNO_3 to pH < 2 Cool to ≤6°C	28 days
Dissolved Mercury	EPA 245.1 SW-846 7470A	1 L	P, G	HNO_3 to pH < 2 after filtration Cool to ≤6°C	28 days
Alkalinity	SM 2320B	1 L	P, G	Cool to ≤6°C	14 days
Total Hardness	200.7/200.8/SM 2340B	1 L	P, G	HNO_3 to pH < 2 Cool to ≤6°C	6 months
Total Suspended Solids (TSS)	160.2/SM2540D	1 L	P, G	Cool to ≤6°C	7 days
Total Dissolved Solids (TDS)	SM 2540C	1 L	P, G	Cool to ≤6°C	7 days
pH	EPA 150.1/SM 4500	1 L	P, G	Cool to ≤6°C	24 hours
Toxicity Evaluation Whole Sediment Elutriate Plume Polymer	Inland Testing Manual/ EPA 821/R-02/012 EPA 600/R-99/064 EPA 821/R-02/013	variable with test min. 2.5 gal	2.5 & 5 gal cubitainers	Cool to 0 - 6°C (must not be frozen)	14 days

G = Glass container.
P = Plastic container (polyethylene container used for metals).

Table 2: Sample Containers, Preservation, and Holding Times
Sediment Samples

Parameter	Method	Suggested Volume	Container	Preservative	Holding Time
Metals	EPA 200.7/200.8 SW-846 6010B/6020	50 g	WM, no brass	None	6 months
Mercury	EPA 245.1 SW-846 7471A	50 g	WM, no brass	Cool to ≤6°C	28 days
Acid Volatile Sulfide	EPA 821-R-91-100/ SW-846 9034	50 g	WM	Cool to ≤6°C	14 days
Simultaneously Extracted Metals	EPA 821-R-91-100/ SW-846 6010B	50 g	WM	Cool to ≤6°C	14 days
Ammonia	EPA 350.1	50 g	WM	Cool to ≤6°C	28 days
Sulfides	SW-846 9030	50 g	WM	Cool to ≤6°C	7 days
Total Organic Carbon	SW-846 9060 mod	50 g	WM	Cool to ≤6°C	14 days
Grain Size	ASTM D422	500 g	WM	Cool to ≤6°C	N/A
Total Solids	ASTM D2216	50 g	WM	Cool to ≤6°C	N/A
Specific Gravity of Soils	ASTM D854-00	100 G	WM	None	N/A
Toxicity Evaluation Whole Sediment Elutriate	Inland Testing Manual/ EPA 600/R-99/064 (Method 100.1/100.3) EPA 821/R-02/012	min. 30 gal per location	5 gal P bucket (pre-washed)	Cool to 4°C (must not be frozen)	8 weeks

WM = Wide-mouth glass jar with Teflon®-lined cap. Brass or stainless steel ring with Teflon-lined cap may be used for sediment borings.

Table 3: Sample Containers, Preservation, and Holding Times
Biological Tissue Samples

Parameter	Method	Suggested Volume	Container	Preservative	Holding Time
Metals	SW-846 6020	10 - 15 g	Zip-lock bag	Freeze to < -10°C	1 year*
Mercury	SW-846 6020/7471A	10 - 15 g	Zip-lock bag	Freeze to < -10°C	1 year*

* Holding time is 1 year when samples are frozen to < -10°C.

Table 4. Analytes, Methods, and Target Reporting Limits: Water, Elutriate, and Dilution Water		
Test Parameter	**Test Method**	**Reporting Limit**
Basic Water Chemistry		
pH	EPA 150.1/SM 4500	0.1 pH Units
Alkalinity	SM 2320B	10 mg/L
Total Hardness	EPA 200.7/200.8/ SM 2340B	1 mg/L
Total Suspended Solids (TSS)	SM 2540D	1.0 mg/L
Total Dissolved Solids (TDS)	SM 2540C	1.0 mg/L
Metals—Total and Dissolved		
Aluminum	6010B/6020/200.7/200.8	100 μg/L
Antimony	6010B/6020/200.7/200.8	2 μg/L
Arsenic	6010B/6020/200.7/200.8	2 μg/L
Barium	6010B/6020/200.7/200.8	200 μg/L
Beryllium	6010B/6020/200.7/200.8	2 μg/L
Boron	6010B/6020/200.7/200.8	200 μg/L
Cadmium	6010B/6020/200.7/200.8	1 μg/L
Calcium	6010B/6020/200.7/200.8	100 μg/L
Chromium	6010B/6020/200.7/200.8	2 μg/L
Cobalt	6010B/6020/200.7/200.8	10 μg/L
Copper	6010B/6020/200.7/200.8	5 μg/L
Iron	6010B/6020/200.7/200.8	100 μg/L
Lead	6010B/6020/200.7/200.8	2 μg/L
Magnesium	6010B/6020/200.7/200.8	1000 μg/L
Manganese	6010B/6020/200.7/200.8	10 μg/L
Mercury	7470/245.1	0.2 μg/L
Molybdenum	6010B/6020/200.7/200.8	40 μg/L
Nickel	6010B/6020/200.7/200.8	5 μg/L
Potassium	6010B/6020/200.7/200.8	1000 μg/L
Selenium	6010B/6020/200.7/200.8	2 μg/L
Silver	6010B/6020/200.7/200.8	2 μg/L
Sodium	6010B/6020/200.7/200.8	1000 μg/L
Thallium	6010B/6020/200.7/200.8	2 μg/L
Vanadium	6010B/6020/200.7/200.8	4 μg/L
Zinc	6010B/6020/200.7/200.8	50 μg/L

Table 5. Analytes, Methods, and Target Reporting Limits: Ash and Sediment Samples

Test Parameter	Test Method	Reporting Limit*
Ammonia	EPA 350.1	5 mg/kg
Sulfides	SW-846 9030	5 mg/kg
Total Organic Carbon	SW-846 9060 modified	100 mg/kg
Aluminum	SW-846 6010B	40 mg/kg
Antimony	SW-846 6010B	6.0 mg/kg
Arsenic	SW-846 6010B	2.0 mg/kg
Barium	SW-846 6010B	1.0 mg/kg
Beryllium	SW-846 6010B	1.0 mg/kg
Boron	SW-846 6010B	20 mg/kg
Cadmium	SW-846 6010B	0.5 mg/kg
Calcium	SW-846 6010B	500 mg/kg
Chromium	SW-846 6010B	1.5 mg/kg
Cobalt	SW-846 6010B	5.0 mg/kg
Copper	SW-846 6010B	2.5 mg/kg
Iron	SW-846 6010B	20 mg/kg
Lead	SW-846 6010B	1.5 mg/kg
Magnesium	SW-846 6010B	500 mg/kg
Manganese	SW-846 6010B	1.5 mg/kg
Molybdenum	SW-846 6010B	4.0 mg/kg
Nickel	SW-846 6010B	4.0 mg/kg
Potassium	SW-846 6010B	500 mg/kg
Selenium	SW-846 6010B	1.5 mg/kg
Silver	SW-846 6010B	3.0 mg/kg
Sodium	SW-846 6010B	500 mg/kg
Thallium	SW-846 6010B	3.5 mg/kg
Vanadium	SW-846 6010B	2.5 mg/kg
Zinc	SW-846 6010B	6.0 mg/kg
Mercury	SW-846 7471	0.02 mg/kg
SEM Cadmium	EPA 821-R-91-100	0.001112 umoles/g
SEM Copper	EPA 821-R-91-100	0.009835 umoles/g
SEM Lead	EPA 821-R-91-100	0.0007239 umoles/g
SEM Mercury	EPA 821-R-91-100	0.00006232 umoles/g
SEM Nickel	EPA 821-R-91-100	0.01704 umoles/g
SEM Zinc	EPA 821-R-91-100	0.03823 umoles/g
Acid Volatile Sulfide	EPA 821-R-91-100	0.499 umoles/g
Grain Size	ASTM D422	1.0%
Total Solids	ASTM D2216	1.0 %
Specific Gravity of Soils	ASTM D-854-00	0.01

* Reporting limits are dry-weight correcting assuming 100% solids; sample-specific reporting limits may be higher based upon dry-weight correction

Table 6. Analytes, Methods, and Target Reporting Limits: Tissue Samples

Test Parameter	Test Method	Reporting Limit*
Aluminum	SW-846 6020	25 mg/kg
Antimony	SW-846 6020	0.1 mg/kg
Arsenic	SW-846 6020	0.1 mg/kg
Barium	SW-846 6020	0.1 mg/kg
Beryllium	SW-846 6020	0.1 mg/kg
Boron	SW-846 6020	0.5 mg/kg
Cadmium	SW-846 6020	0.1 mg/kg
Calcium	SW-846 6020	100 mg/kg
Chromium	SW-846 6020	0.1 mg/kg
Cobalt	SW-846 6020	0.1 mg/kg
Copper	SW-846 6020	0.5 mg/kg
Iron	SW-846 6020	25 mg/kg
Lead	SW-846 6020	0.1 mg/kg
Magnesium	SW-846 6020	100 mg/kg
Manganese	SW-846 6020	0.5 mg/kg
Molybdenum	SW-846 6020	1.0 mg/kg
Nickel	SW-846 6020	0.1 mg/kg
Potassium	SW-846 6020	100 mg/kg
Selenium	SW-846 6020	0.2 mg/kg
Silver	SW-846 6020	0.05 mg/kg
Sodium	SW-846 6020	100 mg/kg
Thallium	SW-846 6020	0.1 mg/kg
Vanadium	SW-846 6020	0.2 mg/kg
Zinc	SW-846 6020	2 mg/kg
Mercury	SW-846 6020	0.02 mg/kg
Mercury	SW-846 7471	0.01 mg/kg

* Reporting limits for tissue samples are presented on a wet-weight basis.

Table 7
Summary of Precision and Accuracy Objectives for Quality Control Samples
Aqueous Matrices (Surface Water)

Analyte	Method	LCS Accuracy (% Recovery)	MS/MSD Accuracy (% Recovery)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision**
Total Metals	EPA 200.7/200.8 SW-846 6010/6020	85-115 80-120	75-125	20	20	20	RPD < 20% difference < the RL
Dissolved Metals	EPA 200.7/200.8 SW-846 6010/6020	85-115 80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Mercury	EPA 245.1 SW-846 7470	85-115 80-120	75-125	20	20	20	RPD < 20% difference < the RL
Dissolved Mercury	EPA 245.1 SW-846 7470	85-115 80-120	75-125	20	20	20	RPD < 20% difference < the RL
Alkalinity	SM 2320B/EPA 310.2	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Hardness	SM 2340/EPA 200.7	80-120	75-125	20	20	20	RPD < 20% difference < the RL
Total Dissolved Solids	SM 2540C	80-120	NA	20	NA	20	RPD < 20% difference < the RL
Total Suspended Solids	SM 2540 D/EPA 160.2	80-120	NA	20	NA	20	RPD < 20% difference < the RL
pH	EPA 150.1/SM 4500	NA	NA	NA	NA	±0.1 pH units	±0.1 pH units

** When both field duplicate results are > 5× the RL, the RPD must be < 20%. When at least one result is < 5× the RL, the difference must be < the RL.

Table 8
Summary of Precision and Accuracy Objectives for Quality Control Samples
Solid Matrices (Released Ash, Sediment, Tissue)

Analyte	Method	LCS Accuracy (% Recovery)	MS/MSD Accuracy (% Recovery)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision**
Metals	SW-846 6010/6020	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Mercury	SW-846 7471	80-120	75-125	35	35	35	RPD < 35% difference < 2× the RL
Acid Volatile Sulfide	EPA 821-R-91-100/ SW-846 9034	85-115	75-125	20	20	20	RPD < 35% difference < 2× the RL
Simultaneously Extracted Metals	EPA 821-R-91-100/ SW-846 6010/7470	85-115	75-125	20	20	20	RPD < 35% difference < 2× the RL
Ammonia	EPA 350.1 mod.	80-120	75-125	35	35	20	RPD < 35% difference < 2× the RL
Sulfides	SW-846 9030	80-120	75-125	35	35	20	RPD < 35% difference < 2× the RL
Total Organic Carbon	SW-846 9060 mod.	80-120	75-125	35	35	20	RPD < 35% difference < 2× the RL
Grain Size	ASTM D422	NA	NA	NA	NA	20	RPD < 35% difference < 2× the RL
Percent Solids	ASTM D2216	NA	NA	NA	NA	10	RPD < 35% difference < 2× the RL
Specific Gravity of Soils	ASTM D854-00	NA	NA	NA	NA	20	RPD < 35% difference < 2× the RL

** When both field duplicate results are > 5× the RL, the RPD must be < 35%. When at least one result is < 5× the RL, the difference must be < 2× the RL.

APPENDICES

APPENDIX A

DATA PACKAGE DELIVERABLE REQUIREMENTS

1.0 Introduction

The following sections describe in detail the types of data packages designed for the Kingston Ash Recovery Project. These details are provided to all TVA Contract laboratories to produce data packages that are similar in format, order of presentation, and content.

TVA data package deliverables are categorized into two levels as follows:

Full	-	See Section 2.0
Limited	-	See Section 3.0

Full hard copy data package deliverables will be required for all sample delivery groups. Limited data package deliverables will be requested as a mechanism to report final results in an expeditious manner; when limited data package deliverables are requested, full data package deliverables must still be prepared at the standard 5-day TAT. Electronic data deliverables (EDD) must be provided for all data package deliverables via the format required for the project and should be delivered with the full hard copy data package deliverable.

The laboratory is responsible for ensuring that all electronic and hardcopy data deliverables are in parity, including but not limited to significant figures, analyte names, and any qualifiers and/or footnotes used. All electronic data and hardcopy data deliverables are the property of TVA and must be maintained for a minimum of ten years. Under no circumstances is the laboratory to discard, dispose of, alter, or destroy any electronic data or hardcopy data deliverables without the express written consent of TVA.

Prior to issuance to the client, all data must undergo at least an initial technical review by a trained analyst and a second technical review by a supervisor or another trained analyst.

2.0 General Format for Full Data Package Deliverables

The Full Sample Data Package will include data for analyses of all samples in one sample delivery group (SDG), including field samples, re-analyses, secondary dilutions, blanks, laboratory control samples, laboratory control sample duplicates, matrix spikes, matrix spike duplicates, and/or laboratory duplicates. One single set of data representing the best of results (if multiple analyses are performed) for each sample should be reported. The Full Data Package is divided into sections, each specific to an analytical fraction. A fraction-specific unit is not a required deliverable if the analysis of that fraction was not required for samples in the SDG. The Full Data Package must be completed before submission and must be single-sided and consecutively paginated. The Full Data Package will be arranged in the following order:

- Cover Letter/Letter of Transmittal signed by Technical Project Manager or designee

- Title Page
- Table of Contents
- SDG Narrative signed by Technical Project Manager or designee [The SDG Narrative must include a statement or statements relative to compliance with this document, the TVA technical requirements, and the Quality Assurance Project Plan (QAPP) and description of any deviations.]
- References to preparation and analytical methods performed and applicable project documents (*i.e.*, QAPP)
- Field and Internal Laboratory Chain-of-Custody Records
  - Sample Receipt Information
  - Project Correspondence
- For each analytical method and matrix included in the SDG, the laboratory must provide the summary of the full MDL study (seven replicates, standard concentrations, *etc.*) and the most recent single point verification summary, as applicable.

I. ICP, ICP/MS, and CVAA Metals Results and QC

A. Target Analyte Results Summaries: Target analyte results summaries are required for all samples and will be arranged in increasing alphanumeric order by TVA sample number. The target analyte results summary must include the following:

- SDG Number
- TVA sample number
- laboratory sample identifier
- matrix of the TVA sample
- date of sample collection
- sample percent solids
- name and CAS number for each target analyte
- concentration of positives and project-required detection limit (PRDL) and/or MDL for each target analyte
- any applicable flags for target analyte results (*e.g.*, “U” to designate a “not-detected” result)

- concentration units

B. QC and Quarterly Verification of Instrument Parameters Summaries

- Initial and Continuing Calibration Verification Summary: The initial and continuing calibration verification summaries will be arranged in chronological order, by instrument and must include the following:

  - SDG number
  - names for all target analytes
  - instrument identifier
  - start and end dates and times of the analytical sequence
  - true concentrations for all target analytes for the initial calibration verification (ICV) and continuing calibration verification (CCV) standards
  - observed concentrations for all target analytes for each ICV and CCV analyses
  - calculated percent recoveries for all target analytes for each ICV and CCV analyses
  - control limits for ICV and CCV percent recoveries
  - concentration units

- Reporting Limit (RL) Standard Summary: The RL standard summaries will be arranged in chronological order, by instrument and must include the following:

  - SDG number
  - names for all target analytes
  - instrument identifier
  - dates and times for the RL standard analyses
  - true concentrations for all target analytes
  - observed concentrations for all target analytes for each RL standard analysis
  - calculated percent recoveries for all target analytes for each RL standard analysis

- control limits for RL standard recoveries
- concentration units

- Initial and Continuing Calibration Blank Summary: The initial and continuing calibration blank summaries will be arranged in chronological order, by instrument and must include the following:
  - SDG number
  - names for all target analytes
  - instrument identifier
  - start and end dates and times of the analytical sequence
  - observed concentration or MDL for each target analyte for each initial calibration blank (ICB) or continuing calibration blank (CCB) analysis
  - acceptance limits for ICB and CCB analyses
  - concentration units

- Preparation Blank Analytical Summary: The preparation blank analytical summaries will be arranged in chronological order, by instrument and must include the information presented in Section 1A.

- ICP and/or ICP/MS Interference Check Sample Summary: The ICP and/or ICP/MS interference check sample summaries for <u>both</u> the ICSA and ICSAB solutions will be arranged in chronological order, by instrument and must include the following: [NOTE: Aluminum, Calcium, Iron, and Magnesium results are to be reported even if these are not target analytes.]
  - SDG number
  - names for all target analytes
  - instrument identifier
  - dates and times for the ICP interference check standard analyses
  - true concentrations for all target analytes
  - observed concentrations for all target analytes observed in each ICP interference check standard analysis

- calculated percent recoveries for all target analytes for each ICP interference check standard analysis
- control limits for ICP interference check standard recoveries
- concentration units

- MS Sample Recovery Summary: The MS sample recovery summaries will be arranged in alphanumeric order by laboratory sample number and must include the following:

  - SDG number
  - TVA sample number for the spiked sample
  - percent solids for the TVA sample
  - names for all target analytes
  - analyte concentration observed in the non-spiked sample aliquot
  - true concentrations for all target analytes in the MS solution
  - observed concentrations for all target analytes in the MS sample analysis
  - calculated percent recoveries for all target analytes
  - control limits for MS sample recoveries
  - concentration units

If an MSD is performed, the summary must also include:

- MSD identifier
- observed concentration for each all target analytes in the MSD sample
- percent recovery for all target analytes
- RPD between the MS/MSD results for each analyte
- RPD limit for each analyte

- Post-Spike Sample Recovery Summary: The post-spike sample recovery summaries will be arranged in alphanumeric order by laboratory sample number and must include the following:

    - SDG number
    - TVA sample number for the post-spiked sample
    - percent solids for the TVA sample
    - names for all target analytes
    - analyte concentration observed in the non-spiked sample aliquot
    - true concentrations for all target analytes in the post-spike solution
    - observed concentrations for all target analytes in the post-spike sample analysis
    - calculated percent recoveries for all target analytes
    - control limits for post-spike sample recoveries
    - concentration units

- Duplicates Precision Summary: The duplicate precision summaries will be arranged in alphanumerical order by TVA sample number and must include the following:

    - SDG number
    - TVA sample number for the duplicate sample
    - percent solids for the TVA sample
    - names for all target analytes
    - analyte concentration observed in the original sample aliquot
    - observed concentrations for all target analytes in the duplicate sample analysis
    - calculated RPD for all target analytes
    - control limits for RPD

- concentration units

- LCS Recovery Summary: The LCS recovery summaries will be arranged in chronological order, by instrument and must include the following:

  - SDG number
  - LCS identifier
  - names for all target analytes
  - true concentrations for all target analytes in the LCS solution
  - observed concentrations for all target analytes in the LCS analysis
  - calculated percent recoveries for all target analytes
  - control limits for LCS recoveries
  - concentration units

- ICP and/or ICP/MS Serial Dilution Summary: The ICP and/or ICP/MS serial dilution summaries will be arranged in alphanumeric order by laboratory sample number and must include the following:

  - SDG number
  - TVA sample number for the ICP or ICP/MS serial dilution sample
  - names for all target analytes
  - analyte concentration observed in the original sample aliquot
  - observed concentrations for all target analytes in the ICP or ICP/MS serial dilution analysis
  - calculated percent difference for all target analytes
  - control limits for percent difference
  - concentration units

- RL and Method Detection Limit (MDL) Summary: The RL and MDL summaries will be arranged in chronological order, by instrument and must include the following:

    - SDG number
    - instrument identifier
    - date the MDL determination was performed
    - names for all target analytes
    - determined MDL for all target analytes
    - RL for all target analytes
    - concentration units

- ICP Interelement Correction Factors Summary: The ICP interelement correction factors summaries will be arranged in chronological order, by instrument and must include the following:

    - SDG number
    - instrument identifier
    - date the ICP interelement correction factors determination was performed
    - names for all target analytes
    - determined ICP interelement correction factors concentrations for all target analytes
    - concentration units

- ICP and/or ICP/MS Linear Range Summary: The ICP and/or ICP/MS linear range summaries will be arranged in chronological order, by instrument and must include the following:

    - SDG number
    - instrument identifier
    - date the ICP linear range determination was performed
    - names for all target analytes
    - determined ICP linear range concentrations for all target analytes

- concentration units

- TCLP Preparation Logs and worksheets (if performed)

- TVA sample and QC sample preparation logs

- Analytical Sequence Form: The analytical sequence forms will be arranged in chronological order, by analyte, by instrument and must include the following:

  - SDG number

  - instrument identifier

  - TVA sample numbers associated with the sequence

  - QC sample identifiers associated with the sequence

  - analysis date and time for each TVA sample and QC sample associated with the sequence

  - identification of all target analytes reported from each TVA sample and QC sample analysis

  - dilution factor for each TVA sample and QC sample analysis

  - start and end dates and times for the sequence

- ICP/MS Data Packages will include the following forms in addition to the requirements listed above.

  - ICP/MS Tune Summary

  - ICP/MS Internal Standards Relative Intensity Summary [the summary must include the acceptance limits and reference internal standards intensity.]

C. Raw Data

For each reported value, the laboratory will provide all raw data used to obtain that value; this requirement applies to all required QA/QC measurements and instrument standardization as well as all sample analysis results. This statement does not apply to the Quarterly Verifications Parameters submitted as part of each data package. Raw data must contain all instrument readouts used for the sample results. Each exposure or instrumental reading must be provided, including those readouts that may fall below the RL but greater than the MDL. All ICP, ICP/MS, and AA instruments must provide a legible hardcopy of the direct

real-time instrument readout (*e.g.*, strip-charts, printer tapes, *etc.*). A photocopy of the instrument's direct sequential readout must be included.

II. General Chemistry Results and QC

The general chemistry data will be arranged in the following order by individual parameter requested for the samples in the SDG (as applicable).

A. Target Analyte Results Summaries: Target analyte results summaries are required for all samples and will be arranged in increasing alphanumeric order by TVA sample number. The target analyte results summary must include the following:

- SDG Number
- TVA sample number
- laboratory sample identifier
- matrix of the TVA sample
- date of sample collection
- sample percent solids
- name and CAS number for each target analyte
- concentration of positives and PRDL and/or MDL for each target analyte
- any applicable flags for target analyte results (*e.g.*, "U" to designate a "not-detected" result)
- concentration units

B. QC Summaries

- Initial and Continuing Calibration Verification Summary: The initial and continuing calibration verification summaries will be arranged in chronological order, by instrument and must include the following:

  - SDG number
  - names for all target analytes
  - instrument identifier
  - start and end dates and times of the analytical sequence

- true concentrations for all target analytes for the ICV and CCV standards
- observed concentrations for all target analytes for each ICV and CCV analyses
- calculated percent recoveries for all target analytes for each ICV and CCV analyses
- control limits for ICV and CCV percent recoveries
- concentration units

- Initial and Continuing Calibration Blank Summary: The initial and continuing calibration blank summaries will be arranged in chronological order, by instrument and must include the following:
  - SDG number
  - names for all target analytes
  - instrument identifier
  - start and end dates and times of the analytical sequence
  - observed concentration or MDL for each target analyte for each ICB or CCB analysis
  - acceptance limits for ICB and CCB analyses
  - concentration units

- Preparation Blank Analytical Summary: The preparation blank analytical summaries will be arranged in chronological order, by instrument and must include the information presented in Section 1.A.

- MS Sample Recovery Summary: The spike sample recovery summaries will be arranged in alphanumeric order by laboratory sample number and must include the following:
  - SDG number
  - TVA sample number for the spiked sample
  - percent solids for the TVA sample
  - names for all target analytes

- analyte concentration observed in the non-spiked sample aliquot
- true concentrations for all target analytes in the spike solution
- observed concentrations for all target analytes in the spike sample analysis
- calculated percent recoveries for all target analytes
- control limits for spike sample recoveries
- concentration units

If an MSD is performed, the summary must also include:

- MSD identifier
- observed concentration for each all target analytes in the MSD sample
- percent recovery for all target analytes
- RPD between the MS/MSD results for each analyte
- RPD limit for each analyte

- Duplicates Precision Summary: The duplicate precision summaries will be arranged in alphanumeric order by laboratory sample number and must include the following:
  - SDG number
  - TVA sample number for the duplicate sample
  - percent solids for the TVA sample
  - names for all target analytes
  - analyte concentration observed in the original sample aliquot
  - observed concentrations for all target analytes in the duplicate sample analysis
  - calculated RPD for all target analytes
  - control limits for RPD

- concentration units

- LCS Recovery Summary: The LCS recovery summaries will be arranged in chronological order, by instrument and must include the following:

  - SDG number
  - LCS identifier
  - names for all target analytes
  - true concentrations for all target analytes in the LCS solution
  - observed concentrations for all target analytes in the LCS analysis
  - calculated percent recoveries for all target analytes
  - control limits for LCS recoveries
  - concentration units

- Analytical Sequence Form: The analytical sequence forms will be arranged in chronological order, by analyte, by instrument and must include the following:

  - SDG number
  - instrument identifier
  - identification of the target analyte
  - TVA sample numbers associated with the sequence
  - QC sample identifiers associated with the sequence
  - analysis date and time for each TVA sample and QC sample associated with the sequence
  - start and end dates and times for the sequence

C. Raw Data

For each reported value, the laboratory will provide all raw data (instrument printouts or logbook pages) used to obtain that value; this requirement applies to all required QA/QC measurements and instrument standardization, as well as all sample analysis results. Raw data must contain all instrument readouts/logbooks pages used for the sample

results. Each exposure or instrumental reading must be provided, including those readouts/logbook pages that may fall below the quantitation limit. A photocopy of the instrument's direct sequential readout must be included if the instrumentation has the capability.

D. General Chemistry Preparation Logs (by parameter)

III. Radiological Data

The radiological data will be arranged in the following order by individual parameter requested for the samples in the SDG.

A. Target Analyte Results Summaries: Target analyte results summaries are required for all samples and will be arranged in increasing alphanumeric order by TVA sample number. The target analyte results summary must include the following:

- SDG Number
- TVA sample number
- laboratory sample identifier
- matrix of the TVA sample
- date of sample collection
- date of sample analysis
- sample activity, uncertainty, and the sample-specific minimum detectable concentration (MDC). The sample-specific MDC will be based on the background of the detector that the sample was counted on. The sample activity (positive or negative), uncertainty, and sample-specific MDC will be reported for positive and "not-detected" results
- any applicable flags for target analyte results (e.g., "U" to designate a "not-detected" result)
- concentration units

B. Quality Control Summaries

- Chemical Yield (Tracer/Carrier) Recovery Summary that must include the following:
  - SDG number
  - TVA sample number

- Method blank sample number
- MS sample number
- MSD sample number
- LCS identification number
- LCSD identification number (if performed)
- percent recovery for all tracers/carriers
- applicable recovery limits for each tracer/carrier

- Method Blank Summary: The method blank summaries will be arranged in chronological order, by instrument and method and must include the following:
  - SDG number
  - names for all target analytes
  - observed activity, uncertainty, and MDC for each target analyte for each method blank analysis
  - concentration units

- MS Sample Recovery Summary: The MS sample recovery summaries will be arranged by instrument and method and must include the following:
  - SDG number
  - TVA sample number for the spiked sample
  - names for all target analytes
  - analyte concentration observed in the non-spiked sample aliquot
  - true concentrations for all target analytes in the MS solution
  - observed concentrations for all target analytes in the MS sample analysis
  - calculated percent recoveries for all target analytes
  - control limits for MS sample recoveries

- concentration units

If an MSD is performed, the summary must also include:

- MSD identifier
- observed concentration for each all target analytes in the MSD sample
- percent recovery for all target analytes
- RPD/RER between the MS/MSD results for each analyte
- RPD/RER limit for each analyte

- Duplicates Precision Summary: The duplicate precision summaries will be arranged by instrument and method and must include the following:
  - SDG number
  - TVA sample number for the duplicate sample
  - names for all target analytes
  - analyte activity, uncertainty, and MDC observed in the original sample aliquot
  - observed activity, uncertainty, and MDC for all target analytes in the duplicate sample analysis
  - calculated RPD/Replicate Error Ratio (RER) for all target analytes
  - control limits for RPD/RER
  - concentration units
- LCS Recovery Summary: The LCS recovery summaries will be arranged by instrument and method and must include the following:
  - SDG number
  - LCS identifier
  - names for all target analytes
  - true concentrations for all target analytes in the LCS solution

- observed concentrations for all target analytes in the LCS analysis
- calculated percent recoveries for all target analytes
- control limits for LCS recoveries
- concentration units

- Calibration Verification Summary: The calibration verification summaries will be arranged by instrument and method and must include the following:
  - SDG number
  - names for all target analytes
  - instrument identifier
  - date the calibration verification was performed. For each method and analyte, the Contracted Laboratories will provide Calibration Verification summaries that include or bracket the analysis dates of the field and QC samples.
  - acceptance limits for the calibration verification
  - the following calibration verification summaries will be provided for Gas Flow Proportional Counter data
    a. Efficiency Checks
    b. Background Checks
  - the following calibration verification summaries will be provided for Alpha Spectroscopy data
    a. Energy Calibration Checks
    b. Efficiency Checks
    c. Background Checks (
    d. Resolution (FWHM) Checks
  - the following calibration verification summaries will be provided for Alpha Scintillation data
    a. Daily Instrument Performance Checks
    b. Background Checks

C. Raw Data

For each reported value, the Contracted Laboratories will provide all raw data (instrument printouts) used to obtain that value. This applies to all required QA/QC measurements (including tracer/carrier recoveries) as well as all sample analysis results. Raw data must contain all instrument readouts and worksheets used for the sample results. An exhibit work sheet per method (including example calculations showing how sample activity, TPU and MDA are calculated) will be provided.

D. Preparation Logs (by method)

E. Traceability Documents (by method)

3.0 General Format for Limited Data Package Deliverables

Limited Data Package Deliverables will contain data for all samples in one SDG. All Limited Data Packages will be arranged in the following order:

- Cover Letter/Letter of Transmittal signed by Technical Project Manager or designee
- SDG Narrative signed by Technical Project Manager or designee [The SDG Narrative must include a statement or statements relative to compliance with this document and any applicable QAPP or WP and description of any deviations.]
- References to preparation and analytical methods performed and applicable project documents (*i.e.,* QAPP)
- Field and Internal Laboratory Chain-of-Custody Records
- Sample Receipt Information
- Project Correspondence
- Analytical Result Summaries for all samples

APPENDIX B

KINGSTON FLY ASH RECOVERY PROJECT

ESI Complex EDD Specifications
4/5 File

ENVIRONMENTAL STANDARDS, INC
INFORMATION TECHNOLOGY GROUP
02/05/2009

PREPARED BY

Steven M. Sampson

Acknowledgements

This document was prepared for the Tennessee Valley Authority (TVA) by Steven M. Sampson of Environmental Standards.

TABLE OF CONTENT

Electronic Data Deliverable Requirements

The purpose of this document is to describe the specifications of the Environmental Standards, Inc. 5-file Electronic Data Deliverable (EDD) for use within the Earthsoft EQuIS system

File Format

All data from the database must be stored in an ASCII file using a tab-delimited standard format. Maximum length of text fields is indicated in the parentheses. If the information is less than the maximum length, do not pad the record with spaces.

Each record must be terminated with a carriage return/line feed (i.e., standard DOS text file). The file can be produced using any software with the capability to create ASCII files. Date is reported as MM/DD/YY (month/day/year) and time as HH:MM (hour: minute). Time uses a 24-hour clock, thus 3:30 p.m. will be reported as 15:30.

Each record in an import file must have one or more fields with values that make the row unique. These fields are indicated in the **Req.** column, along with fields that are required for other reasons. In the **Req.** column a **Y** indicates that the field is required. If a field is to be considered part of the primary key of a table, it is indicated below by the presence of "PK" in the *PK* column.

File Naming Convention

Five files are required: field sample, lab sample, lab tests, lab results, and lab batches. The filename extensions are used to indicate the file type as follows:

Type of Rows		File Name
Sample level data	Field	COC.ESI_EFW2FSample_v2.txt
	Lab	SDG.ESI_EFW2LabSMP_v2.txt
Lab test level data		SDG.ESI_EFW2LabTST_v2.txt
Analyte result level data		SDG.ESI_EFW2LabRES_v2.txt
Lab batch level data		SDG.ESI_EFW2LabBCH_v2.txt

Where SDG is the Sample Delivery Group and COC is the Chain of Custody number.

The character portion of the filenames must be the same for each group of five files. Filename conventions may be defined however the laboratory and EQuIS Chemistry project manager determine. For example, the date, sample delivery group, or project name may be encoded in the filename if desired. Although we anticipate that all five files will be prepared and loaded into EQuIS Chemistry together in one group, this is not necessary. Each file can be loaded separately if desired.

For the TVA project, all five files indicated above are required to be generated by analytical aaboratories.

File Delivery

The file must be "zipped" together using a compression program such as WinZip. The file naming convention for the zip file is as follows:

SDG.Site.ESI_v3.zip, where SDG is the Sample Delivery Group and Site is the value from the "Site ID #" block on the Chain of Custody. Example: 080209123.Station12.ESI_v3.zip

The zipped file must contain a valid EQuIS certificate obtained from Environmental Standards. Laboratories will need to request an EQuIS certificate from Environmental Standards by sending an email to ssampson@envstd.com indicating the email address for which the certificate should be linked. This email address will receive all notifications regarding the status of the EDD receipt.

The zipped file should be emailed to TVAEDD@envstd.com. Once EQuIS receives and checks the EDD, a notification will be sent to the email address supplied by the laboratory. EDD load failure notifications will be accompanied with a detailed error report outlining the errors found in the EDD. Laboratories are responsible for correcting any errors and resubmitting the EDD. The corrected EDD file name must be different from the initial file. However, laboratories need only to add a letter to the SDG to create a unique deliverable. If the resubmitted file has the same name as the initial file, it will be rejected as a duplicate submittal.

EQuIS EDP Format ESI_v3

EDDs should be tested prior to submission. The ESI_v3 EDP Format package can be obtained by contacting Environmental Standards. However, laboratories will be responsible for obtaining the appropriate Earthsoft EDP user license.

ESI_v3 EDP Format Package contains four files are follows:

- Esi_v3.xsd
- ESI_v3.vb
- ESI_v3-enum.xsd
- ESI_v3.rvf

All four files are necessary for testing EDDs and must be stored in the same folder. You will receive the four files in a zipped file from Environmental Standards along with project details.

The ESI_v3.rvf contains all the reference values for this project. All EDDs for this project must comply with the reference values in this file. A new "RVF" will be sent each time the reference values are update. Laboratories can request these reference values in a spreadsheet from Environmental Standards.

Null Format

Many fields are optional, and the list of valid values may be defined in a project or lab specific manner as determined by the laboratory and project manager. When a field is not listed as required, this means that a null or blank may be appropriate. However, tabs must still surround the blank value. In other words, the number of fields is always the same, whether or not the fields include data is optional.

EDD Specifications

EDD formats for the five individual required EDD files are described on the following tables. These files are the Field Sample file, the Sample file, the Test file, the Result file, and the Batch file.

Field Sample Import Format - ESI_EFW2FSample_v2

*Only field samples should be included in this file

Pos#	Field Name	Data Type	PK	Required?	VVL	Field Definition
1	sys_sample_code	Text (40)	PK	Y		Unique sample identifier as shown on Chain of Custody.
2	sample_name	Text (30)		Y		Same as sys_sample_code.
3	sample_matrix_code	Text (10)		Y	Table 2	Code that distinguishes between different types of sample matrices.
4	sample_type_code	Text (20)		Y	Table 1	Code that distinguishes between different types of samples.
5	sample_source	Text (10)		Y		This field identifies where the sample came from. Should be **Field** for all samples in this file.
6	parent_sample_code	Text (40)		See Chart 1		The value of "sys_sample_code" that uniquely identifies the sample that was the source of this sample.
7	sample_date	Date		Y		Date of sample collection (MM/DD/YY).

Pos#	Field Name	Data Type	PK	Required?	VVL	Field Definition
8	sample_time	Time		Y		Time of sample collection (HH:MM).
9	sys_loc_code	Text(20)		Y		Sample collection location as shown on chain of custody
10	start_depth	Double		N		Beginning depth (top) of sample.
11	end_depth	Double		N		Ending depth (bottom) of sample.
12	depth_unit	Text (15)		N	Table 3	Unit of measurement for the sample begin and end depths.
13	chain_of_custody	Text (15)		Y		Chain of custody identifier. A single sample may be assigned to only one chain of custody.
14	sent_to_lab_date	Date		N		Date sample was sent to lab (MM/DD/YY)
15	sampler	Text (30)		N		Name or initials of sampler.
16	sampling_company_ code	Text (10)		N		Name or initials of sampling company
17	sampling_reason	Text (30)		N		Reason for sampling.
18	sampling_technique	Text (40)		N		Sampling technique.
19	method_analyte_group	Text (40)		Y	Y	Field Method Analyte Group Name
20	task_code	Text (10)		N		Same as chain of custody number from chain of custody.
21	collection_quarter	Text (5)		N		Quarter of the year sample was collected (e.g., "1Q96")

Pos#	Field Name	Data Type	PK	Required?	VVL	Field Definition
22	composite_yn	Text (1)		Where applicable		Y/N field used to indicate whether a sample is a composite sample
23	composite_desc	Text (255)		Where applicable		Description of composite sample
24	sample_class	Text (10)		N		Navy sample class code.
25	comment	Text(255)		N		Sample comments as necessary.
26	tat_start_date	Date		Y		Date sample was shipped to lab (MM/DD/YY)
27	TAT	Text(2)		Y		Turn around time. <=48 hours should be reported in hours, >48 hours should be reported in days
28	matrix_spike_yn	Text(1)		Y		Y/N field used to indicate whether a matrix spike is required.
29	matrix_spike_dup_yn	Text(1)		Y		Y/N field used to indicate whether a matrix spike duplicate is required.

Sample Import Format -ESI_EFW2LabSMP_v2

*Both field and laboratory samples should be included in this file

Pos#	Field Name	Data Type	PK	Required?	VVL?	Field Definition
1	chain_of_custody	Text(15)		Y		Chain of custody identifier. A single sample may be assigned to only one chain of custody. Chain of custody identifier can be found on the chain of custody
2	sys_sample_code	Text(40)	PK	Y		Unique sample identifier. Sample Id from chain of custody. Lab sample's sys_sample_code should have the SDG appended to its value to insure uniqueness throughout the life of the EQuIS database.
3	sample_type_code	Text(20)		Y	Table 1	Code that distinguishes between different types of samples.
4	sample_matrix_code	Text(10)		Y	Table 2	Code that distinguishes between different types of sample matrices
5	sample_source	Text(10)		Y		Must be either **Field** for field samples or **Lab** for internally generated laboratory QC samples.
6	parent_sample_code	Text(40)		See Chart 1		The value of "sys_sample_code" that uniquely identifies the sample that was the source of this sample.
7	comment	Text(255)		N		Sample comments.
8	sample_date	Date		See Chart 1		Date of sample collection (MM/DD/YY).

Pos#	Field Name	Data Type	PK	Required?	VVL?	Field Definition
9	sample_time	Text(5)		See Chart 1		Time of sample collection (HH:MM).
10	sample_receipt_date	Date		See Chart 1		Date of sample receipt by laboratory (MM/DD/YY).
11	sample_delivery_group	Text(10)		Y		Sample delivery group as by defined laboratory
12	standard_solution_ source	Text(20)		N		Relevant only for laboratory-generated samples. Textual description of the source of standard solutions as needed for certain laboratory samples
13	sample_receipt_time	Text (5)		See Chart 1		Time of sample receipt by laboratory (HH:MM).

Test Import Format - ESI_EFW2LabTST_v2

Pos#	Field Name	Data Type	PK	Required?	VVL?	Field Definition
1	sys_sample_code	Text(40)	PK	Y		Unique sample identifier. Sample Id from chain of custody. Lab sample's sys_sample_code should have the SDG appended to its value to insure uniqueness throughout the life of the EQuIS database..
2	lab_anl_method_ name	Text(35)	PK	Y	Y	Laboratory analytic method name or description.
3	analysis_date	Date	PK	Y		Date of sample analysis (MM/DD/YY).
4	analysis_time	Text(5)	PK	Y		Time of sample collection (HH:MM).
5	total_or_dissolved	Text(1)	PK	Y		"T" for total [metal] concentration, "D" for dissolved or filtered [metal] concentration, "C" for TCLP, or "N" for organic (or other) constituents for which neither "total" nor "dissolved" is applicable.
6	column_number	Text(2)	PK	Y		"1C" for first column analyses, "2C" for second column analyses, or "NA" for analyses for which neither "1C" nor "2C" is applicable.
7	test_type	Text(10)	PK	Y		Type of test. Valid values include "initial", "reextract", and "reanalysis".

Pos#	Field Name	Data Type	PK	Required?	VVL?	Field Definition
8	lab_matrix_code	Text(10)		Y	Table 2	Code that distinguishes between different types of sample matrices
9	analysis_location	Text(2)		Y		Must be either "FI" for field instrument or probe, "FL" for mobile field laboratory analysis, or "LB" for fixed-based laboratory analysis.
10	basis	Text(10)		Y		Must be either "Wet" for wet-weight basis reporting, "Dry" for dry-weight basis reporting, or "NA" for tests for which this distinction is not applicable.
11	container_id	Text(30)		Where applicable		Sample container identifier.
12	dilution_factor	Single		Y		Effective test dilution factor.
13	prep_method	Text(35)		Where applicable		Laboratory sample preparation method name or description.
14	prep_date	Date		Where applicable		Date of sample preparation (MM/DD/YY).
15	prep_time	Text(5)		Where applicable		Time of sample preparation (HH:MM).
16	leachate_method	Text(15)		Where applicable		Laboratory leachate generation method name or description.
17	leachate_date	Date		Where		Date of sample leachate (MM/DD/YY).

Pos#	Field Name	Data Type	PK	Required?	VVL?	Field Definition
				applicable		
18	leachate_time	Text(5)		Where applicable		Time of sample leachate (HH:MM).
19	lab_name_code	Text(10)		Y	Table 4	Unique identifier of the laboratory
20	qc_level	Text(10)		N		Data validation QC level.
21	lab_sample_id	Text(20)		Y		Laboratory sample identifier.
22	percent_moisture	Text(5)		Y		Percent moisture of the sample portion used in this test; this value may vary from test to test for any sample. Numeric format is "NN.MM", i.e., 70.1% could be reported as "70.1" but not as "70.1%".
23	subsample_amount	Text(14)		See Chart 1		Amount of sample used for test.
24	subsample_amount_ unit	Text(15)		See Chart 1	Table 3	Unit of measurement for subsample amount.
25	analyst_name	Text(30)		N		Name or initials of laboratory analyst
26	instrument_id	Text(50)		N		Instrument identifier.
27	comment	Text(255)		N		Comments about the test.
28	preservative	Text(50)		N		Sample preservative used.
29	final_volume	Text(15)		See Chart 1		The final amount of the sample after sample preparation.

Pos#	Field Name	Data Type	PK	Required?	VVL?	Field Definition
30	final_volume_unit	Text(15)		See Chart 1	Table 3	The unit of measure that corresponds to the final_volume

Result Import Format - ESI_EFW2LabRES_v2

Pos #	*Field Name*	Data Type	PK	Required?	VVL?	Field Definition
1	sys_sample_code	Text(40)	PK	Y		Unique sample identifier. Sample Id from chain of custody. Lab sample's sys_sample_code should have the SDG appended to its value to insure uniqueness throughout the life of the EQuIS database.
2	lab_anl_method_name	Text(35)	PK	Y	Y	Laboratory analytic method name or description.
3	analysis_date	Date	PK	Y		Date of sample analysis (MM/DD/YY).
4	analysis_time	Text(5)	PK	Y		Time of sample analysis (HH:MM).
5	total_or_dissolved	Text(1)	PK	Y		"T" for total [metal] concentration, "D" for dissolved or filtered [metal] concentration, or "N" for organic (or other) constituents for which neither "total" nor "dissolved" is applicable.
6	column_number	Text(2	PK	Y		"1C" for first column analyses, "2C" for second column analyses, or "NA" for analyses for which neither "1C" nor "2C" is applicable.
7	test_type	Text(10)	PK	Y		Type of test. Valid values include "initial", "reextract", and "reanalysis".

Pos #	*Field Name*	Data Type	PK	Required?	VVL?	Field Definition
8	cas_rn	Text(15)	PK	Y	Y	Chemical Abstracts Registry Number for the parameter.
9	chemical_name	Text(60)		Y		Chemical name
10	result_value	Text(20)		Where Applicable		Analytic result reported at an appropriate number of significant digits. Must be null for non-detects.
11	result_error_delta	Text(20)		N		Error range applicable to the result value; typically used only for radiochemistry results.
12	result_type_code	Text(10)		Y		Must be either "TRG" for a target or regular result, "TIC" for tentatively identified compounds, "SUR" for surrogates, "IS" for internal standards, or "SC" for spiked compounds.
13	reportable_result	Text(10)		Y		Y/N field used to indicate whether a result is reportable.
14	detect_flag	Text(2)		Y		Y/N field used to indicate whether a result is detected
15	lab_qualifiers	Text(7)		N		Qualifier flags assigned by the laboratory.
16	organic_yn	Text(1)		Y		Y/N field used to indicate whether a result is organic.

Pos #	*Field Name*	Data Type	PK	Required?	VVL?	Field Definition
17	method_detection_limit	Text(20)		Y		Method detection limit.
18	reporting_detection_limit	Text(20)		Y		Detection limit that reflects conditions such as dilution factors and moisture content.
19	quantitation_limit	Text(20)		Y		Concentration level above which results can be quantified with confidence. It must reflect conditions such as dilution factors and moisture content.
20	result_unit	Text(15)		Y	Table 3	Units of measurement for the result.
21	detection_limit_unit	Text(15)		Y	Table 3	Units of measurement for the reporting limit(s).
22	tic_retention_time	Text(8)		N		Retention time in seconds for tentatively identified compounds.
23	result_comment	Text(255)		N		Result specific comments.
24	qc_original_conc	Text(14)		See Chart 2		The concentration of the analyte in the original (unspiked) sample.
25	qc_spike_added	Text(14)		See Chart 2		The concentration of the analyte added to the original sample.
26	qc_spike_measured	Text(14)		See Chart 2		The measured concentration of the analyte. Use zero for spiked compounds that were not detected in the sample.

Pos #	*Field Name*	Data Type	PK	Required?	VVL?	Field Definition
27	qc_spike_recovery	Text(14)		See Chart 2		The percent recovery calculated.
28	qc_dup_original_conc	Text(14)		See Chart 2		The concentration of the analyte in the original (unspiked) sample.
29	qc_dup_spike_added	Text(14)		See Chart 2		The concentration of the analyte added to the original sample. Use zero for spiked compounds that were not detected in the sample.
30	qc_dup_spike_measured	Text(14)		See Chart 2		The measured concentration of the analyte in the duplicate. Use zero for spiked compounds that were not detected in the sample.
31	qc_dup_spike_recovery	Text(14)		See Chart 2		The duplicate percent recovery calculated.
32	qc_rpd	Text(8)		See Chart 2		The relative percent difference calculated.
33	qc_spike_lcl	Text(8)		See Chart 2		Lower control limit for spike recovery.
34	qc_spike_ucl	Text(8)		See Chart 2		Upper control limit for spike recovery.
35	qc_rpd_cl	Text(8)		See Chart 2		Relative percent difference control limit.
36	qc_spike_status	Text(10)		See Chart 2		Used to indicate whether the spike recovery was within control limits. Use the "*" character to indicate failure, otherwise leave blank.

Pos #	*Field Name*	Data Type	PK	Required?	VVL?	Field Definition
37	qc_dup_spike_status	Text(10)		See Chart 2		Used to indicate whether the duplicate spike recovery was within control limits. Use the "*" character to indicate failure, otherwise leave blank.
38	qc_rpd_status	Text(10)		See Chart 2		Used to indicate whether the relative percent difference was within control limits. Use the "*" character to indicate failure, otherwise leave blank.

Batch Import Format - ESI_EFW2LabBCH_v2

Pos #	Field Name	Data Type	PK	Required?	VVL?	Field Definition
1	sys_sample_code	Text (40)	PK	Y		Unique sample identifier. Sample Id from chain of custody. Lab sample's sys_sample_code should have the SDG appended to its value to insure uniqueness throughout the life of the EQuIS database.
2	lab_anl_method_name	Text (35)	PK	Y	Y	Laboratory analytic method name or description.
3	analysis_date	Date	PK	Y		Date of sample analysis (MM/DD/YY).
4	analysis_time	Text(5)	PK	Y		Time of sample analysis (HH:MM).
5	total_or_dissolved	Text(1)	PK	Y		"T" for total [metal] concentration, "D" for dissolved or filtered [metal] concentration, or "N" for organic (or other) constituents for which neither "total" nor "dissolved" is applicable.
6	column_number	Text(2)	PK	Y		"1C" for first column analyses, "2C" for second column analyses, or "NA" for analyses for which neither "1C" nor "2C" is applicable.
7	test_type	Text(10)	PK	Y		Type of test. Valid values include "initial", "reextract", and "reanalysis".

Pos #	Field Name	Data Type	PK	Required?	VVL?	Field Definition
8	test_batch_type	Text(10)	PK	Y		Lab batch type. Valid values include "Prep", "Analysis", and "Leach".
9	test_batch_id	Text(20)		Y		Unique identifier for all lab batches. For example, the same identifier cannot be used for a prep batch and an analysis batch.

EQuIS VALID VALUES

Table 1 - Sample Types

Sample_type_code	Sample_type_desc
AB	Ambient Conditions Blank
BD	Blank Spike Duplicate
BS	Blank Spike
EB	Equipment Blank
FD	Field Duplicate
FR	Field Replicate
LB	Lab Blank
LR	Lab Replicate
MB	Method Blank
MS	Lab Matrix Spike
N	Normal Environmental Sample
RB	Material Rinse Blank
SD	Lab Matrix Spike Duplicate
TB	Trip Blank

Table 2 - Matrix Codes

Matrix_code	Matrix_desc
A	Aqueous
AIR	Air
S	Solid
W	Wipe

Table 3 - Unit of Measure

Reported_unit	Unit_desc	Reported_ unit	Unit_desc
%v/v	percent by volume	g/kg	grams per kilogram
1/s	per second	g/l	grams per liter
acre ft	acre feet	g/m2/yr	grams per square meter per year
acres	acres	g/ml	grams per milliliter
admi color	admi (american dye manufacturers institute) color units	gal	gallons
bars	bars	gal/min	gallons per minute
cfs	cubic feet per second	gpd	gallons per day
cfu/100ml	colony forming units per 100 milliliters	gpd/ft	gallons per day per foot
cfu/g	colony forming units per gram	gpd/ft2	gallons per day per foot squared
cfu/ml	colony forming units per milliliters	gpm/ft	gallons per minute per foot
cm	centimeters	gpy	gallons per year
cm/hr	centimeters per hour	hrs	hours
cm/sec	centimeters per second	hrs/day	hours per day
cm/yr	centimeters per year	in	inches
cm2/sec	square centimeters per second	in(hg)	inches of mercury
colf/100ml	coliform bacteria per 100 milliliters	in/day	inches per day
colf/g	coliform bacteria per gram	in/ft	inches per foot
color unit	color unit	in/hr	inches per hour
day	days	in/in	inches per inch
deg c	degrees Celsius	in/wk	inches per week
deg c/hr	degrees Celsius per hour	in2/ft	square inches per foot
deg f	degrees Fahrenheit	jcu	jackson candle units
digits	number of digits to the right of the decimal point	jtu	jackson turbidity units
dollars	dollars	kg/1000gal	kilograms per 1000 gallons
dpy	drums per year	kg/batch	kilograms per batch
dynes/cm	dynes per centimeter	kg/day	kilograms per day
fibers/l	fibers per liter	kg/m3	kilogram per meter cubed
ft	feet	kg/m3/s	kilogram per meter cubed per second
ft candles	foot candles	kg/s	kilogram per second
ft msl	feet above mean sea level	km2	square kilometers
ft/day	feet per day	knots	knots
ft/in	feet per inch	lb/1000lb	pounds per thousand pounds
ft/min	feet per minute	lb/barrel	pound per barrel

ft/sec	feet per second	lb/in2	pounds per square inch
ft2	square feet	lb/ton	pounds per ton
ft2/day	square feet per day (cubic feet/day-foot)	lbs	pounds
ft2/min	feet squared per minute (for units of transmissivity)	lbs/day	pounds per day
ft3	cubic feet	lbs/mon	pounds per month
ft3/yr	cubic feet per year	lbs/yr	pounds per year
g/cc	grams per cubic centimeter	m	meter
g/g	grams per gram	m/day	meters per day
m/s	meter per second	pci/g	picocuries per gram
m2	meter squared	pci/l	picocuries per liter
m2/s	meter squared per second	pci/ml	picocuries per milliliters
m3 x 10(6)	meter cubed (in millions)	per loss	percent loss
m3/kg	meter cubed per kilogram	percent	percent
m3/s	meter cubed per second	pg/g	picogram per gram
meq/100g	milliequivalents per 100 grams	pg/kg	picograms per kilogram
mg/100cm2	Milligrams per 100 square centimeters	pg/l	picogram per liter
mg/flt	Milligrams per filter	pg/m3	picograms per cubic meter
mg/g	Milligrams per gram	pg/ul	picograms per microliter
mg/kg	milligrams per kilogram	ph units	ph units
mg/l	milligrams per liter	ppb	parts per billion
mg/m2	milligrams per square meter	ppbv	parts per billion by volume
mg/m2/day	milligrams per meter squared per day	ppm	parts per million
mg/m3	milligrams per cubic meter (ppbv)	ppmv	parts per million by volume
mg/ml	milligrams per milliliter	pptv	parts per trillion by volume
mgal	million gallons	psf	pounds per square foot
mgd	millions of gallons per day	psi	pounds per square inch
mgdo/l	milligrams dissolved oxygen per liter	s	second
mgm	millions of gallons per month	t.o.n.	threshold order number
mgy	millions of gallons per year	tons/acre	tons per acre
mile2	square miles	tons/day	tons per day
miles	miles	ug/100cm2	micrograms per 100 square centimeters
mill ft3	million feet cubed	ug/cm2	microgram per square centimeters
millivolts	millivolts	ug/g	micrograms per gram
min	minutes	ug/kg	micrograms per kilogram
ml	milliliter	ug/l	micrograms/liter
ml/l	milliliter per liter	ug/m3	micrograms per cubic meter
mm	millimeter	ug/yr	micrograms per year
mm/m2/hr	millimeter per meter squared per hour	um/sec	micrometer per second

mm/yr	millimeter per year	umhos/cm	umhos per centimeter
mmhos/cm	milliohms (mmhos) per centimeter	upy	units per year
mol %	mole percent		
mon	month		
mph	miles per hour		
mpn/100ml	most probable number per 100 ml		
ms/cm	microsiemens per centimeter		
naut.mile	nautical mile		
ng/100cm2	nanograms per 100 square centimeters		
ng/g	nanograms per gram		
ng/kg	nanogram per kilogram		
ng/l	nanogram per liter		
ng/m3	nanogram per cubic meter		
ng/ml	nanograms per milliliter		
none	no unit of measure		
ntu	nephelometric turbidity units		
pcf	pounds per cubic foot		

Table 4 – Laboratory Name

Lab Code	Lab name
ESC	ESC Lab Sciences
MB-KNOX	Microbac - Knoxville Division
TA	TEST AMERICA
TAA	TEST AMERICA - ANCHORAGE
TAK	Test America Knoxville
TAN	Test America Nashville
TAP	TEST AMERICA PORTLAND
TAPitt	Test America Pittsburgh

Chart 1 – Sample Level Required Fields

	AB	BD	BS	EB	FD	FR	LB	LR	MB	MS	N	RB	SD	TB
parent_sample_code		X	X					X		X			X	
sample_date	X			X	X	X					X	X		X
sample_time	X			X	X	X					X	X		X
sample_receipt_date	X			X	X	X					X	X		X
sample_receipt_time	X			X	X	X					X	X		X
subsample_amount	X			X	X	X	X		X	X	X	X	X	X
subsample_amount_unit	X			X	X	X	X		X	X	X	X	X	X
final_volume	X			X	X	X	X		X	X	X	X	X	X
final_volume_unit	X			X	X	X	X		X	X	X	X	X	X

Chart 2 – Result Level Required Fields

	TRG												
	AB	BD	BS	EB	FD	FR	LB	LR	MS	N	RB	SD	TB
qc_original_conc					X	X		X	X				
qc_spike_added			X						X				
qc_spike_measured			X						X				
qc_spike_recovery			X						X				
qc_dup_original_conc		X										X	
qc_dup_spike_added		X										X	
qc_dup_spike_measured		X										X	
qc_dup_spike_recovery		X										X	
qc_rpd		X						X				X	
qc_rpd_cl		X						X				X	
qc_spike_lcl		X	X						X			X	
qc_spike_ucl		X	X						X			X	
qc_spike_status			X						X				

	SUR												
	AB	BD	BS	EB	FD	FR	LB	LR	MS	N	RB	SD	TB
qc_original_conc													
qc_spike_added	X		X	X	X	X	X	X	X	X	X		X
qc_spike_measured	X		X	X	X	X	X	X	X	X	X		X
qc_spike_recovery	X		X	X	X	X	X	X	X	X	X		X
qc_spike_recovery													
qc_dup_spike_added		X										X	
qc_dup_spike_measured		X										X	
qc_dup_spike_recovery		X										X	
qc_rpd													
qc_rpd_cl													
qc_spike_lcl	X	X	X	X	X	X	X	X	X	X	X	X	X
qc_spike_ucl	X	X	X	X	X	X	X	X	X	X	X	X	X
qc_spike_status	X		X	X	X	X	X	X	X	X	X		X
qc_dup_spike_status		X										X	
qc_rpd_status													

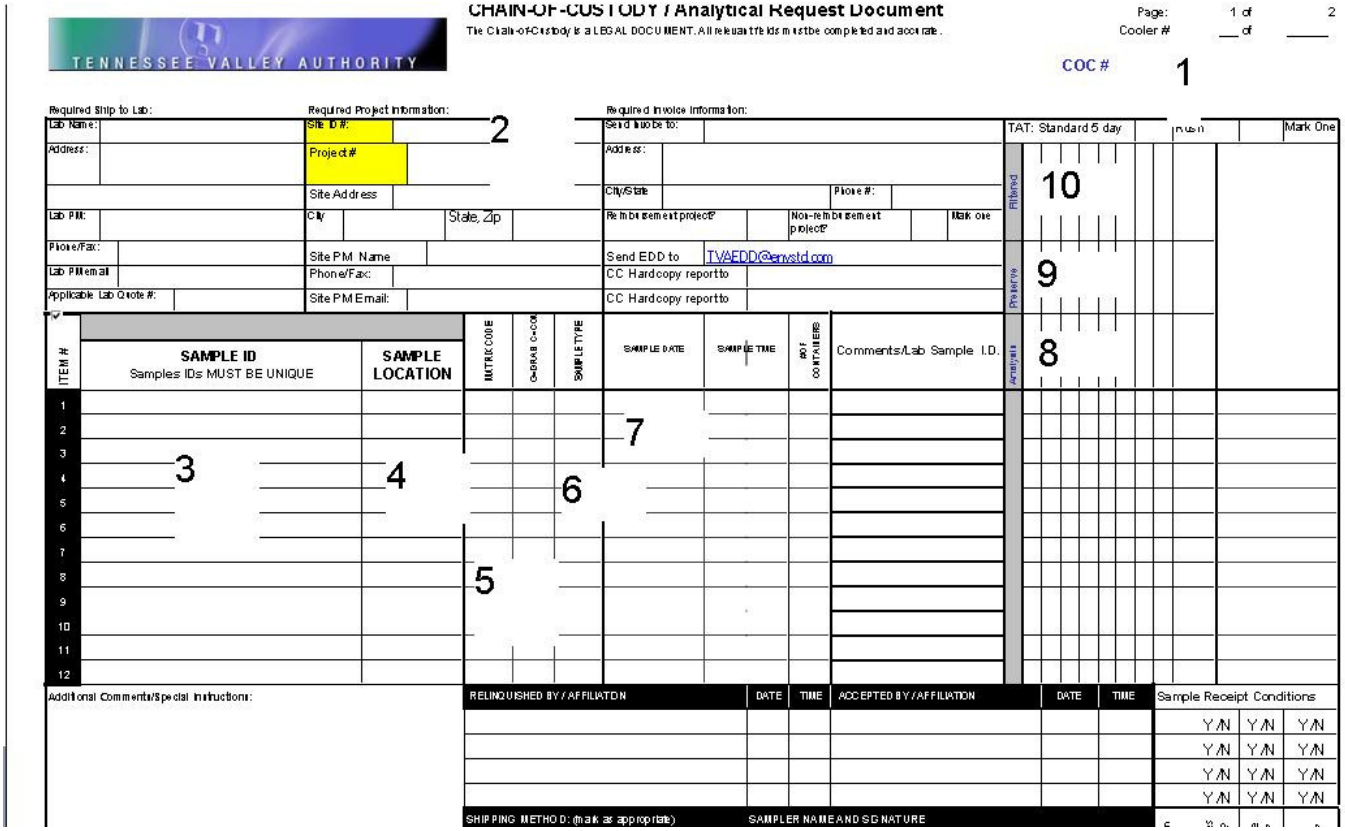

Figure 1: Chain of Custody

Chain of Custody/EDD Match

Chain of Custody Field	EDD Format File	EDD Column
1. Chain of Custody	- ESI_EFW2FSample_v2	Chain_of_custody
		Task_code
	- ESI_EFW2LabSMP	Chain_of_custody
2. Site #	EDD Zip File Deliverable	Site Name
3. Sample ID	ALL EDD Format Files	Sys_sample_code
	- ESI_EFW2FSample_v2	Sample_name
4. Sample Location	- ESI_EFW2FSample_v2	Sys_loc_code
5. Matrix Code	- ESI_EFW2FSample_v2 - ESI_EFW2LabSMP	Sample_matrix_code
6. Sample Type	- ESI_EFW2FSample_v2 - ESI_EFW2LabSMP	Sample_type_Code
7. Sample Date & Time	ALL EDD Format Files	Sample Date, Sample Time

Chain of Custody Field	EDD Format File	EDD Column
8. Analysis	- ESI_EFW2FSample_v2	Method_analyte_group

APPENDIX C

Table C1
Sample Vessel/Media Shipment Preparation
Quality Control Requirements

Item	Requirement	Activity	Corrective Action
Sample Vessels/Media	Sample containers must be pre-cleaned and pre-certified clean. Sample vessels/media must be certified for all analytical parameters for which the bottle type is to be used for collection to the project-required reporting limit. Sample vessel/media and preservative lot numbers must be recorded for each outgoing bottleware shipment to maintain traceability. Sufficient sample vessels/media of appropriate volume must be provided for the collection of project samples. Triple the number of sample containers will be provided for the collection of MS/MSD samples. For extractable methods, the laboratory must provide sufficient bottleware to allow for reextraction in the event of a QC failure.	Documentation of bottleware cleanliness must be maintained and available for inspection.	N/A

Table C1
Sample Vessel/Media Shipment Preparation
Quality Control Requirements

Item	Requirement	Activity	Corrective Action
Sample Documentation	The sampling personnel will complete a TVA COC. If requested, the laboratory must provide blank container labels. Sample container labels, if requested, must include the following information at a minimum: site location, sample number, analytical method, and preservative.	The laboratory must provide sample containers and blank container labels when requested.	N/A
Preservatives	The laboratory must provide high-purity preservatives for the bottleware supplied for samples collected for analytes/methods requiring preservative. Lot numbers of preservatives added to the sample containers must be recorded to maintain traceability to each container in each bottleware shipment. The laboratory must label each bottle of preservative utilized in the laboratory with the preparation date (as applicable for prepared reagents), the lot number, the concentration, and the expiration date.	Preservatives must be pre-tested to ensure the preservative is free from contamination to the project reporting limit for all analytes of concern.	The laboratory will be held responsible for any resampling/reanalysis resulting from the use of contaminated preservatives.

Table C1
Sample Vessel/Media Shipment Preparation
Quality Control Requirements

Item	Requirement	Activity	Corrective Action
Field Blanks/ Rinse Blanks/ Equipment Blanks/ Bottle Blanks	Ultra-pure, deionized water must be provided for use when field personnel collect field, rinse, bottle, or equipment blanks.	Target compounds/analytes must not be present at concentrations greater than the project-specified reporting limit. All blanks must meet QC criteria (*e.g.*, surrogates, internal standards).	Field blanks, rinse blanks, bottle blanks, and equipment blanks must not be reanalyzed solely for the purpose of reporting "not-detected" results. Blanks may only be reanalyzed if there is a valid technical reason for reanalysis (*e.g.,* injection failure or QC failure). If target compounds/analytes are detected at concentrations greater than the project reporting limit, the TVA QA Specialist technical liaison and Environmental Standards QA oversight representative must be notified immediately.
Chain-of-Custody	All bottleware shipments must be documented under COC procedures.	The laboratory must place sample containers in appropriate custody-sealed sample coolers for outgoing shipment.	When tampering with bottleware shipments is evident, the TVA QA Specialist technical liaison and Environmental Standards QA oversight representative must be notified immediately for instructions on how to proceed.

Table C2
Sample Receipt
Quality Control Requirements

Quality Control Item	Requirement	Activity	Corrective Action
Sample Receipt and Custody	The validated time of sample receipt (VTSR) must be recorded as the time the samples arrive at the laboratory, not the time the cooler is opened. Samples received outside of the laboratory's normal hours of operation must be unpacked; the COC must be signed and dated with the date and time of sample receipt; and the temperature of the cooler must be measured and documented on the COC prior to placement in cold storage. The Sample Custodian must document the conditions of samples upon receipt at the laboratory utilizing a hard copy or electronic sample receipt checklist. The integrity of each sample container must be documented; broken or leaking bottles are not acceptable. The Sample Custodian must note the condition of the custody seals and any discrepancies between the sample label information and field COC documentation.	Completed COCs must be received. The Laboratory Sample Custodian must sign and record the date and time of sample receipt as well as the temperature of the cooler on the COC Record upon sample arrival. A sample receipt checklist documenting the integrity of the samples and the consistency of the sample documentation will be completed.	Provide an e-mail to the TVA QA specialist technical liaison and Environmental Standards if sample integrity has been compromised or if discrepancies between the sample label information and the field COC documentation are identified.

Table C2
Sample Receipt
Quality Control Requirements

Quality Control Item	Requirement	Activity	Corrective Action
Temperature	A calibrated thermometer must be used to measure the temperature of the temperature blank in the cooler or utilize a calibrated IR gun to determine sample temperature upon receipt. If an IR gun is utilized, the temperature should be determined by pointing the IR gun at the bottle label of a representative sample in the cooler. The temperature measuring device must be calibrated on a minimum of an annual basis utilizing a NIST-certified thermometer. Temperature measurements must take into account any correction factors of the temperature device. All temperature devices must be labeled with a unique ID, the date of last calibration, the due date for the next calibration, and a correction factor. The temperature of the sample cooler must be documented on the COC Record.	The temperature of the samples upon receipt at the laboratory must be < 6°C (not frozen). The laboratory must prepare a nonconformance report that documents all samples received at temperatures outside of the acceptance criteria. When multiple coolers are received for a single sampling event and the temperature of one or more coolers is outside of the acceptance range, the laboratory must provide a listing of the affected samples and specific containers.	Provide an e-mail to the TVA QA Specialist technical liaison and Environmental Standards QA oversight representative if samples are received outside of the temperature range.

Table C2
Sample Receipt
Quality Control Requirements

Quality Control Item	Requirement	Activity	Corrective Action
Preservation	All preservatives added to project samples must be pretested to ensure purity. The pH of each preserved sample must be checked upon laboratory receipt. The pH verification must be documented on the sample receipt checklist.	Sample pH must meet method requirements.	The lot number of preservatives added to sample bottleware must be documented and traceable. The amount of preservative and the time of addition of the preservative must also be documented. Provide an e-mail to the TVA QA Specialist technical liaison and Environmental Standards QA oversight representative if the sample pH does not meet method requirements. If so directed by the TVA QA Specialist technical liaison and Environmental Standards QA oversight representative, the same type and amount of preservative must be added to any associated field blank and documented.
Holding Time	Check each sample/parameter for holding time.	Holding time must meet method requirements.	Provide an e-mail to the TVA QA Specialist technical liaison and Environmental QA oversight representative if the sample must be analyzed outside of holding time.
Sample Storage	All samples requiring temperature preservation must be stored according to method preservation requirements.	The sample storage refrigerators must be maintained at the method-specified temperature requirements. Sample storage freezers must be maintained at < -10°C. Sample storage cooler temperatures must be verified daily (at a minimum).	Provide an e-mail to the TVA QA Specialist technical liaison and Environmental Standards QA oversight representative if storage acceptance criteria are not met. When sample storage cooler temperatures are outside of the acceptance range, the laboratory must document corrective action taken. Resampling may be required for samples stored in the out-of-criteria units.

Table C2
Sample Receipt
Quality Control Requirements

Quality Control Item	Requirement	Activity	Corrective Action
Sample Identification	Each sample and container must be assigned a unique laboratory sample identification.	N/A	N/A

Table C3
Metals by ICP-AES – SW-846 Method 6010B/US EPA Method 200.7
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Initial Calibration, Verification, and Blank (ICV/ICB)	Once per 24 hours and each time the instrument is set up. Initial calibration consists, at a minimum, of a blank and one standard verified with a low and mid standard with acceptance of 90-110%. Alternatively, the instrument may be calibrated using a blank and three or more standards with a minimum correlation coefficient of 0.995. Immediately after instrument calibration, the ICV standard must be analyzed. ICV standard must be prepared from a second, independent source. An initial calibration blank (ICB) must be analyzed immediately following the ICV.	ICV must be within 90-110% recovery for SW-846 Method 6010B and 95-105% for US EPA Method 200.7. Absolute value of ICB must be within 2× the MDL or less than the RL, whichever is lower. If a blank and one standard are used for the initial calibration, the calibration must be verified with two check standards (a mid-level and a high) with acceptance criteria of 90-110%. The ICV and RL standard can be used for verification but must be from a second source and must be at differing concentrations.	If either the ICV or ICB do not meet acceptance criteria, terminate analysis, correct problem, recalibrate instrument, and verify calibration.

Table C3
Metals by ICP-AES – SW-846 Method 6010B/US EPA Method 200.7
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Continuing Calibration Verification and Blank (CCV/CCB)	CCVs and CCBs must be analyzed at the beginning of each analysis run (immediately following ICB), at the end of each analysis run, and once per 10 samples. Samples must be bracketed by two successful CCVs. CCB must be analyzed immediately following CCV.	CCV must be within 90-110% recovery. Absolute value of CCB must be within 2× the MDL or <RL, whichever is lower.	Terminate analysis, correct problem, recalibrate instrument, verify calibration, and reanalyze all analytical samples since the last compliant CCV/CCB.
Reporting Limit Standard (RL)	RL standard analyses are required at the beginning and end of every analysis run (maximum 8 hours). Not to be analyzed before the ICV.	Recoveries must be between 80-120%	Terminate analysis, correct problem, recalibrate instrument, verify calibration, and reanalyze all associated analytical samples. If not feasible due to project TAT requirements, flag data and report unacceptable percent recoveries in the SDG Narrative.
ICP Interference Check Samples (ICSA and ICSAB)	The ICSA and ICSAB must be analyzed at the beginning and end of each analytical run (maximum 8 hours) but not before the CCV.	ICSA and ICSAB recoveries must be within 80-120% for the analytes included in each standard. The absolute value of the concentrations for analytes not spiked into the ICSA must be less than 2× the RL.	If either criterion is not met, terminate the analysis, correct the problem, recalibrate the instrument, and reanalyze all project samples and QC samples since last compliant ICSA/ICSAB.

Table C3
Metals by ICP-AES – SW-846 Method 6010B/US EPA Method 200.7
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Preparation Blank for SW-846 Method 6010B Laboratory Reagent Blank (LRB) for US EPA Method 200.7	One per digestion batch of ≤ 20 samples per matrix per day. Must undergo all sample preparative procedures. If dissolved metals and total metals are to be analyzed, a preparation blank must be prepared for each and the dissolved preparation blank must be filtered.	The absolute value of the concentration must not exceed the RL of the analyte. The LRB < 2.2 X MDL	Redigest and reanalyze all associated samples. Corrective action is not required if the contaminant concentration is > 10× blank level in all associated samples or if blank contaminant is "not detected" in the associated samples.
Laboratory Control Sample (LCS) for SW-846 Method 6010B Laboratory Fortified Blank (LFB) for US EPA Method 200.7	One per batch of ≤ 20 samples per matrix per day. Must be from a second source. If dissolved and total metals are to be analyzed, an LCS must be prepared for each and the dissolved LCS must undergo filtration.	80-120% recovery for aqueous or "synthetic" solid (Teflon chip or glass beads) or within manufacturer's control limits for solids. The LFB must be within 85-115% recovery	Terminate analysis, correct problem, and redigest and reanalyze all associated samples.
Pre-Digestion Matrix Spike/Matrix Spike Duplicates (MS/MSD) for SW-846 Method 6010B Laboratory Fortified Matrix (LFM) for US EPA Method 200.7	One per batch of ≤ 20 samples per matrix per day for SW-846 Method 6010B and one per batch of ≤ 10 samples per matrix per day for US EPA Method 200.7 . Must undergo all sample preparative procedures.	75-125% recovery. For precision, use RPD limits of 20% for aqueous samples and 35% for solid samples. Not applicable if sample concentration is > 4× spike added.	Flag all associated data and report any unacceptable recoveries in the SDG Narrative; matrix effect may be the cause. The redigestion, reanalysis, or otherwise performance of additional corrective action on the MS/MSD is acceptable only if the same corrective action is also performed on the entire SDG of samples.

Table C3
Metals by ICP-AES – SW-846 Method 6010B/US EPA Method 200.7
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Post-Digestion Matrix Spike	One per batch of ≤ 20 samples per matrix per day performed on the same sample as the pre-digestion matrix spike. Must undergo all sample preparative procedures.	80-120% recovery of the known value or within laboratory acceptance criteria.	Note any unacceptable recoveries or precision in the SDG Narrative.
Laboratory Duplicate	One per batch of ≤ 20 samples per matrix per day. Must undergo all sample preparative procedures.	RPD 20% for aqueous and 35% for solid when results are ≥ 5× RL or ± the RL for aqueous and ± 2× RL for solids if sample or duplicate result is < 5× RL.	Flag all associated data and report unacceptable precision in the SDG Narrative. The redigestion, reanalysis, or otherwise performance of additional corrective action on the laboratory duplicate is acceptable only if the same corrective action is also performed on the entire SDG of samples.
ICP Serial Dilution (five-fold)	One per batch of ≤ 20 samples per matrix per day. Must undergo all sample preparative procedures.	Within 10% difference if the original sample concentration is ≥ 50× IDL or MDL.	Flag data and report unacceptable percent differences in the SDG Narrative.

Table C3
Metals by ICP-AES – SW-846 Method 6010B/US EPA Method 200.7
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Qualitative/ Quantitative Issues	If the instrument level of any target analyte in a sample exceeds the calibration range for SW-846 Method 6010B or > 90% of the linear range for US EPA Method 200.7,, the sample must be diluted and reanalyzed. For all multiple injections/integrations, the Coefficient of Variation (CV) must be evaluated.	The instrument level of all target compounds must be within the calibration range. CV must be < ± 20%.	Dilute the sample to bring the target compound level within the calibration range. When the CV is > 20% (for samples with concentration > the RL), rerun once. Report the results for the analysis displaying the lower CV.

Table C3
Metals by ICP-AES – SW-846 Method 6010B/US EPA Method 200.7
Quality Control Requirements

Notes:

- Aqueous samples for total metals must be preserved with nitric acid to a pH < 2. All dissolved samples must be preserved to a pH <2 after filtration. Sample pH must be measured and recorded at the time of sample receipt on the sample receipt checklist. See sample receipt QC Requirements (Table 2) if samples are not received with proper preservation.

- Solid/soil samples must be preserved to a temperature of < 6°C (not frozen).

- All samples must be digested and analyzed within 180 days of sample collection.

- MS/DUP samples must be prepared and analyzed concurrently with the project samples.

- When the LCS target compound recovery criteria are not met (confirmed by reanalysis), the entire batch must be reprepped and reanalyzed. Repreparation and reanalysis are not required when high recoveries are observed for a target compound and that compound is not detected in the associated project samples. No action is required when MS/MSD analyses are outside of recovery and/or precision criteria, provided the associated LCS results are within criteria; probable matrix interference must be reported in the SDG Narrative.

- For MS/MSD analyses, acceptance criteria must not be used for %Rs (or RPDs calculated using %Rs) that are outside of criteria if the original concentration of an analyte is > 4× the spiking level for that analyte. RPDs calculated using MS/MSD results can be used to evaluate precision.

- Post-digestion matrix spike analyses are performed once per batch of 20 samples/matrix per day regardless of the recoveries obtained for the pre-digestion matrix spike analyses on the corresponding sample.

- Initial calibration curve points must not be dropped and rerun unless a valid technical reason is identified. The laboratory must provide documentation of the reason for reanalysis of initial calibration points.

Table C3
Metals by ICP-AES – SW-846 Method 6010B/US EPA Method 200.7
Quality Control Requirements

- The ICV standard must be made from an independent (second source) material at or near the midrange of the calibration curve. It is highly preferable that the second-source reference be obtained from a vendor other than the vendor from which the primary reference was purchased. When a single vendor is used to provide the primary and secondary reference, the laboratory must obtain written warranties that the two references were not prepared from the same reference material (a separate lot number is not sufficient to document a second source of reference materials in this case).

- The calibration standards must be prepared using the same type of acid or combination of acids and at the same concentration as the associated sample digests.

- The control limit for solid laboratory duplicates must be corrected for sample weight and percent solids. If both the sample and duplicate values are less than the RL, the RPD should not be calculated.

- Aqueous and solid LCSs must be analyzed for each analyte using the same sample preparations, analytical methods, and QA/QC procedures employed for the samples.

- For the post-digestion spike, the unspiked aliquot of the sample must be spiked at 2× the indigenous level or 2× the RL, whichever is greater. The result of the post-digestion spike must be reported on a post-digestion MS summary form.

- All instrument maintenance, both routine and major maintenance, must be meticulously recorded in the associated instrument logbook.

- Field blanks must not be reanalyzed when contamination is observed.

- Analysis sequence logs must contain <u>all</u> analyses, not only those reported for the project samples.

Table C4
Metals by ICP-MS – SW-846 Method 6020A/ US EPA Method 200.8
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Mass Calibration and Resolution Checks	A mass calibration and resolution check must be performed every time instrument is calibrated before the initial calibration.	Mass calibration must result in differences less than 0.1 amu from the true value. Resolution must also be verified to be less than 0.9 amu full width at 10% peak height.	Mass calibration must be within acceptance criteria before instrument is calibrated and any samples are analyzed.
Initial Calibration, Verification, and Blank (ICV/ICB)	The ICV and ICB must be analyzed once per 24 hours and each time the instrument is set up. Initial calibration consists, at a minimum, of a blank and one standard verified with a low and mid standard with acceptance of 90-110%. Alternatively, the instrument may be calibrated using a blank and three or more standards with a minimum correlation coefficient of 0.995. Immediately after instrument calibration, the ICV standard must be analyzed. ICV standard must be prepared from a second, independent source. An initial calibration blank (ICB) must be analyzed immediately following the ICV.	ICV must be within 90-110% recovery for SW-846 Method 6020A and 95-105% for US EPA Method 200.8. Absolute value of ICB must be within 2× the MDL or less than the RL, whichever is lower. If a blank and one standard are used for the initial calibration, the calibration must be verified with two check standards (a mid-level and a high) with acceptance criteria of 90-110%. The ICV and RL standard can be used for verification but must be from a second source and must be at differing concentrations.	If either the ICV or ICB does not meet acceptance criteria, terminate analysis, correct problem, recalibrate instrument, and verify the new calibration before any samples are analyzed.

Table C4
Metals by ICP-MS – SW-846 Method 6020A/ US EPA Method 200.8
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Continuing Calibration Verification and Blank (CCV/CCB)	CCVs and CCBs must be analyzed at the beginning of the analysis run, (immediately following ICB), at the end of each analysis run, and once per 10 samples a CCV and CCB. Samples must be bracketed by two successful CCVs. CCB must be analyzed immediately following CCV.	CCV must be within 90-110% recovery. Absolute value of CCB must be within 2× the IDL or RL, whichever is lower.	Terminate analysis, correct problem, recalibrate instrument, verify calibration, and reanalyze all analytical samples since the last compliant CCV/CCB.
Internal Standards	Intensities of all internal standards must be monitored for every analysis.	The percent relative intensity (%RI) in a sample must be within 60-125% of the response in the associated calibration blank.	The calibration blank must be immediately reanalyzed if the %RI of the sample does not meet the acceptance criteria. If the low internal standards intensities are also seen in the nearest calibration blank, terminate the analysis, correct the problem, recalibrate, verify the new calibration, and reanalyze the affected samples.
RL Standard	RL standard analyses are required at the beginning and end of every analysis run (maximum 8 hours). Not to be analyzed before the ICV.	80-120% recovery.	Terminate analysis, correct problem, recalibrate instrument, verify calibration, and reanalyze all associated analytical samples. If not feasible due to project TAT requirements, flag data and report unacceptable percent recoveries in the SDG Narrative.
ICP-MS Interference Check Samples (ICSA and ICSAB)	The ICSA and ICSAB must be analyzed at the beginning and end of each analytical run (maximum 8 hours). Not to be analyzed before the ICV.	ICSA and ICSAB are within 80-120% recovery for the analytes included. Absolute value of the concentrations for analytes not spiked into the ICSA must be less than 2× the RL.	In either criterion is not met, terminate the analysis, correct the problem, recalibrate the instrument, and reanalyze all project samples and QC samples since the last compliant ICSA/ICSAB.

Table C4
Metals by ICP-MS – SW-846 Method 6020A/ US EPA Method 200.8
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Preparation Blank for SW-846 Method 6020A Laboratory Reagent Blank (LRB) for US EPA Method 200.8	One per digestion batch of ≤ 20 samples per matrix per day. Must undergo all sample preparative procedures. If dissolved metals and total metals are to be analyzed, a preparation blank must be prepared for each fraction. The preparation blank for dissolved metals must be filtered.	The absolute value of the concentration must not exceed the RL of the analyte. LRB target analytes < 2.2 x MDL	Redigest and reanalyze all associated samples. Corrective action is not required if the contaminant concentration is > 10× blank level in all associated samples or if blank contaminant is "not detected" in the associated samples.
Laboratory Control Sample (LCS) for SW-846 Method 6010B Laboratory Fortified Blank (LFB) for US EPA Method 200.8	One per batch of ≤ 20 samples per matrix per day. Must be from a second source. If dissolved and total metals are to be analyzed, an LCS must be prepared for each and the dissolved LCS must undergo filtration.	80-120% recovery for aqueous or "synthetic" solid (Teflon chip or glass beads) or within manufacturer's control limits for solids. The LFB must be within 85-115% recovery.	Terminate analysis, correct problem, and redigest and reanalyze all associated samples.
Matrix Spike/Matrix Spike Duplicates (MS/MSD) for SW-846 Method 6010B Laboratory Fortified Matrix (LFM) for US EPA Method 200.8	One per batch of ≤ 20 samples per matrix per day for SW-846 Method 6020A. One per 10 samples per matrix per day for US EPA Method 200.8. Must undergo all sample preparative procedures.	For accuracy, use recovery limits of 75-125%. For precision, use RPD limits of 20% for aqueous samples and 35% for solid samples.	MS/MSD recovery criterion is not applicable if sample concentration is > 4×spike added. The redigestion, reanalysis, or otherwise performance of additional corrective action on the MS/MSD is acceptable only if the same corrective action is also performed on the entire SDG of samples. Flag data and report unacceptable precision in the SDG Narrative.

Table C4
Metals by ICP-MS – SW-846 Method 6020A/ US EPA Method 200.8
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Post-Digestion Matrix Spike	One per batch of ≤ 20 samples per matrix per day for SW-846 Method 6020A. One per 10 samples per matrix per day for US EPA Method 200.8. Must be performed on the same sample as the pre-digestion matrix spike. Must undergo all sample preparative procedures.	80-120% recovery of the known value or within laboratory acceptance criteria.	Note any unacceptable recoveries or precision in the SDG Narrative.
Laboratory Duplicate	One per batch of ≤ 20 samples per matrix per day for SW-846 Method 6020A. One per 10 samples per matrix per day for US EPA Method 200.8. Must undergo all sample preparative procedures.	RPD 20% for aqueous and 35% for solid when the results are ≥ 5× the RL or ± the RL for aqueous and ± 2× the RL for solid if sample or duplicate result is < 5× the RL.	Flag data and report unacceptable precision in the SDG Narrative. The redigestion, reanalysis, or otherwise performance of additional corrective action on the MS/MSD is acceptable only if the same corrective action is also performed on the entire SDG of samples.
ICP Serial Dilution (five-fold)	One per batch of ≤ 20 samples per matrix per day. Must undergo all sample preparative procedures.	Within 10% difference if the original sample concentration is ≥ 50× IDL or MDL.	Flag data and report unacceptable percent differences in the SDG Narrative.

Table C4
Metals by ICP-MS – SW-846 Method 6020A/ US EPA Method 200.8
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Qualitative/ Quantitative Issues	If the instrument level of any target analyte in a sample exceeds the calibration range (> 90% of the linear range for US EPA Method 200.8), the sample must be diluted and reanalyzed. For all multiple injections/integrations, the Coefficient of Variation (CV) must be evaluated.	The instrument level of all target analytes must be within the calibration range. CV must be < ± 20%.	Dilute the sample to bring the target analyte level within the calibration range. When the CV is > 20% (for samples with concentration > the RL), rerun once. Report the results for the analysis displaying the lower CV.

Table C4
Metals by ICP-MS – SW-846 Method 6020A/ US EPA Method 200.8
Quality Control Requirements

Notes:

- Aqueous samples for total metals must be preserved with nitric acid to a pH < 2. All dissolved samples must be preserved to a pH <2 after filtration. Sample pH must be measured and recorded at the time of sample receipt on the sample receipt checklist. See sample receipt QC requirements (Table 2) if samples are not received with proper preservation.

- Solid/soil samples must be preserved to a temperature of < 6°C (not frozen).

- All samples must be analyzed within 180 days of collection.

- Prior to analysis, samples must be prepped or digested using appropriate Sample Preparation Methods.

- MS/DUP samples must be prepared and analyzed concurrently with the project samples.

- The average of at least three integrations for both calibration and sample analyses must be used.

- Operating conditions: Follow the instructions provided by the instrument manufacturer. Allow at least 30 minutes for the instrument to equilibrate before analyzing samples. A tuning solution must be analyzed at least four times and relative standard deviation must be ≤ 5% for the analytes contained in the tuning solution.

- For MS/MSD analyses, acceptance criteria must not be used for %Rs (or RPDs calculated using %Rs) that are outside of criteria if the original concentration of an analyte is > 4× the spiking level for that analyte. RPDs calculated using MS/MSD results can be used to evaluate precision.

- Post-digestion matrix spike analyses are performed once per batch of 20 samples/matrix per day regardless of the recoveries obtained for the pre-digestion matrix spike analyses on the corresponding sample.

- Initial calibration curve points must not be dropped and rerun unless a valid technical reason is identified. The laboratory must provide documentation of the reason for reanalysis of initial calibration points.

Table C4
Metals by ICP-MS – SW-846 Method 6020A/ US EPA Method 200.8
Quality Control Requirements

- The ICV standard must be made from an independent (second source) material at or near the midrange of the calibration curve. It is highly preferable that the second-source reference be obtained from a vendor other than the vendor from which the primary reference was purchased. When a single vendor is used to provide the primary and secondary references, the laboratory must obtain written warranties that the two references were not prepared from the same reference material (a separate lot number is not sufficient to document a second source of reference materials in this case).

- The calibration standards must be prepared using the same type of acid or combination of acids and at the same concentration as the associated sample digests.

- Internal standards must be added to all calibration standards, samples, and QC samples. Internal standard area counts and retention times for CCV standards must be compared to the mid-level calibration standard. Sample and QC sample internal standard area counts and retention times must be compared to the associated CCV standard. Internal standard area counts and retention times must meet the criteria specified above.

- Aqueous and solid LCS analyses must be analyzed for each analyte (spiked with all target analytes) using the same preparations, analytical methods, and QA/QC procedures employed for the samples.

- When the LCS analyte recovery criteria are not met (confirmed by reanalysis), the entire batch must be reprepped and reanalyzed. Repreparation and reanalysis are not required when high recoveries are observed for a target compound and that compound is not detected in the associated project samples. No action is required when MS/MSD analyses are outside of recovery and/or precision criteria, provided the associated LCS results are within criteria; probable matrix interference must be reported in the SDG Narrative.

- The control limits for solid laboratory duplicates must be corrected for sample weight and percent solids. If both the sample and duplicate values are less than the RL, the RPD should not be calculated.

- For the post-digestion spike, the unspiked aliquot of the sample must be spiked at 2× the indigenous level or 2× the RL, whichever is greater. The result of the post-digestion spike must be reported on a post-digestion MS summary form.

Table C4
Metals by ICP-MS – SW-846 Method 6020A/ US EPA Method 200.8
Quality Control Requirements

- All instrument maintenance, both routine and major maintenance, must be meticulously recorded in the associated instrument logbook.

- Field blanks must not be reanalyzed when contamination is observed.

- Analysis sequence logs must contain all analyses, not only those reported for the project samples.

- If the MS % Recovery is outside of acceptance criteria, flag all data for that analyte in all samples associated with the spike sample and determined by the same analytical method.

Table C5
SW-846 Method 7470A/US EPA Method 245.1 (Mercury in Water) and Method 7471A (Mercury in Soil)
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Initial Calibration, Verification, and Blank (ICV/ICB)	Once per 24 hours and each time the instrument is set up. Initial calibration consists, at a minimum, of a blank and five digested standards. Immediately after instrument calibration, the ICV standard must be analyzed. ICV must be prepared from a second, independent source and must be digested in the same manner as the project samples. An initial calibration blank (ICB) is analyzed immediately following the ICV.	Correlation coefficient of at least 0.995 for the calibration curve. ICV is within 90-110% recovery. ICB must not contain target analytes at or above ½ the RL.	All criteria must be met or analysis must be terminated, the problem corrected, instrument recalibrated, and a new calibration performed and verified prior to sample analysis.

Table C5
SW-846 Method 7470A/US EPA Method 245.1 (Mercury in Water) and Method 7471A (Mercury in Soil)
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Continuing Calibration Verification and Blank (CCV/CCB)	CCVs and CCBs must be analyzed at the beginning of each analysis run, (immediately following ICB), at the end of each analysis run, and once per 10 samples. Samples must be bracketed by two successful CCVs. CCB must be analyzed immediately following CCV. CCV standards must be digested in the same manner as project samples.	CCV is within 90-110% recovery. CCB must not contain target analytes at or above ½ the RL.	Terminate analysis, correct problem, recalibrate instrument, verify calibration, and reanalyze all analytical samples since the last compliant CCV/CCB.
RL Standard	RL standard analyses are required at the beginning and end of every analysis run. Not to be analyzed before the ICV.	Recoveries between 80-120%.	Terminate analysis, correct problem, recalibrate instrument, verify calibration, and reanalyze all associated analytical samples. If not feasible due to project TAT requirements, flag data and report unacceptable percent recoveries in the SDG Narrative.
Preparation Blank	One per digestion batch of ≤ 20 samples per matrix per day. Must undergo all sample preparative procedures (*e.g.*, digestion).	The absolute value of the concentration must not exceed the RL of the analyte.	Redigest and reanalyze all associated samples. Corrective action is not required if the contaminant concentration is > 10× blank level in all associated samples or if blank contaminant is “not detected” in the associated samples.

Table C5
SW-846 Method 7470A/US EPA Method 245.1 (Mercury in Water) and Method 7471A (Mercury in Soil)
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Laboratory Control Sample (LCS)	One per batch of ≤ 20 samples per matrix per day. Must be from a second source and must undergo all sample preparative procedures (*e.g.*, digestion).	80-120% recovery for aqueous and solid samples.	Check calculations and spike preparation for documentable errors. All samples (including the LCS) after the last acceptable laboratory control sample must be reprepped and reanalyzed, including all appropriate batch QC samples.
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)	One per batch of ≤ 20 samples per matrix per day. Must undergo all sample preparative procedures (*e.g.*, digestion).	75-125% recovery or laboratory control limits. RPD ≤ 20 for precision. Not applicable if sample concentration is > 4× spike added.	Flag all associated data and report any unacceptable recoveries in the SDG Narrative; matrix effect may be the cause. The redigestion, reanalysis, or otherwise performance of additional corrective action on the MS/MSD is acceptable only if the same corrective action is also performed on the entire SDG of samples.
Laboratory Duplicate	One per batch of ≤ 20 samples per matrix per day. Must undergo all sample preparative procedures (*e.g.*, digestion).	RPD 20% for aqueous and 35% for solid when results are ≥ 5× the RL or ±RL for aqueous and ± 2× RL for solids if sample or duplicate result is < 5× the RL.	Flag all associated data and report unacceptable precision in the SDG Narrative. The redigestion, reanalysis, or otherwise performance of additional corrective action on the laboratory duplicate is acceptable only if the same corrective action is also performed on the entire SDG of samples.
Post-digestion Spike	One per batch of ≤ 20 samples per matrix per day. Must undergo all sample preparative procedures (*e.g.*, digestion).	85-115% recovery for the sample.	Flag all associated data and report unacceptable recoveries in the SDG Narrative.

Table C5
SW-846 Method 7470A/US EPA Method 245.1 (Mercury in Water) and Method 7471A (Mercury in Soil)
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Coefficient of Variation (CV)	All reported results must be the average of at least two integrations per sample injection if instrument capability allows.	± 20%.	If the concentration is > the RL, rerun once. Report the results for the analysis displaying the lower CV.
Qualitative/ Quantitative Issues	If the instrument level of mercury in a sample exceeds the calibration range, the sample must be diluted and reanalyzed.	The instrument level of mercury must be within the calibration range.	Dilute the sample to bring the mercury level within the calibration range.

Table C5
SW-846 Method 7470A/US EPA Method 245.1 (Mercury in Water) and Method 7471A (Mercury in Soil)
Quality Control Requirements

Notes:

- Aqueous samples for total metals must be preserved with nitric acid to a pH < 2; preservation must be verified and recorded upon sample receipt.

- Solid/soil samples must be preserved to a temperature of < 6°C (not frozen).

- The holding time for preparation and analysis of samples for mercury is 28 days from sample collection.

- Initial calibration curve points must not be dropped and rerun unless a valid technical reason is identified. The laboratory must provide documentation of the reason for reanalysis of initial calibration points.

- The ICV standard must be prepared from an independent (second source) material at or near the midrange of the calibration curve. It is highly preferable that the second-source reference be obtained from a vendor other than the vendor from which the primary reference was purchased. When a single vendor is used to provide the primary and secondary reference, the laboratory must obtain written warranties that the two references were not prepared from the same reference material (a separate lot number is not sufficient to document a second source of reference materials in this case).

- The calibration standards must be prepared using the same type of acid or combination of acids and at the same concentration as the associated project samples.

- The CCV standards must be made from the same material as the initial calibration standards at or near midrange.

- Calibration standards can be prepared fresh each time a batch of samples is analyzed. The ICV standard must be prepared daily and if within acceptance criteria, calibration standards do not need to be prepared daily and may be stored for as long as the calibration standard can be verified through the use of the ICV. If the ICV is outside of acceptance criteria, the calibration standards must be prepared fresh and the instrument recalibrated.

- MS/MSD/DUP samples must be prepared and analyzed concurrently with the project samples.

Table C5
SW-846 Method 7470A/US EPA Method 245.1 (Mercury in Water) and Method 7471A (Mercury in Soil)
Quality Control Requirements

- The method of standard additions (MSA) is the addition of known amounts of standard to one or more aliquots of the processed sample solution. This technique attempts to compensate for a sample that enhances or depresses the analyte signal causing a shift in the calibration slope. MSA may be appropriate for analysis of extracts, when a new sample matrix is analyzed, and on every batch that fails the recovery test.

- When the LCS target compound recovery criteria are not met (confirmed by reanalysis), the entire batch must be reprepped and reanalyzed. Repreparation and reanalysis are not required when high recoveries are observed and mercury is not detected in the associated project samples. No action is required when MS/MSD analyses are outside of recovery and/or precision criteria, provided the associated LCS results are within criteria; probable matrix interference must be reported in the SDG Narrative.

- For MS/MSD analyses, acceptance criteria must not be used for %Rs (or RPDs calculated using %Rs) that are outside of criteria if the original concentration of mercury is > 4× the spiking level. RPDs calculated using MS/MSD results can be used to evaluate precision.

- The control limit for solid laboratory duplicates must be corrected for sample weight and percent solids. If both the sample and duplicate values are < the RL, the RPD should not be calculated.

- Aqueous and solid LCSs must be analyzed using the same sample preparations, analytical methods, and QA/QC procedures employed for the samples.

- If the MS recovery is outside of acceptance criteria, flag all data in all samples associated with the spike sample and determined by the same analytical method.

Table C6

Alkalinity – Standard Method 2320B Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Two-Point Calibration of pH Meter With Verification Using Buffers 4, 7, and 10	Daily prior to sample analysis	Buffers 4, 7, and 10 must be within ± 0.05 pH units of true value	Recalibrate. Prepare new standards and recalibrate if still out.
Continuing Calibration Verification (CCV)	Beginning of run, after every 10 samples, and end of run.	Buffer 7 must be within ± 0.05 pH units of true value	Recalibrate. Re-prepare and reanalyze all samples after last acceptable CCV.
Method Blank	One per batch of ≤20 samples per day. Must undergo all sample preparative procedures.	< reporting limit	Reanalyze all associated samples.
Laboratory Control Sample	One per batch of ≤20 samples per day. Must undergo all sample preparative procedures. Must be prepared (or purchased certified solution) at a concentration at or near the mid-point of the calibration curve.	80-120%	Reanalyze all associated samples.
Laboratory Duplicate	One per batch of ≤20 samples, per day.	RPD < 20%	Flag all associated data and report unacceptable precision in the SDG Narrative. The reanalysis otherwise performance of additional corrective action on the laboratory duplicate is acceptable only if the same corrective action is also performed on the entire SDG of samples.

Table C7

Total Suspended Solids (TSS) – Standard Methods 2540D/US EPA Method 160.1
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Method Blank	One per batch of ≤20 samples, per day. Must undergo all sample preparative procedures.	< reporting limit	Reanalyze all associated samples.
Laboratory Control Sample	One per batch of ≤20 samples per day. Must undergo all sample preparative procedures.	90-110%	Reanalyze all associated samples.
Laboratory Duplicate	One per batch of ≤20 samples, per day,	RPD < 10%	Flag all associated data and report unacceptable precision in the SDG Narrative. The reanalysis or otherwise performance of additional corrective action on the laboratory duplicate is acceptable only if the same corrective action is also performed on the entire SDG of samples.

Table C8

pH – Standard Method 4500B/US EPA Method 150.1
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Two-Point Calibration of pH Meter With Verification Using Buffers 4, 7, and 10	Daily prior to sample analysis	Buffers 4, 7, and 10 must be within ± 0.05 pH units of true value	Recalibrate. Prepare new standards and recalibrate if still out.
Mid-Range Initial Calibration Verification (ICV)	Immediately after calibration curve. Must be second-source standard.	Must be within ± 0.1 pH units of true value	Reanalyze. Troubleshoot and recalibrate if still out.
Continuing Calibration Verification (CCV)	Beginning of run, after every 10 samples, and end of run.	Buffer 7 must be within ± 0.05 pH units of true value	Recalibrate and reanalyze all samples after last acceptable CCV.
Laboratory Control Sample (if performed)	One per batch of ≤20 samples per matrix per day. Must undergo all sample preparative procedures. Must be prepared (or purchased certified solution) at a concentration at or near the mid-point of the calibration curve.	Must be within ± 0.2 pH units of true value	Reanalyze all associated samples.
Laboratory Duplicate	One per batch of ≤20 samples, per day, not to exceed 20 samples of a given matrix.	RPD < 5%	The reanalysis or otherwise performance of additional corrective action on the laboratory duplicate is acceptable only if the same corrective action is also performed on the entire SDG of samples.

Table C9

Percent Solids – Standard Methods 2540G/US EPA Method 160.3
Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Laboratory Duplicate	One per batch of ≤20 samples, per day	RPD < 10%	Flag all associated data and report unacceptable precision in the SDG Narrative. The reanalysis or otherwise performance of additional corrective action on the laboratory duplicate is acceptable only if the same corrective action is also performed on the entire SDG of samples.