

# **APPENDIX B**

## **FIELD SAMPLING PLAN (FSP)/ QUALITY ASSURANCE PROJECT PLAN (QAPP)**

**Hamilton Army Airfield  
Marin Airfield Inboard Sites  
Excavate Unlined Perimeter Drainage Ditch  
Excavate South of the Runway DDT Hotspot  
Demolish Revetments**

**REMEDIAL ACTION  
FOR  
HAMILTON ARMY AIRFIELD  
NOVATO, CALIFORNIA**

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**ATTACHMENTS**

- Attachment A: CALIBRATION AND QUALITY CONTROL PROCEDURES
- Attachment B: IMMUNOASSAY TEST INSTRUCTIONS

## ACRONYMS

BRAC	Base Realignment and Closure
COC	Chain of Custody
DDD	4,4'-Dichlorodiphenyldichloroethylene
DDE	4,4'-Dichlorodiphenyldichloroethane
DDT	4,4'-Dichlorodiphenyltrichloroethane
DoD	Department of Defense
DQO	Data Quality Objective
EDS	Environmental Design Section
EPA	Environmental Protection Agency
FSP	Field Sampling Plan
GC	Gas Chromatograph
HAAF	Hamilton Army Airfield
IDW	Investigation-derived waste
LCS	Laboratory Control Sample
MDL	Method Detection Limit
mg/kg	milligram/kilogram
PE	Performance Evaluation Sample
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QL	Quantitation Limit
QSM	Quality Systems Manual
ROD/RAP	Record of Decision/Remedial Action Plan
SOP	Standard Operating Procedure
SFBRWQCB	San Francisco Bay Area Regional Water Quality Control Board
SRW	South of the Runway DDT Hotspot Site
UPDD	Unlined Perimeter Drainage Ditch Site
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
WP	Work Plan

## **1.0 INTRODUCTION**

This Field Sampling Plan (FSP)/Quality Assurance Project Plan (QAPP) presents the project scope, regulatory authorities, project objectives, sampling procedures, and quality control requirements for the Soil Confirmation Samples for the document: *Work Plan - Remedial Action - Excavate Unlined Perimeter Drainage Ditch, Excavate South of the Runway DDT Hotspot, Demolish Revetments - Hamilton Army Airfield Main Airfield Inboard Sites* (hereafter referred to as the “WP”).

### **1.1 Scope of Work**

The soil confirmation sampling at the Unlined Perimeter Drainage Ditch (UPDD) and the South of the Runway DDT Hotspot (SRW) excavation sites is designed to collect the data necessary to ensure the removal of soils with concentrations of Total DDTs (defined as the total of 4,4'-Dichlorodiphenyltrichloroethane (DDT), 4,4'-Dichlorodiphenyldichloroethylene (DDD) and 4,4'-Dichlorodiphenyldichloroethane (DDE)) greater than 1 mg/kg. The US Army Corps of Engineers (USACE), Sacramento District will perform the sampling and field analysis.

### **1.2 Regulatory Authorities**

The San Francisco Bay Area Regional Water Quality Control Board (RWQCB) shall administer primary regulatory oversight. The WP and final report for all activities shall be provided to the RWQCB for review.

### **1.3 Chemicals of Concern**

The chemicals of concern for this sampling are Total DDTs. Soil with Total DDTs concentrations in excess of 1 mg/kg must be excavated and disposed of off-site.

### **1.4 Sampling Objectives**

To achieve the objective of removing contaminated soils (at DDT levels that are above established action goals) and to advance the environmental closure of the HAAF Inboard Area, soil remaining on the property may not contain greater than 1 mg/kg Total DDTs in accordance with the *Main Airfield Parcel Record of Decision/Remedial Action Plan* (ROD/RAP) (Army, DTSC, RWQCB 2003). The objective of this confirmation sampling is to validate the removal of soil with known or suspected DDT concentrations in excess of 1 mg/kg and to quantify any remaining concentrations of Total DDTs at the UPDD and SRW sites.

### **1.5 Project Staffing**

The Environmental Design Section (EDS), Sacramento District, USACE, under the supervision of Richard Meagher, Professional Engineer, California License Number 44858, prepared this FSP/QAPP, and will perform the fieldwork and write the report.

Key project contacts are:

<u>Person</u>	<u>Responsibility</u>
Raymond Zimny	Project Manager
Kathy Siebenmann	Design Lead/Chemist
James Stellmach	Engineer, Field Sampler

### **1.6 Proposed Project Schedule**

Confirmation sampling will be conducted following excavation of DDT-contaminated soil. As stated in the WP, a detailed project schedule will be prepared by the contractor and will be updated on a weekly basis once work begins. If confirmation sampling indicates additional soil removal, the additional excavation will be negotiated, and integrated into the ongoing project schedule. Excavation of additional material, above the initially estimated quantity, shall occur only as directed by the Contracting Officer.

## 2.0 DATA QUALITY OBJECTIVES

To generate data that will meet the project objectives, it is necessary to define the decisions that will be made, identify the intended use of the data, and design a data collection program. Data Quality Objectives (DQOs) are an integrated set of thought processes that define data quality requirements based on the intended use of the data. This includes any type of information utilized to form the sampling strategy or achieve the objective, not just analytical data. The DQO process will assist in determining the appropriate sampling design, detection and quantitation limits, analytical methods, and sample handling procedures.

The objective is to ensure that the soil at the SRW and UPDD sites with Total DDTs concentrations greater than 1 mg/kg is excavated for off site disposal and to quantify the level of any remaining DDTs. The DQOs for these objectives are presented below.

### **State the Problem**

Through previous sampling events at the SRW and UPDD sites within the Inboard Area at HAAF, locations of DDT contamination (with Total DDTs concentrations greater than 1 mg/kg) have been identified. In this sampling effort, data will be produced that verifies the removal of those soils that were previously identified, in accordance with the BRAC ROD/RAP (Army, DTSC, SFRWQCB 2003) and will also quantify the level of any remaining DDTs.

### **Identify the Decision**

The decision is to confirm that all soil at the Inboard Area SRW and UPPD sites containing greater than 1 mg/kg Total DDTs has been excavated for off-site disposal.

### **Identify the Inputs to the Decision**

The following information will be used to make the decision regarding confirmation sampling.

<b>Information Required</b>	<b>Location of Information</b>	<b>Activity to Provide Information</b>
Soil removal criteria	HAAF Final ROD/RAP (Army, DTSC, RWQCB 2003)	None
Total DDTs data from each previously delineated sampling grid and areas.	USACE Technical Memorandum of Pre-remedial Sampling (to be published)	None

<b>Information Required</b>	<b>Location of Information</b>	<b>Activity to Provide Information</b>
Total DDTs results from the boundary of excavated soil	To be collected during this field effort	Sampling and analysis of soil (from the walls and floors of excavations) for Total DDTs

### **Define the Boundaries**

*Spatial Boundaries:* The physical boundary of the sampling area is the area of the soils exposed upon excavation, as indicated in the WP (those grids with greater than 1 mg/kg Total DDTs, as indicated).

*Temporal Boundaries:* Excavation of affected soils will take place as funding allows.

### **Develop a Decision Rule**

After excavation, if the Total DDTs concentration from remaining soils is greater than 1 mg/kg, excavation will continue in the location of the soil sample.

If the Total DDTs concentration from remaining soils is not greater than 1 mg/kg, excavation will cease in the location of the soil sample.

### **Consequences of Decision Errors**

The decision errors inherent in selecting sampling locations and analyzing chemicals consist of potential errors in sample design, location, heterogeneity, and sample analysis. Any decision errors due to analytical non-conformance will be evaluated during the data review, evaluation and validation process. The nature of any deficiency and the proximity to the associated action level and other quality control measures will be used to assess the usability of the data. Adherence to quality control protocols should reduce the probability of decision errors.

For all samples, the assumption is that the sampling locations and numbers of samples will be sufficient to identify any remaining soil with Total DDTs concentrations above 1 mg/kg.

*Null Hypothesis:* There are no constituents greater than 1 mg/kg.

*False Rejection Error and Consequences:* The data indicate that the Total DDTs concentration is greater than the associated criteria (high bias). The excavation of soil would continue in the portion of the excavation represented by this sample, at unnecessary cost.

*False Acceptance Error and Consequences:* The data indicate that no constituents exceed the criteria (false negative or low bias) and the soil would remain onsite. Contamination would be left in the future wetland area and could adversely affect the species that inhabit the wetland area. The tolerance for the false acceptance error is

extremely low, so any potential for false negatives would be scrutinized during data validation.

**Optimize the Sampling Design**

Samples will be collected in the locations presented on Figures 1 and 2 of this Appendix. Verification of lateral extent will occur by sampling the sidewall at the top edge of the excavation. Each sample will be analyzed for Total DDTs using USEPA Method SW4042, a field screening method. When the field screening results indicate Total DDTs concentrations do not exceed 1 mg/kg, the sample will be shipped to an off-site laboratory for analysis of Total DDTs using USEPA Method SW8081A.

### **3.0 FIELD SAMPLING PLAN (FSP)**

#### **3.1 Sampling Plan**

Confirmation sampling will occur as soon as possible after soil excavation so that results may be used to direct any further excavation without remobilizing. The field sampler may alter the sampling locations based upon site conditions. The actual sample locations, results, and any variances to this sampling plan will be presented in the Remedial Action Report.

##### **3.1.1 UPDD Confirmation Sampling Plan**

On the excavation floor, one sample will be collected at each location shown in Figure 1. The locations shown on Figure 1 are spaced at about 100 foot centers along the ditch.

For the excavation perimeter, one sample will be collected for approximately each 100 feet of sidewall. Samples will be collected at the top edge of the sidewall.

##### **3.1.2 SRW Confirmation Sampling Plan**

On each excavation floor, one sample will be collected at each location shown on Figure 2.

For the excavation perimeter, one sample will be collected approximately each 100 to 125 feet of sidewall. Samples will be collected at the top edge of the sidewall.

#### **3.2 Analytical Plan**

Confirmation samples will be analyzed for Total DDTs on-site using USEPA Method SW4042. Once Method SW4042 results indicate Total DDTs not greater than 1 mg/kg, the sample will be shipped to an off-site laboratory for definitive analysis using Method SW8081A.

#### **3.3 Investigative Equipment and Procedures**

All samples will be surface samples and will be collected using various hand tools as appropriate for soil conditions, such as shovels, spoons, and a digger bar, if needed. All samples will be homogenized and then split and placed in glass jars, and labeled as described in Section 3.5.

#### **3.4 Equipment Decontamination Procedures**

During sampling activities, appropriate decontamination measures will be taken to minimize sample contamination from sampling equipment. The decontamination procedures for sampling equipment will incorporate the washing steps outlined below.

All sampling equipment (excluding disposable equipment) used in the collection of samples will be decontaminated as described in the following paragraphs.

Decontamination should be executed prior to equipment use. Clean disposable gloves will be worn while decontaminating sampling equipment and tools. Clean sampling equipment will not be placed on the ground or other contaminated surfaces prior to use.

Detergent and reagent grade water rinses are the first steps in the decontamination process. Deionized water will be stored in plastic containers and applied via pump sprayers or decanted directly from the storage container. The waste decontamination fluids will be collected and handled in accordance with Section 3.10.

Decontamination will consist of:

- 1) Wash with non-phosphate detergent,
- 2) Rinse with potable water,
- 3) Rinse with analyte free water (type II reagent grade water or equivalent),
- 4) Air dry,
- 5) Wrap equipment completely with aluminum foil (shiny side out) and place in a plastic bag to prevent contamination if equipment is to be stored or transported.

### **3.5 Sampling Containers And Preservation**

For samples to be shipped offsite, the laboratory performing the analyses will supply sample containers for this project. For samples to be analyzed onsite, the appropriate sample containers will be supplied. A complete set of sampling containers will be prepared for each sample in advance of the sampling event. These will include glass jars with Teflon™-lined lids and completed sample labels. Containers will be labeled with the date, time, project name, sample number, samplers initials, parameters for analysis, and preservative. Samples shipped to the off-site laboratory will be preserved with ice and a temperature blank included in each cooler to verify the appropriate temperature upon receipt by the laboratory.

### **3.6 Sample Numbering System**

A unique identification number will be assigned to each sample. An alphanumeric sequence will be used, serving as an abbreviation to identify each sample. The abbreviation “CS” will be used to indicate “Confirmation Sample.” UPDD samples shall be numbered starting with HAAF-UPDD-CSX-XXXX. Perimeter samples will have the same identifier with a “N, E, S, or W” added after “CS” to denote which sidewall it was collected from. The XXXX will be replaced with the numerical digits from the closest historical sample identification number. For example, the sample identification designation for the north sidewall of the UPDD excavation, where characterization (and

ultimately excavation) was halted based upon the results from historical sample number HAAF-UPDD-1241 would be HAAF-UPDD-CSN-1241. Floor samples will contain a “B” following the “CS” to denote the bottom of the excavation. The sample identification designation for the bottom of the UPDD excavation, where excavation depth was determined by historical sample number HAAF-UPDD-1234 will be identified as HAAF-UPDD-CSB-1234. Samples from the south of the runway DDT hotspot will be numbered analogously, starting with HAAF-SRW-CSX-XXXX.

### **3.7 Field Logbook**

A field notebook bound with serially numbered pages will be used to record personnel on site, sample identification numbers, sampling date and time, and any significant observations or events during field activities. The project name, site location, sampling event, project leader, telephone number and address of contact office (should the book be misplaced or lost) will be listed in ink. The field notebook is intended to record events during sampling in sufficient detail to allow field personnel to reconstruct events that transpired during the project

The sampling personnel, who will sign and date the notebook prior to initiation of fieldwork will maintain the field notebook. If it is necessary to transfer the logbook to alternative personnel during the course of fieldwork, the person relinquishing the logbook will sign and date the logbook at the time the logbook is transferred and the person receiving the logbook will do likewise. Crossing a line through the entry and entering the correct information will make corrections to erroneous data. The correction will be initialed and dated by the person making the entry. Unused portions of logbook pages will be crossed out, signed, and dated at the end of each workday. Logbook entries must be dated, legible, in ink, and contain accurate documentation. Language used will be objective, factual, and free of personal opinions. Hypotheses for observed phenomena may be recorded, however they must be clearly indicated as such and only relate to the subject observation.

The sample identification number, sample media, number of containers and laboratory analyses to be conducted are recorded with the sample identification number in the field log book and on the chain-of-custody.

The date and time of sample collection, and the personnel who conducted sampling are recorded with the sample identification number in the field logbook and on the chain-of-custody form. The names of visitors and other persons on site are also recorded in the field logbook. Sampling personnel will also record the ambient weather conditions and

other conditions at the sampling location that may affect sample collection, the apparent representativeness of the sample, or sample analysis in the field log book.

### **3.8 Sample Packaging and Shipping**

Samples will be transported as soon as possible after sample collection for immunoassay field test kit analysis or offsite laboratory analysis. The following procedures are to be used when packing and transporting samples to the offsite laboratory:

- Use rigid plastic coolers;
- Tape the cooler drain closed both inside and out;
- Wrap glass containers with cushioning material;
- Package samples in individual plastic bags and place in cooler;
- Place a temperature blank in the cooler;
- Package ice in double plastic bags and place bags around, among, and on top of the samples;
- Put paperwork (chain-of-custody record, etc.) in a waterproof plastic bag and tape it to the inside lid of the cooler;
  
- Tape the cooler lid shut with fiber-reinforced tape;
- Place two signed custody seals on cooler, one at the front right and one at the back left of cooler;
- Attach completed shipping label to the top of cooler and ship following the carrier's instructions.

Sample coolers are typically shipped to the laboratory using an overnight express carrier. A copy of the bill of lading (air bill) is to be retained and becomes part of the sample custody documentation. The offsite laboratory will be notified in advance of all shipments, preferably by telephone on the day of shipment and by advanced scheduling.

### **3.9 Chain of Custody Procedures**

Custody of samples must be maintained and documented from the time of sample collection to completion of the analyses. Each sample will be considered to be in the sampler's custody, and the sampler will be personally responsible for the care and custody of the samples until they are delivered to the courier service for delivery to the laboratory. A sample is considered to be under a person's custody if:

- The sample is in the person's physical possession,
- The sample is in view of the person after that person has taken possession,
- The sample is secured by that person so that no one can tamper with the sample, or
- The sample is secured by that person in an area that is restricted to authorized personnel.

All samples will be accompanied to the off-site laboratory by a chain-of-custody (COC) form. The chain-of-custody form contains the following information:

- Project name,
- Sample numbers,
- Sample collection point,
- Date and time of collection of samples (these must match the date and time recorded on the sample label),
- Sample matrix description,
- Analyses requested for each sample
- Preservation method,
- Number and type of containers used,
- Any special handling or analysis requirements,
- Signature of person collecting the samples,
- Signature of persons involved in the chain of possession,
- Names and telephone numbers of the project points of contact, and
- Airbill Number (none for this project)

The chain-of-custody record forms will be filled out with ink. Prior to packaging samples for shipment, all samples should be double checked against the chain of custody form. When the samples are transferred from one party to another, the individuals will sign, date, and note the time on the form. A separate COC will accompany each delivery of samples to the laboratory. The chain-of-custody form will be included in the cooler used for preservation and transport of the samples. The sampling personnel will retain a copy of the form.

### **3.10 Investigation Derived Waste**

Expected or potential sources of investigation derived waste (IDW) for this project include rinse water from decontamination procedures. The waste decontamination fluids will be collected during the decontamination procedures. Rinse water shall be collected in separate buckets during decontamination. All containers shall be Department of Transportation approved. Each container shall be labeled with a potential hazardous waste label indicating date sample was collected and “Contaminated Waste Water.” IDW in each container shall be characterized prior to disposal. If the characterization results indicate the materials in a container are hazardous, the container shall be labeled with a Hazardous Waste Label. USACE will dispose of the small amounts of IDW in accordance with all Federal, state, and local regulations.

Personal protective equipment, including nitrile gloves, will be handled as non-hazardous waste.

## 4.0 QUALITY ASSURANCE PROJECT PLAN

This section presents functions, procedures, and specific quality assurance (QA) and quality control (QC) activities designed to achieve the data quality goals for the objectives of the sampling effort for the SRW and UPDD sites described in the Data Quality Objectives (DQOs). This section of the work plan is prepared in accordance with EPA QA/R-5, EPA Requirements for Quality Assurance Project Plans (U.S. EPA, 2001), where applicable.

Standard procedures and specifications are established to ensure that all data are comparable, and that data quality is consistently assessed and documented. The specific objectives of this QAPP are to:

- provide standardized references and quality specifications for all anticipated field sampling, analysis, and data review procedures required for the project sites;
- provide guidance and criteria for selected field and analytical procedures; and
- establish procedures for reviewing and documenting compliance with field and analytical procedures.

### 4.1 Analytical Method

This section contains a brief description of the analytical methods that will be used to analyze soil samples collected for this project. The methods are SW4042, a field method for analysis of Total DDTs and SW3550B and SW8081A, fixed laboratory methods for preparation and analysis of DDD, DDE, and DDT. Various cleanup methods may be employed to meet the quantitation limits required for this project. Some are listed below.

The analytical methods identified in this document is published by the United States Environmental Protection Agency (U.S. EPA) in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846*, Third Edition (November 1986; Revision 1, July 1992; and Revision 2, November 1992, Update I, August 1993, Update II, September 1994, Update III, 1998). Preservation for the field method is not required, since samples will be analyzed within 4 hours of collection. Preservation for the laboratory method is 4°C. Attachment A summarizes the calibration and the internal quality control procedures for both of these methods. A description of each method follows.

#### **4.1.1 Method SW3550B: Sonication Extraction**

Method 3550B is a procedure for extracting nonvolatile and semivolatile organic compounds from solids such as soils, wastes, and sludges. The sonication process ensures intimate contact of the sample matrix with the extraction solvent. A weighted portion of the solid material is mixed with the anhydrous sodium sulfate, ground to form a free-flowing powder, and then dispersed into the methylene chloride. The extract is separated from the sample by vacuum or gravity filtration, or centrifugation, and then dried with anhydrous sodium sulfate and concentrated to an appropriate volume for analysis.

#### **4.1.2 Method SW3630C: Silica Gel Cleanup**

Generally, solid-phase extraction cartridges filled with silica gel are used. Aliquots of sample extract are loaded onto the cartridges that are then eluted with suitable solvents, depending upon the analysis method. The collected fractions are analyzed by the appropriate method.

#### **4.1.3 Method SW3640A: Gel-Permeation Cleanup**

The extract is passed through a column containing a hydrophobic gel absorbent. The column is then flushed with clean organic solvents to separate the interferences from the analytes of interest by retention time.

#### **4.1.4 Method 3660B: Sulfur Cleanup**

The extract is shaken with either copper or tetrabutylammonium sulfite to remove interfering sulfur from the extract. The mixture is allowed to settle and the eluent is removed for analysis.

#### **4.1.5 Method 4042: Immunoassay for Total DDTs**

Total DDTs will be analyzed according to Method SW4042 in the field using an immunoassay field test kit. A weighed portion of the soil sample is extracted with deionized water and filtered. An aliquot of the extract and an enzyme-DDT conjugate are added to immobilized DDT antibody. The enzyme-DDT conjugate competes with DDT present in the sample for binding to the DDT antibody. The enzyme-DDT conjugate bound to the DDT antibody then catalyzes a colorless substrate to a colored product. The concentration range is indicated by comparing the color of the sample to the response produced by a reference reaction. The reference standard concentrations will include both 0.2 mg/kg and a 1 mg/kg of DDT. The manufacturer's instructions are included in Attachment B.

#### **4.1.6 Method SW8081A: Organochlorine Pesticides**

Method 8081A is used to determine the concentration of various organochlorine pesticides. For this project the methods will be used to determine the concentrations of DDD, DDE, DDT (total DDTs) on a gas chromatograph (GC). Prior to analysis, the sample is extracted into solution. An aliquot of solution is injected into an open-tubular capillary column which separates constituents from one another, and detected by an electron capture detector or electrolytic conductivity detector. Any compounds identified tentatively in the primary analysis are confirmed on a second GC column.

### **4.2 Calibration Procedures and Frequency**

All instruments and equipment used during sample analysis are operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations. Personnel properly trained in these procedures will operate, calibrate, and maintain the instruments. Calibration of instruments is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established quantitation limits.

#### **4.2.1 Gas Chromatography**

The field of chromatography involves a variety of instrumentation and detection systems. While calibration standards and acceptance criteria vary depending on the type of system and analytical methodology required for a specific analysis, the general principles of calibration apply uniformly. As outlined in EPA SW-846 procedures, each chromatographic system is calibrated prior to performance of analyses using five concentrations by external standard technique for all columns. The lowest calibration standard shall be within a factor of two relative to the QL, and the others corresponding to the expected range of concentrations or defining the working range of the detector. This is done on each chromatographic column and each instrument at the beginning of the contract period and each time a new column is installed. The results are used to determine a calibration curve and response factors for each analyte. Initial calibration consists of determining the working range, establishing limits of detection, and establishing retention time windows. The calibration is checked on a daily basis to ensure that the system remains within specifications. Second column confirmation is required for single compound analytes.

Continuing calibration standards are analyzed to check the instrument response relative to the initial calibration curve at the beginning and end of each analytical run. Calibration checks are also performed for overall system performance and for retention time shifts, as

specified in SW-846. Individual and standard mixes are analyzed to establish response factors and absolute retention time. The response factors and retention times are verified throughout the analytical run and at the end of the analytical sequence. Each analyte must be within its retention time window or the analyst shall take corrective action. Calibration procedures for all GCs are summarized in the method-specific tables in Attachment A.

#### **4.2.2 Immunoassay Test Kits**

Calibration for the immunoassay test kits consists of at least two standard and a blank. A small photometer is used to measure the Total DDTs in prepared samples and standards. The photometer is shipped directly from the manufacturer of the test kits (Strategic Diagnostics, Incorporated) and is maintained at their facility. Standards are prepared at two concentrations with each batch of samples according to the manufacturer's instructions.

#### **4.3 Standard and Reagent Preparation**

A critical element in the generation of quality data is the purity and traceability of the standard solutions and reagents used in the analytical operations. The preparation and maintenance of standards and reagents will be performed per the specified analytical methods. The laboratory shall continually monitor the quality of reagents and standard solutions through a series of well-documented standard operating procedures (SOPs). In general, SOPs for standards preparation should incorporate the following items:

- Documentation and labeling of date received, lot number, date opened, and expiration date;
- Documentation of traceability;
- Preparation, storage, and labeling of stock and working solutions; and
- Establishing and documenting expiration dates and disposal of unusable standards.

Primary reference standards and standard solutions used by the laboratory are to be obtained from the National Institute of Standards and Technology, or other reliable commercial sources to ensure the highest level of purity possible. All standards and standard solutions shall be catalogued to identify the supplier, lot number, purity/concentration, receipt/preparation date, preparer's name, method of preparation, expiration date, and all other pertinent information included in the specific SOP. Standard solutions and reagents are validated prior to use. Validation procedures can range from a check for chromatographic purity to verification of the concentration of the

standard using a standard prepared at a different time, concentration or source. Reagents are examined for purity by subjecting an aliquot or subsample to the analytical method in which it will be used; for example, every lot of dichloromethane (for organic extractables) is analyzed for undesirable contaminants prior to use in the laboratory. Stock and working standards are checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or change in concentration.

#### **4.4 Field Quality Control Checks**

Quality control checks in the field will include the collection of field duplicates and temperature blank samples. These QC checks are described below.

##### **4.4.1 Field Duplicates**

QC duplicate samples collected in the field will provide precision information for the entire measurement system, including sample acquisition, homogeneity, handling, shipping, storage, preparation, and analysis. The field duplicates will be placed in a separate sample jar from the normal sample after homogenization of the sample in the mixing bowl. The identity of these samples will be held blind to the analysts and laboratory personnel until the data are in deliverable form. Duplicate analyses will be performed on approximately 10% of the total investigative samples for each method. QC sample locations are defined in this FSP; however, the locations may be adjusted based on information determined in the field. Odors or visual indicators may be used to assist in directing the location of QC samples to areas suspected to have the highest concentrations of the contaminants of interest. Duplicate samples will be analyzed by the laboratory for the same parameters as the primary sample (i.e., the sample that is being duplicated).

##### **4.4.2 Temperature Blanks**

A small sample container of water will be labeled as a temperature blank. One temperature blank will be included in each cooler. The temperature blank will be packaged and handled in the same manner as the other samples to assure that its temperature is representative of the samples in that cooler. The laboratory will use a calibrated thermometer to directly measure the temperature of this sample. The temperature reading from the temperature blank will be used to determine whether samples were stored under the appropriate thermal conditions.

#### **4.5 Laboratory Quality Control Checks**

The project laboratories will have a QA/QC program that monitors data quality with internal QC checks. Internal QC checks are used to determine if laboratory operations

are in-control (i.e., operating within acceptable QC guidelines) during data generation and the effect the sample matrix has on the data being generated.

Laboratory performance QC is based on the use of a standard control matrix to generate precision and accuracy data that are compared, on a daily basis, to control limits (CLs). **The control limits are laboratory-specific and shall be derived statistically from recent data produced by the laboratory.** The number of samples used to develop the statistical CLs shall be all those analyzed within the previous six months or a minimum of 20 data points. The laboratory shall statistically calculate CLs for all analytes from laboratory control samples (LCSs) and for surrogates from method blanks and/or LCSs. Corrective action shall be based upon these laboratory limits. Sporadic marginal failures are acceptable for no more than five percent of the analytes in any given analyte suite. Comparison recovery limits are presented in Appendix A only for assessment of the laboratory-specific CLs. The comparison recovery limits are based upon statistically-derived limits using data from numerous laboratories to ensure that the laboratory can produce data with acceptable accuracy. Standard limits were estimated for each method with multiple analytes. If the laboratory statistical limits are consistently different from the comparison limits, a different laboratory shall be selected for that analytical method, or an alternate analytical or preparation method shall be selected that increases the accuracy of that method within the primary laboratory. The laboratory performance QC information, in conjunction with method blank data, is used to assess daily laboratory performance.

Matrix effects are assessed by using an actual environmental sample for precision and accuracy determinations. This information can be obtained from matrix spike and matrix spike duplicate results and /or surrogate results. Matrix effects are observed when recoveries are outside the statistical limits for analysis of a clean matrix. These include LCS recovery limits for analytes and surrogate recovery limits from method blank and/or LCS analyses. Corrective actions are not required for non-compliant MS/MSD or surrogate results if the laboratory provides evidence of matrix interference. This may include chromatograms with peaks at or near the same retention time as the spiked compound or surrogate, or consistent MS and MSD pair recoveries or out-of-control surrogate recoveries from multiple project samples where laboratory performance QC samples indicate the analytical system is in control.

Laboratory performance QC will be provided as a standard part of every routine analysis. Matrix-specific QC will be required when identified on the COC by field personnel, but at a minimum of 5% of samples per method per matrix.

The analytical batch is defined as a preparation batch when no separate preparation of the sample is required. The analytical batch and preparation batch shall not exceed 20 samples and are defined as a set of samples that are analyzed or prepared concurrently or sequentially. Significant gaps (greater than two hours) in the analytical sequence will result in the termination of the previous sequence and the initiation of a new analytical sequence. The preparation batch shall be analyzed sequentially on a single instrument, when possible. Only instrument QC such as calibration checks and instrument blanks may be run in the sequence when any sample requires reanalysis or dilution outside of the initial analytical sequence. The practice of "holding a batch open" and performing a single set of batch QC samples for all analyses performed during that period is unacceptable.

The laboratory shall analyze internal QC samples at the frequency specified in this QAPP. These QC samples for each preparation batch shall include, at a minimum, one method blank and one LCS. The matrix used for LCS analyses shall be reagent grade water for aqueous analyses and reagent sand for soil/sediment matrices.

A brief summary of the required QC samples follows.

#### **4.5.1 Blanks**

Two types of blanks routinely analyzed in the laboratory are method blanks and reagent blanks. Method blanks and reagent/solvent blanks are used to assess laboratory procedures as possible sources of sample contamination.

Method or preparation blanks for all samples consist of deionized water or reagent sand that is subjected to the entire analytical procedure, including extraction, distillation, digestion, etc., as appropriate for the analytical method being utilized. One method blank will be analyzed for each analytical batch (minimum of one per day; one every 12 hours for GC/MS analyses). If the blank does not meet acceptance criteria, the source of contamination will be investigated and appropriate corrective action will be taken and documented. Investigation includes an evaluation of the data to determine the extent and effect of the contamination on the sample results. Corrective actions may include reanalysis of the blank and/or re-preparation and reanalysis of the blank and all associated samples. No method blank may exhibit a detected concentration greater than the quantitation limit. However, exceptions may be made when the analyte is not detected in the related sample. Sample results are not corrected for blank contamination unless required by the analytical method.

Reagent/solvent blanks consist of individual reagents or solvents subjected to the entire analytical procedure as appropriate for the analytical method being utilized. The blanks

are only used if contamination problems are indicated by the method blank or if a new lot of materials are being checked before use.

#### **4.5.2 Laboratory Control Samples**

Laboratory control samples (LCS) are used as a means of evaluating the efficiency of the analytical process. As discussed above, LCS is used to generate precision and accuracy data that are compared, on a daily basis, to control limits. Laboratory control samples are subjected to the entire sample procedure, including extraction, digestion, etc., as appropriate for the analytical method utilized. They are generally introduced into an analytical batch (20 samples) immediately before extraction or analysis. LCS samples will be performed for both inorganic and organic laboratory methods.

#### **4.5.3 Matrix Spikes and Matrix Spike Duplicates**

A Matrix Spike (MS) is an environmental sample to which known concentrations of analytes have been added. The MS is taken through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as percent recovery. The MS is used to evaluate the effect of the sample matrix on the accuracy of the analysis.

A Matrix Spike Duplicate (MSD) is a duplicate of the environmental sample described above, each of which is spiked with known concentrations of analytes. The two spiked samples are processed separately and the results compared to determine the effects of the matrix on the precision and accuracy of the analysis. Results are expressed as relative percent difference (RPD) and percent recovery (%R).

#### **4.5.4 Surrogate Recoveries**

Surrogates are organic compounds which are similar to the analytes of interest in chemical behavior, but which are not normally found in environmental samples. Surrogates are added to samples to monitor the effect of the matrix on the accuracy of the analysis for each sample. Results are reported in percent recovery. Laboratories routinely add surrogates to samples requiring GC or GC/MS analysis and report these surrogate recoveries to the client. The laboratory does not modify its operations based on surrogate recoveries in environmental samples. However, obvious problems with sample preparation and analysis (e.g. evaporation to dryness, leaking septum, etc.) which can lead to poor surrogate spike recoveries must be ruled out prior to attributing low surrogate recoveries to matrix effects.

### **4.6 Sensitivity**

The laboratory must determine and document the limits of detection and quantitation on a periodic basis. The method of determination for each is described below.

#### 4.6.1 Method Detection Limit (MDL)

The MDL is the lowest concentration at which a specific analyte in a matrix can be measured and reported with 99-percent confidence that the analyte concentration is greater than zero. MDLs are experimentally determined for each target analyte of the method. Each individual instrument will maintain a current MDL study. MDLs are based on the results of seven spikes of clean matrix at the estimated MDL and are statistically calculated in accordance with the Title 40, Code of Federal Regulations Part 136 (40 CFR 136), Appendix B. The standard deviation of the seven replicates is determined and multiplied by 3.143 (i.e., the 99-percent confidence interval from the one-sided student t-test). The MDLs are updated annually and whenever significant instrument maintenance is performed. Alternatively, the MDLs can be verified on a quarterly basis by analyzing a standard no more than two times the calculated MDL.

#### 4.6.2 Quantitation Limit

The QL is defined by the lowest concentration in the multi-point initial calibration. The QL is the lowest level for quantitation decisions based on individual measurements for a given method and representative matrix. The QLs shall be considered maximum QLs; the project laboratory may report lower QLs if supported by the lowest concentration of the initial calibration. QLs may be adjusted based upon the capability of the selected laboratory. Detected results above the MDL but below the QL shall be qualified with a J flag. The J flag will denote the sample results as below the QL and as qualitative, estimated concentrations. Analyst judgment will be used to determine if an apparent detected value should be reported or appears to be a false positive due to the sample matrix (e.g., from baseline “noise”).

If dilution is necessary to bring the reported concentration of a single compound of interest within the linear range of the calibration, results in non-detect values for all other analytes, the results of the original undiluted, or less diluted run will be reported for those analytes. The diluted result will be reported for the compound(s) with the high concentrations. Appropriate notations shall be included in the narrative of the report. Matrix effects (i.e., highly contaminated samples requiring dilution for analysis, dilution to bring detected levels within the range of calibration, and matrix interference requiring elevation of detection limits) will be considered in assessing compliance with the requirements for sensitivity. However, cleanup procedures must be used to minimize interferences and lower the QLs.

The QLs required for this project area listed below.

Method SW4042 – Total DDTs QL = 0.2 mg/kg

Method SW8081A – DDD, DDE, DDT QLs = 0.005 mg/kg AFTER correction for dry weight and any dilution not due to high analyte concentrations

#### **4.7 Corrective Action**

The laboratory QA Director in consultation with the project chemist is responsible for implementing corrective actions in the laboratory. It is their combined responsibility to see that all analytical and sampling procedures are followed as specified and that the data generated meet the acceptance criteria. Corrective action procedures are summarized for each method in Appendix A.

Corrective actions for the laboratory may include, but are not limited to:

- Reanalyzing samples;
- Correcting laboratory procedures;
- Recalibrating instruments using freshly prepared standards;
- Replacing solvents or other reagents that give unacceptable blank values;
- Training laboratory personnel in correct sample preparation and analysis procedures; and
- Accepting data with an acknowledged and documented level of uncertainty.

Whenever corrective action is deemed necessary, the Laboratory Director will ensure that the following steps are taken:

- The problem is defined;
- The cause of the problem is investigated and determined;
- Appropriate corrective action is determined; and
- Corrective action is implemented and its effectiveness verified.

If the laboratory determines that failure to meet QC criteria for accuracy or precision is a result of objectively verifiable matrix effects, no further re-extractions will be required. However, the narrative must contain an explicit description of the laboratory's rationale in this regard with reference to objectively verifiable features of raw data and contain documentation to support that rationale. The sufficiency of the laboratory's explanation will be determined by the USACE Project Chemist.

Out-of-control analyses are generally described on a QA/QC discrepancy form and submitted to the laboratory supervisor for corrective action. Copies are distributed to the laboratory QA coordinator and laboratory director for approval, and to the case file. The calibration information is filed with the raw data in the reports area.

#### **4.8 Laboratory Data Reduction and Verification**

All analytical data generated within the laboratories shall be reviewed prior to report generation to verify the reported data. The data verification process consists of data generation, reduction, and three levels of documented review. In each stage, the review process will be documented by the signature of the reviewer and the date reviewed.

The analyst who generates the analytical data will have the prime responsibility for the correctness and completeness of the data. All data will be generated and reduced following protocols specified in laboratory SOPs. Each analyst will review the quality of his or her work based on an established set of guidelines outlined in the SOPs. The analyst will review the data package to ensure that:

- The correct samples were analyzed and reported in appropriate units,
- Preservation and holding time requirements were met,
- Sample preparation information is correct and complete,
- Appropriate SOPs have been followed,
- Analytical results are correct and complete,
- QC samples are within established control limits,
- Blanks are within appropriate QC limits,
- Special sample preparation and analytical requirements have been met, and
- Documentation is complete (e.g., all anomalies in the preparation and analysis have been documented, anomaly forms are complete; holding times are documented, etc.).

The data reduction and verification steps shall be documented, signed and dated by the analyst. The analyst will then pass the data package to a senior analyst or supervisor, who will perform an independent review of the data package. This review is also to be conducted according to an established set of guidelines and to be structured to ensure that:

- Calibration data are scientifically sound, appropriate to the method, and completely documented,
- QC samples are within established guidelines,
- Qualitative identification of sample components is correct
- Quantitative results are correct,
- Documentation is complete and correct (e.g., anomalies in the preparation and analysis have been documented; anomaly forms are complete; holding times are documented, etc.), and
- The data are ready for incorporation into the final report; and the data package is complete and ready for data archive.

The review is to be structured so that all calibration data and QC sample results are reviewed and all of the analytical results from 10% of the samples are checked back to the bench sheet. If no problems are found with the data package, the review is complete. If any problems are found with the data package, an additional 10% of the samples will be checked to the bench sheet. This process will continue until no errors are found or until the data package has been reviewed in its entirety.

Data reviews shall be documented and the signature of the reviewer and the date of review recorded. The reviewed data are then approved for release and a final report is prepared. Before the report is released to the client, the data are reviewed for completeness and to ensure that the data satisfy the overall objectives of the project. This review is typically done by the laboratory Project Manager.

Each step of this review process involves evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of the data is essential in ensuring that data of high quality are generated consistently.

#### **4.9 Laboratory Data Reporting**

At the conclusion of all analytical work for this project, the primary laboratory will submit a comprehensive certificate of analysis. The final certificates of analysis will be submitted no later than 21 days after the last sample has been submitted to the laboratory for the project. All samples shall be reported in a legally defensible package. Legible

copies of all data shall be organized systematically on numbered pages. A table of contents shall be provided at the beginning of the data package. All data packages will contain the following information.

- **Case Narrative:** The case narrative will be written and the release of data will be authorized by the laboratory director or his/her designee. Items to be included in the case narrative are the field sample ID with the corresponding laboratory ID, parameters analyzed in each sample and the methodology used (EPA method numbers or other citation), detailed description of all problems encountered and corrective actions taken, discussion of possible reasons for out-of-control QA/QC results, and observations regarding any occurrences which may affect sample integrity or data quality.
- **Chain-of-Custody Documentation:** Legible copies of COCs for each sample will be included in the data package. Cooler receipt forms associated with the corresponding COC and any integral laboratory-tracking document will also be included.
- **Summary of Environmental Results:** For each environmental sample analysis, this summary shall include field ID and corresponding laboratory ID, sample matrix, date of sample extraction (if applicable), date and time of analysis, identification of the instrument used for analysis, instrument specifications, weight or volume of the sample used for analysis/extraction, dilution or concentration factor used for the sample extract, MDL or QL, definitions of any data qualifiers used, and analytical results.
- **Summary of QA/QC Results:** The QA/QC results will be presented in summary form. Acceptance limits for all categories of QC criteria will be provided with the data. Specific QC data for organic and inorganic analyses to be included in the data package are method blank results, laboratory control samples, matrix spike/matrix spike duplicate results, and surrogate spike results.
- **Initial Calibration:** The concentrations of the standards used for analysis and the date and time of analysis. The response factor, RSD, and retention time for each analyte will be included in initial calibration summaries. Information demonstrating the samples or dates for which a single initial calibration applies shall also be provided.

- Calibration Verification Standard and Second Source Standard: The concentration of the calibration standard used for calibration verification and the second source standard will be reported. The response factor, percent difference, and retention time (GC and GC/MS) for each analyte will be reported. Daily calibration information will be linked to sample analyses by summary.
- Compound Identification (GC and GC/MS): The retention times and the concentrations of each analyte detected in environmental and QC samples will be reported for both primary and confirmation analyses. The raw data for each analysis will include chromatograms (with target compound, internal standard, and surrogate compounds labeled by name) with a quantitation report and/or area printout, as applicable. GC/MS analyses will also include the mass spectra and ion chromatograms for each reported analyte in the sample along with the spectra of the standard analyte itself.
- Method detection limit study: The date, instrument, spiking amount and matrix will be included with the seven replicates for the method detection limit study associated with the analysis of project samples.

#### **4.10 Records Storage**

All records related to the analytical effort are maintained at the primary laboratory in secured filing cabinets (i.e., cost information, scheduling, and custody). All records are maintained for five years after the final report is issued. Additional types of records to be maintained by the laboratory for the project include the following:

- All electronic copies of instrument analyses, along with the type of software used to reduce the data
- Any discrepancy/deficiency report forms due to problems encountered during sampling, transportation, or analysis
- Sample destruction authorization forms containing information on the manner of final disposal of samples upon completion of analysis
- All laboratory notebooks including raw data readings, calibration details, QC checks, etc.

Field and laboratory data packages shall be stored in hard copy and electronic format (when applicable) as part of the project file. This information is retained in the project file until project completion and closeout. Upon project closeout, all records shall be archived for permanent storage for a minimum of five years.

#### **4.11 Preventive Maintenance**

To minimize downtime and interruption of analytical work, preventive maintenance is routinely performed on each analytical instrument. Each laboratory shall have detailed SOPs on file that describe preventive maintenance procedures and schedules. All service and maintenance will be conducted by qualified laboratory staff or under service agreement with the manufacturer or their approved agent. All repairs, adjustments, and calibrations will be documented in a maintenance notebook or data sheet that will be maintained in a permanent file. The instrument notebook will clearly document the date, the problem description, corrective action taken, results of actions, and the name of the person performing the work.

#### **4.12 Assessments**

##### **4.12.1 Laboratory and Field Audits**

All laboratories analyzing samples from the USACE are required to be USACE validated. USACE validation is an evaluation of laboratory procedures or documentation and includes initial and periodic laboratory audits. The laboratory on-site inspections or audits are performed by USACE chemists from the Center of Excellence in Omaha, Nebraska. The inspectors verify the following:

- The organization and personnel are qualified to perform assigned tasks,
- Adequate facilities and equipment are available,
- Complete documentation, included chain-of-custody of samples, is being implemented,
- Proper analytical methodology is being used without deviations, adequate analytical quality control (including reference samples, control charts, documented corrective actions, etc.) is being provided,
- Acceptable data handling and documentation techniques are being used,
- Adequate facilities and operations are installed to ensure laboratory health and safety, and
- Proper waste disposal procedures are implemented.

The on-site laboratory inspection helps to ensure that the laboratory is technically competent and that all the necessary quality control is being applied by the laboratory in order to deliver a quality product.

#### **4.12.2 Laboratory Performance Evaluation Samples**

At a minimum, the contract laboratory will participate in at least one performance evaluation program.

The performance evaluation (PE) samples are single blind (prepared by the laboratory from ambulated standards) and are often associated with the regular laboratory audits performed by the USACE and/or regulatory agencies. USACE, Center of Excellence, Omaha, Nebraska reviews the results of the PE samples to determine if the laboratory should continue to receive USACE validation.

#### **4.12.3 Quality Assurance Samples**

QA samples are replicate samples submitted to a different laboratory, and subjected to the same environmental conditions and steps in the measurement process as the primary sample. They serve as an oversight function in assessing the analytical portion of the measurements system. QA samples will be collected once during the SI field effort for the groundwater samples.

#### **4.12.4 Data Validation**

The laboratory data will be validated using guidelines in the attached table. The validation guidelines are based on EPA SW-846 methods and the EPA National Functional Guidelines for Organic and Inorganic Data Review. The procedures in this document shall supercede the procedures in these references. However, professional judgment shall be used when deciding if qualification of data is applicable. When professional judgment is applied that differs from the qualification scheme, the rationale shall be provided. Data validation will be performed by personnel in the Environmental Chemistry Section, Sacramento District, USACE. The report shall be accompanied by tables of qualified data and the reasons for qualification.

### Data Qualifier Conventions

Quality Control Item	Evaluation	Data Qualifier Flag		Sample(s) Qualified
		Detects	Nondetects	
<b>Holding Times (Extraction/Analysis)</b>	1) Holding time exceeded by 2 times or less	J-	UJ	Sample
	2) Holding time exceeded by greater than 2 times	J-	R	
<b>Cooler Temperature</b>	1) > 6 and ≤10 degrees Centigrade	J-	UJ	All samples shipped in the affected cooler
	2) >10 degrees Centigrade	J-	R	
	3) < 2 degrees Centigrade	No qual.	No qual.	
<b>Initial Calibration</b>	1) %RSD > 20%	J	UJ	All samples run on the same instrument under that initial calibration
	2) $r < 0.995$ , $r^2 < 0.990$	J	UJ	
<b>Initial and Continuing Calibration Verification (ICV and CCV) and Second Source Standard</b>	1) % Difference > +20%	J+	No qual.	All samples bracketed by the ICV, CCV or under initial calibration associated with second source standard
	2) % Difference < -20% and ≥ -50%	J-	UJ	
	3) % Difference < -50%	J-	R	
<b>Method Blank Contamination</b>	1) Sample results for common lab contaminant less than or equal to 10 times the blank contamination	U	No qual.	All samples in the same preparation batch
	2) Sample results for other compounds less than or equal to 5 times the blank contamination	U	No qual.	
<b>Surrogate Recovery</b>	1) % Recovery < control limit (CL) but ≥ 10%	J-	UJ	Sample
	2) % Recovery <10%	J-	R	
	3) % Recovery > CL	J+	No qual.	
<b>Matrix Spike Recovery</b>	1) % Recovery < CL but ≥ 10%	J-	UJ	Parent Sample
	2) % Recovery <10%	J-	R	
	3) % Recovery > CL	J+	No qual.	
	4) RPD > CL	J	UJ	
<b>Laboratory Control Sample Recovery</b>	1) % Recovery < CL but ≥ 10%	J-	UJ	All samples in the same preparation batch
	2) % Recovery <10%	J-	R	
	3) % Recovery > CL	J+	No qual.	
	4) RPD > CL	J	UJ	
<b>Quantitation Limits</b>	Quantitation limits not matching the project specified limits.	No qual.	No qual.	Sample (note in validation report)
	Results reported below the quantitation limit.	J	No qual.	Sample

Quality Control Item	Evaluation	Data Qualifier Flag		Sample(s) Qualified
		Detects	Nondetects	
<b>Field Duplicates</b>	RPD > 25 (water); >50 (soil)	No qual.	No qual.	Parent sample-review dataset for systematic occurrences
<b>Equipment Blanks</b>	1) Sample results for common lab contaminant less than or equal to 10 times the blank contamination	U	No qual.	All samples in the same sampling event
	2) Sample results for other compounds less than or equal to 5 times the blank contamination	U	No qual.	
<b>Trip Blanks</b>	1) Sample results for common lab contaminant less than or equal to 10 times the blank contamination	U	No qual.	All samples in the same cooler
	2) Sample results for other compounds less than or equal to 5 times the blank contamination	U	No qual.	

% = percent

CCV = Continuing Calibration Verification Standard

CL = Control Limit

ICV = Initial Calibration Verification Standard

J = Estimated Concentration

J- = Estimated Concentration Biased Low

J+ = Estimated Concentration Biased High

r = coefficient of variation

$r^2$  = Correlation Coefficient

R = rejected datapoint

RPD = Relative Percent Difference

RSD = Relative Standard Deviation

U = Not Detected

UJ = Not Detected; Reporting Limit may be higher than reported

### 4.13 Data Quality and Usability Assessment

The effectiveness of a QA program is measured by the quality of data. Data quality is judged in terms of its PARCC parameters. Once the PARCC parameters are assessed, the usability of any affected results will be determined based upon the objectives addressed in the Data Quality Objectives. The PARCC terms are described as follows:

#### 4.13.1 Precision

Precision is a measure of the reproducibility of analyses under a given set of conditions. Precision will be assessed by comparing the results of replicate measurements of reference materials and environmental samples.

#### **4.13.2 Accuracy**

Accuracy is a determination of how close the measurement is to the true value. Accuracy will be assessed by the comparison of standard concentrations and instrument response and by any external contamination evident from laboratory blank results.

#### **4.13.3 Representativeness**

Representativeness is a qualitative parameter that reflects the extent to which a given sample is characteristic of a given population at a specific location or under a given environmental condition. Representativeness is best satisfied by making certain that sampling locations are selected properly, a sufficient number of samples are collected, and an appropriate sampling technique is employed. Analytical data should represent the sample analyzed regardless of the heterogeneity of the original sample matrix. Sample representativeness will also be evaluated based on results from laboratory blanks.

#### **4.13.4 Completeness**

Completeness will be evaluated qualitatively and quantitatively. The qualitative evaluation of completeness will be determined as a function of all events contributing to the sampling event including items such as correct handling of COC forms, incorporation of QC samples at the appropriate frequency, etc. The quantitative description of completeness is defined as the percentage of acceptable QC parameters that can be controlled. The goals for field sampling and analytical completeness is 100%. Any samples or standards producing questionable results will be reanalyzed.

#### **4.13.5 Comparability**

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. To ensure comparability, field procedures will be standardized and field operations will adhere to standard operating procedures. Analytical data comparability will be assured by use of established and approved analytical methods, consistency in the basis of analysis (wet weight, volume, etc.), and consistency in reporting units ( $\mu\text{g/L}$ ,  $\text{mg/Kg}$ , etc.).

## **5.0 REFERENCES**

EPA 1998. *Test Methods for Evaluating Solid Waste*, USEPA SW-846, Third Edition, (Update III), June.

EPA 2000a. *Guidance for Data Assessment*, USEPA QA/G-9, Final, July.

EPA 2000b. *Guidance on the Data Quality Objectives Process*, USEPA QA/G-4, Final, August.

EPA 2001. *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, Final Interim Final, March.