REMEDIAL INVESTIGATION AND FEASIBILITY STUDY OVERSIGHT
FOR
WOODBROOK ROAD DUMP SITE
SOUTH PLAINFIELD, NEW JERSEY

SAMPLING AND ANALYSIS PLAN
(FIELD SAMPLING PLAN/QUALITY ASSURANCE PROJECT PLAN)

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
1445 Ross Avenue
Dallas, TX 75202-2733

Work Assignment No.	:	118 RSBD 02NX
EPA Region	:	6
Date Prepared	:	August 9, 2004
Revision No.	:	00
Contract No.	:	68-W6-0037
Prepared by	:	Tetra Tech EM Inc.
Tetra Tech Project Manager	:	Eric Johnstone
Telephone No.	:	(214) 740-2001
EPA Work Assignment Manager	:	Pete Mannino
Telephone No.	:	(212) 637-4395

A1 TITLE AND APPROVAL SHEET

QUALITY ASSURANCE PROJECT PLAN
FOR
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
WOODBROOK ROAD DUMP SITE
SOUTH PLAINFIELD, NEW JERSEY

Name: Lou Barinka, P.E.
Title: Tetra Tech Program Manager
Signature: _____ Date: 8/9/04

Name: William Desmond, Ph.D.
Title: Tetra Tech Quality Assurance Officer
Signature: _____ Date: 8-9-04

Name: Pete Mannino
Title: U.S. EPA Region 2 Work Assignment Manager
Signature: _____ Date: _____

Name: Robert Runyon
Title: U.S. EPA Region 2 Quality Assurance Officer
Signature: _____ Date: _____

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A3 ABBREVIATIONS AND ACRONYMS

API	American Petroleum Institute
ASTM	American Society for Testing and Materials
bgs	Below ground surface
CLP	Contract Laboratory Program
COPC	Chemical of potential concern
CRDL	Contract-required detection limit
CRQL	Contract-required quantitation limit
DQA	Data quality assessment
DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
FSP	Field sampling plan
HASP	Health and Safety Plan
HCl	Hydrochloric acid
HNO_3	Nitric acid
LCS	Laboratory control sample
MD	Matrix duplicate
MDL	Method detection limit
mL	Milliliter
MS	Matrix spike
MSD	Matrix spike duplicate
NA	Not applicable
NJDEP	New Jersey Department of Environmental Protection
NPL	National Priorities List
PCB	Polychlorinated biphenyl
PID	Photoionization detector
PQL	Practical quantitation limit
PRC	PRC Environmental Management, Inc.
PRP	Potentially Responsible Party
QA	Quality assurance
QAPP	Quality assurance project plan
QC	Quality control
QMP	Quality management plan
RAC	Response Action Contract
RI/FS	Remedial investigation and feasibility study
RPD	Relative percent difference
SAP	Sampling and analysis plan
SOP	Standard operating procedure
SOW	Statement of work
SVOC	Semivolatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
Tetra Tech	Tetra Tech EM Inc.

A3 ABBREVIATIONS AND ACRONYMS (Continued)

TETC	Texas Eastern Terminal Company
TRC	TRC Solutions, Inc.
VOC	Volatile organic compound
WAM	Work assignment manager
Woodbrook	Woodbrook Road Dump

A4 DISTRIBUTION LIST

U.S. Environmental Protection Agency:

Name: Pete Mannino
Title: U.S. Environmental Protection Agency Region 2 Work Assignment Manager

Name: Hank Thompson
Title: U.S. Environmental Protection Agency Region 6 Project Officer

Name: Cora Stanley
Title: U.S. Environmental Protection Agency Region 6 Contracting Officer

Name: Don Johnson
Title: U.S. Environmental Protection Agency Region 6 Quality Assurance Officer

Tetra Tech EM Inc:

Name: William Desmond, Ph.D.
Title: Tetra Tech EM Inc. Quality Assurance Officer

Name: Lou Barinka, P.E.
Title: Tetra Tech EM Inc. Program Manager

Name: Eric Johnstone
Title: Tetra Tech EM Inc. Project Manager

A5 PROJECT AND TASK ORGANIZATION

Tetra Tech EM Inc. (Tetra Tech) received Work Assignment No. 118 RSBD 02NX from the U.S. Environmental Protection Agency (EPA) under Response Action Contract (RAC) No. 68-W6-0037. Under this work assignment, Tetra Tech is directed to conduct oversight of the Potentially Responsible Party's (PRP) remedial investigation and feasibility study (RI/FS) at the Woodbrook Road Dump (Woodbrook) site, located in South Plainfield, Middlesex County, New Jersey. Tetra Tech has prepared this sampling and analysis plan (SAP), consisting of an integrated field sampling plan (FSP) and a quality assurance project plan (QAPP), in accordance with (1) specifications provided in the EPA statement of work (SOW), dated April 7, 2004 (EPA 2004); (2) meetings between EPA and Tetra Tech; and (3) the approved work plan (Tetra Tech 2004).

This SAP was prepared in accordance with Tetra Tech's generic RAC QAPP (PRC Environmental Management, Inc. [PRC] 1996a) and meets requirements set forth in "EPA Guidance for Quality Assurance Project Plans" (EPA 1998), and "EPA Requirements for QAPPs for Environmental Data Operations (EPA 2001).

This SAP describes procedures to ensure that the project-specific data quality objectives (DQO) are met, and that the quality of data (represented by precision, accuracy, completeness, comparability, representativeness, and sensitivity) are known and documented. It presents the project description, project organization and responsibilities, and quality assurance (QA) objectives associated with the sampling and analytical services to be provided in support of the investigation at the Woodbrook site. Tetra Tech also clarifies the requirements for installing monitoring wells and collecting split samples during the PRP's sampling activities at the Woodbrook site.

This plan serves as the basis to ensure that overall QA objectives are met. The overall QA objectives are as follows:

- Attaining quality control (QC) requirements for analyses discussed in this SAP

- Obtaining data of known quality for the PRP's assessment of human health and ecological risks
- Documenting performance of the quality program including performance of the work and any required changes to work at the site

Many of the sampling and analytical standard operating procedures (SOP) described in the generic RAC QAPP (PRC 1996a) are broadly applicable and are referenced in this SAP.

The EPA Region 2 work assignment manager (WAM), Mr. Pete Mannino, is responsible for the remedial action oversight. Since the project is funded through the EPA Region 6 RAC contract, the project officer is Mr. Henry Thompson (Region 6).

Tetra Tech will perform all tasks under this work assignment in accordance with the RAC quality management plan (QMP) (PRC 1996b). Mr. Lou Barinka is the Tetra Tech Region 6 RAC program manager. Dr. William Desmond is the Tetra Tech RAC QA officer. Dr. Desmond is responsible for the quality of work conducted by Tetra Tech and its subcontractors. Mr. Eric Johnstone is the Tetra Tech project manager. The project manager is responsible for implementing all activities required by the work assignment.

A6 BACKGROUND AND PROBLEM DEFINITION

Site characterization and remedial activities have been performed at the Woodbrook site under the direction of EPA since October 1999. The following discusses existing conditions at the site and the site background.

A6.1 SITE BACKGROUND

The Woodbrook site is located on two properties north of Woodbrook Road currently identified on South Plainfield tax maps as Block 388, Lots 1 and 26, Middlesex County, New Jersey. The site is an inactive, unauthorized dumping area. The properties are heavily wooded and undeveloped, totaling almost 70 acres, and are bordered by Bound Brook and wetlands of the Dismal Swamp.

Previous owners operated the properties as dumps during the 1940s and 1950s, accepting household and industrial wastes until they were shut down by the State of New Jersey in 1958. Texas Eastern Terminal Company (TETC), a subsidiary of Texas Eastern Transmission, LP, currently owns both parcels.

Partially buried capacitors, some of which contained an oily liquid that had discharged into the ground, were discovered at the Woodbrook site in September 1999. During a site visit, New Jersey Department of Environmental Protection (NJDEP) representatives observed the name "Cornell Dubilier" on small, phenolic ballast containers at the Woodbrook site. Cornell-Dubilier Electronics, Inc. manufactured capacitors containing polychlorinated biphenyls (PCBs) from 1936 to 1962 at their South Plainfield facility, a Superfund site located at 333 Hamilton Boulevard, less than a mile from the Woodbrook site.

Sampling conducted by EPA in the fall of 1999 and the summer of 2000 revealed that the soil, sediments, and groundwater at the site are contaminated with volatile organic compounds (VOC), semivolatile organic compounds (SVOC), inorganic constituents, and PCBs.

In March and April 2000, TETC removed and disposed of PCB-contaminated capacitors that were found partially buried at the site. TETC also installed warning signs along the paths leading to the areas where the capacitors were found and temporary fencing around those areas to prevent the public from coming into contact with PCB-contaminated soil. In April 2000, TETC installed guardrails and warning signs at access points to prevent off-road vehicles from entering the site.

On April 30, 2003, EPA announced the listing of the Woodbrook site on the National Priorities List (NPL). In August 2003, TETC entered into an Administrative Order on Consent with EPA to perform the RI/FS and implement additional site security measures. The additional site security measures include the installation of security fencing and signs to limit access to the site.

A6.2 PROBLEM DEFINITION

Tetra Tech will conduct an oversight of the PRP's RI field sampling event at the Woodbrook site in accordance with EPA's Statement of Work (SOW) and other relevant guidance used by EPA in conducting an RI/FS. Tetra Tech will assist EPA in assuring that the RI/FS is conducted in accordance with TETC's approved RI/FS work plan, and all other guidance used by EPA in conducting an RI/FS.

The decision-maker is Mr. Pete Mannino, the EPA WAM for the Woodbrook site. He will be supported by the Tetra Tech project manager and key Tetra Tech staff. The other stakeholder includes the PRP, who is implementing the sampling at the site and who will, presumably, take the lead on implementing necessary remedial actions.

Preliminary information collected by EPA indicates that soil, sediment, and groundwater at the site are contaminated. For the purpose of this SAP, the main problem at the site is that the nature and extent of surface soil, subsurface soil, sediment, and groundwater contamination are unknown. These data will also be used to assess human health and ecological risks at the site. The SAP was prepared to describe activities that will be performed to ensure that the quality of sampling data is known and documented.

An EPA CLP laboratory or an approved non-CLP laboratory will analyze samples collected by Tetra Tech. The schedule for conducting field activities has not yet been determined.

To evaluate the performance and effectiveness of the PRP's RI/FS implementation, Tetra Tech will collect split samples from the groundwater, surface soil, test pit (subsurface soil), surface water, and sediment media.

Sampling activities will be conducted in accordance with the NJDEP's Field Sampling Procedures Manual (FSPM) (1992), the PRP FSP (TRC Solutions, Inc. [TRC] 2003a), the PRP QAPP (TRC 2003b), the Tetra Tech Health and Safety Plan (HASP) (Tetra Tech 2004b), and this SAP.

Groundwater, soil (surface and subsurface), surface water, and sediment samples will be collected to identify the nature and extent of known areas of contamination, as well as to locate other potentially contaminated areas. Based on the distribution and concentrations detected from previous efforts at the Woodbrook site, the RI sampling activities will focus on PCBs. Initial sampling parameters will also include the full target compound list (TCL)/target analyte list (TAL) (VOCs, base neutrals/acids extractables [BNAs], pesticide/PCBs, and TAL metals). A subset of samples will also be analyzed for dioxin and dioxin-like compounds, as directed by EPA in the scoping meeting. As part of the RI, a risk assessment will be conducted by TRC to evaluate the public health risks posed by exposure to contaminated soil, sediments, air, and groundwater. An assessment of ecological risks will also be performed by TRC.

Tetra Tech's field investigation activities are outlined below.

- Oversee the test pit excavations and collect split samples of subsurface soil samples at three intervals: 0.0 to 0.5 feet below ground surface (bgs), 2.0 to 2.5 feet bgs, and 4.0 to 4.5 feet bgs. Ground surface is defined as the interface between the fill and the native soil.
- Collect split samples of surface soil samples from a depth of 0.0 to 2.0 feet bgs.
- Oversee the installation and development of monitoring wells and collect groundwater samples from the newly installed monitoring wells. Additionally, collect split samples of subsurface soil samples during the well installation.

- Collect surface water samples (grab samples) and split samples of sediment samples.
- Data acquired during the field investigation will be analyzed to determine if the data are sufficient to meet established DQOs set forth in this SAP.

A7 DESCRIPTION OF PROJECT OBJECTIVES AND TASKS

This section describes the project objectives and tasks for this SAP.

A7.1 OBJECTIVES

The project objectives include (1) providing oversight of the PRP's sampling events at the Woodbrook site, (2) clarifying the sampling and analytical requirements for decommissioning and installing new monitoring wells, and (3) collecting split samples from groundwater, surface water, surface soil, subsurface soil, and sediment media.

Based upon a review of the PRP's Draft RI/FS Work Plan (TRC 2003c) and assuming split samples will be collected from 10 percent of the samples collected by the PRP, Tetra Tech estimates that the following type and number of samples will be collected:

- 2 groundwater samples
- 2 surface water samples
- 7 surface soil samples
- 5 subsurface soil samples from test pit excavations and borings from monitoring well installation
- 5 sediment samples

The split samples will be analyzed under the EPA Contract Laboratory Program (CLP) or by an accredited, non-CLP laboratory, if the EPA Regional laboratory is not available. The chemicals to be evaluated include VOCs, SVOCs, pesticide/PCBs, metals, and dioxins. Table A7-1 describes the number, types, and locations of samples and the types of analyses to be performed. The procedures included in this SAP are based on site information that was gathered by Tetra Tech or provided by the EPA Region 2 office in New York City and the Region 6 office in Dallas, Texas. Therefore, contingency plans for

TABLE A7-1

SUMMARY OF DATA COLLECTION PLAN
WOODBROOK ROAD DUMP SITE, SOUTH PLAINFIELD, NEW JERSEY

Sample Medium	Analytical Parameters	Number of Samples	Number of QA/QC Samples			
			MS/MSDs[a]	Field Duplicates	Equipment Rinsates[b]	Trip Blanks[c]
Groundwater	VOCs, SVOCs, Metals, and Pesticide/PCBs	2	1	1	1	1
Surface Water	VOCs, SVOCs, Metals, and Pesticide/PCBs	2	1	1	1	1
Surface Soil	VOCs, SVOCs, Metals, Pesticide/PCBs, and Dioxins	7	1	1	1	0
Test Pits/ Subsurface Soil	VOCs, SVOCs, Metals, Pesticide/PCBs, and Dioxins	5	1	1	1	0
Sediments	VOCs, SVOCs, Metals, and Pesticide/PCBs	5	1	1	1	0

Notes:

[a] An MS/MSD is not considered an extra sample; however, additional sample volume is collected for laboratory QA/QC.
[b] One equipment rinsate will be collected for each day of sampling, unless dedicated equipment is used.
[c] Trip blanks are only applicable to water samples being analyzed for VOCs; therefore, one trip blank will be included within every shipping cooler containing an aqueous VOC sample.

MS/MSD Matrix spike/matrix spike duplicate
PCB Polychlorinated biphenyl
QA/QC Quality assurance/quality control
SVOC Semivolatile organic compound
VOC Volatile organic compound

sampling, sample analysis, and logistics will be developed before the sampling visit and, if necessary, during the sampling visit. The procedures described in the FSP are for guidance purposes only and may be modified before site work begins.

A7.2 TASKS

To complete the RI/FS, Tetra Tech will perform the following 13 tasks (with subtasks), which are outlined in the approved work plan (Tetra Tech 2004):

- Project Planning and Support
- Community Relations Technical Support
- Data Acquisition Oversight (Field Investigation)
- Analysis of Split Samples
- Analytical Support and Data Validation of Split Samples
- Data Evaluation of Split Samples
- Review of PRP Risk Assessment
- Treatability Study and Pilot Testing Oversight
- Review the PRP's Remedial Investigation Report
- Review the PRP's Remedial Alternatives Screening
- Review the PRP's Remedial Alternatives Evaluation
- Review the PRP's FS Report
- Post RI/FS Support

To meet project objectives, Tetra Tech's tasks include (1) oversight of work efforts to confirm the PRP's adherence to the FSP and QAPP and (2) collection of split samples. Confirmatory samples will be

collected for analysis during the RI/FS. Split sampling during the RI/FS is required for comparison with the PRP's data.

Tetra Tech will conduct field investigation oversight to ensure the proper management of split samples, including accurate chain-of-custody procedures for sample tracking, protective sample-packing techniques, and proper sample-preservation techniques. Sample management will be conducted with the EPA-approved software Forms II Lite. Tetra Tech will ensure that the PRP characterizes and disposes of investigation-derived wastes in accordance with local, State, and Federal regulations.

Tetra Tech will also provide field oversight and collect split samples during two separate quarterly sampling events. The quarterly sampling events are expected to be performed by the PRP to fill any data gaps identified during the initial field investigation.

A8 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The QA/QC processes are integral to the EPA's CLP and are intended to generate analytical data of known and documented quality. The QC process includes those activities required during data collection to produce the most appropriate data to support the decisions that will be based on the data (for example, decisions to be made prior to, during, and after site remedial actions) (EPA 2000a). After environmental data are collected, QA activities focus on assessing the quality of the data obtained to determine the data's suitability to support remedial or enforcement decisions.

A8.1 DATA CATEGORIES

The EPA Superfund program has developed two descriptive data categories to assist in interpreting data: (1) screening data and (2) definitive data. The type of data generated depends on the qualitative and quantitative DQOs developed for a project. Whether the resulting data are determined to be screening or definitive, all data collected must be of adequate quality for the decision-making process for which it was collected. For this project, both screening and definitive data will be collected. Table A8-1 presents the methods to be used to analyze all samples. Only definitive data will be used to support decisions made for this project. Screening level data will be used (in addition to definitive data) to define the nature and extent of contamination in addition to supporting decisions regarding field sampling.

The types of instrumentation that will be used to screen field samples includes a photoionization detector (PID) for qualitative determination of organic vapors in soil and a flow-through cell meter to monitor groundwater quality parameters in monitoring wells. Screening data require documented adherence to SOPs. The specific analytical methods for each of these screening techniques are discussed in Section B4 of this SAP.

Rigorous analytical methods (such as EPA laboratory methods) are used to generate analyte-specific, definitive data. The definitive quality of the data is assured by (1) strict adherence to SOPs and QC processes during data collection; (2) documented control and traceability of reference standards,

TABLE A8-1

ANALYTICAL METHODS FOR INVESTIGATIVE SAMPLES
WOODBROOK ROAD DUMP SITE, SOUTH PLAINFIELD, NEW JERSEY

Parameter	Screening Method	Definitive Method
On-site Investigative Soil/Sediment Samples		
TAL metals	NA	CLP ILM04.1 [a] or ILM05.2 [b]
TCL SVOCs	NA	CLP OLM04.2 [c]
TCL VOCs	Hand-held PID	CLP OLM04.2 [c]
Pesticide/PCBs	NA	CLP OLM04.2 [c]
Dioxin	NA	CLP DLM01.4 [d]
On-site Investigative Aqueous Samples		
TCL SVOCs	NA	CLP OLM04.2 [c] or OLC03.2 [e]
TCL VOCs	NA	CLP OLM04.2 [c] or OLC03.2 [e]
TAL metals	NA	CLP ILM04.1 [a] or ILM05.2 [b]
Dissolved oxygen	Water quality meter	NA
pH	Water quality meter	NA
Specific conductance	Water quality meter	NA
Water temperature	Water quality meter	NA
Oxidation-reduction potential	Water quality meter	NA
Turbidity	Water quality meter	NA

Notes:

[a] EPA 2000b
[b] EPA 2001c
[c] EPA 1999a
[d] EPA 2002a
[e] EPA 2000d

API American Petroleum Institute
ASTM American Society for Testing and Materials
CLP Contract Laboratory Program
EPA U.S. Environmental Protection Agency
NA Not applicable
PCB Polychlorinated biphenyl
PID Photoionization detector
SVOC Semivolatile organic compound
TAL Target Analyte List
TCL Target Compound List
VOC Volatile organic compound

calibrations, and instrument performance; and (3) acceptable performance of field and laboratory QC procedures within the defined limits established for these procedures.

The EPA Region 2 laboratory in Edison, New Jersey, will perform most of the fixed-laboratory services for the RI/FS, to the extent of their capabilities and capacities. However, if the EPA Region 2 laboratory is not available or cannot perform a specific analysis, a subcontracted laboratory will be used.

A8.2 DATA QUALITY OBJECTIVES

The DQO process is a systematic planning tool designed to ensure that the measurement data collected are of the type, quantity, and quality to best support the decisions based on these data. The DQO process is used for all data collection activities conducted under the EPA Region 6 RAC program so that program resources are used in the most cost-effective manner. This section outlines the data categories appropriate for this project. DQOs are qualitative and quantitative statements developed through the seven-step DQO process (EPA 2000b, 2000d). The DQOs clarify the study objective, define the most appropriate data to collect and the conditions under which to collect the data, and specify tolerable limits on decision errors that will be used as the basis for establishing the quantity and quality of data needed to support decision-making. The DQOs are used to develop a scientific and resource-effective design for data collection. The seven-step iterative process used to prepare plans for environmental data collection activities of the DQO process for this project is presented in Table A8-2.

A8.3 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

To meet DQOs, it is important that procedures be developed and implemented to maintain the quality and integrity of the data generated in the field and in the laboratory. The level of QC effort and the QA objectives for the data quality indicators of sensitivity, accuracy, precision, completeness, representativeness, and comparability of data are discussed in this section. Table A8-3 presents the acceptance criteria for definitive on-site and off-site laboratory data for chemical analyses of investigation samples only (excluding field-screening analyses).

TABLE A8-2

DATA QUALITY OBJECTIVES
WOODBROOK ROAD DUMP SITE, SOUTH PLAINFIELD, NEW JERSEY

STEP 1: STATE THE PROBLEM
• The Woodbrook site was previously operated as an unauthorized dumping area accepting household and industrial waste. Partially buried capacitors, some of which contained an oily liquid that had discharged into the ground, were discovered on site. Samples collected in 1999 revealed that the soil, sediments, and groundwater at the site are contaminated with VOCs, SVOCs, inorganic constituents, and pesticide/PCBs.
STEP 2: IDENTIFY THE DECISIONS
• Did the PRP follow the approved RI/FS work plan and was the PRP's performance effective in determining the extent of contamination?
STEP 3: IDENTIFY INPUTS TO THE DECISIONS
• Analytical results for on-site surface soil samples (0.0 to 2.0 feet bgs) collected. • Analytical results for subsurface soil samples collected at three intervals: 0.0 to 0.5 foot bgs, 2.0 to 2.5 feet bgs, and 4.0 to 4.5 feet bgs. • Analytical results for groundwater samples. • Analytical results for surface water and sediment samples collected. Sediment samples will be collected from the 0.0 to 0.5 foot below the sediment surface. • All soil and sediment samples will be analyzed for VOCs, SVOCs, pesticide/PCBs, and metals. Two surface soil samples will be analyzed for dioxins. • All aqueous samples will be analyzed for VOCs, SVOCs, pesticide/PCBs, and metals. • Analytical data will be obtained by the PRP for comparison with data collected by Tetra Tech.
STEP 4: DEFINE STUDY BOUNDARIES
• For the test pit, samples will be visually assessed to determine the nature and extent of buried wastes and samples will be collected and analyzed to determine the underlying soil conditions. • The vertical extent of the study area for surface and subsurface soil extends from the surface of the native soil to 4.5 feet bgs. • The horizontal extent of the study area in the surface water and sediment area include Bound Brook, the Main Tributary, and the open water wetland area that is upstream of the Secondary Tributary. • For groundwater, the study area includes the water table and the underlying permeable zone.
STEP 5: DEVELOP DECISION RULES
• If the split samples collected agree to a reasonable degree with the data collected by the PRP, then it can be assumed that the PRP is following good data collection techniques and the PRP contractor laboratory is performing adequately. Therefore, no action would be required. • If the split samples collected do not agree with the data collected by the PRP, then (1) additional confirmation/verification sampling or (2) an investigation into sampling techniques and/or laboratory practices should be considered.
STEP 6: SPECIFY TOLERABLE LIMITS ON DECISION ERRORS
A statistically based method to evaluate and compare the data sets (Tetra Tech's split samples versus PRP's samples) should be used to determine whether there is good agreement between the data sets. The specific statistical method will be identified and discussed with EPA. Site-specific sampling locations will be based on prior knowledge of likely hazardous material handling and waste disposal.

TABLE A8-2 (Continued)

DATA QUALITY OBJECTIVES
WOODBROOK ROAD DUMP SITE, SOUTH PLAINFIELD, NEW JERSEY

STEP 7: OPTIMIZE THE SAMPLING DESIGN
The PRP will decide the location of the test pit, soil (surface and subsurface), sediment, surface water, and groundwater samples based on knowledge of historical operations.

Notes:

bgs	Below ground surface
PCB	Polychlorinated biphenyl
PRP	Potentially responsible party
RI/FS	Remedial investigation and feasibility study
SVOC	Semivolatile organic compound
VOC	Volatile organic compound

TABLE A8-3

QUALITY ASSURANCE INDICATOR CRITERIA FOR DEFINITIVE DATA FOR PRELIMINARY COPCS WOODBROOK ROAD DUMP SITE, SOUTH PLAINFIELD, NEW JERSEY

Indicator Parameter	Analytical Parameter	QC Sample	Acceptance Criteria for Laboratory Analysis
Accuracy (Percent recovery)	SVOCs, VOCs, pesticide/PCBs	MS and MSD Blanks	50 to 150 percent recovery Less than CRQL
	Metals	MS LCS Blanks	75 to 125 percent recovery 80 to 120 percent recovery Less than CRDL
	pH	Buffer solution checks	Within 0.01 unit of true value
Precision (Relative percent difference)	SVOCs, VOCs, pesticides/PCBs	MS and MSD Field duplicates	50 percent RPD 50 percent RPD
	Metals	MD Field duplicates	20 percent RPD (35 percent for solid matrix) 50 percent RPD
	pH	MD Field duplicates	20 per RPD 20 per RPD
Sensitivity (Quantitation limits)	All analytical tests	MS and MSD Field duplicates	Not Applicable
Completeness	The objective for data completeness is 90 percent.		
Representativeness	The sampling network and the field screening analytical methods for this site are designed to provide data that are representative of site conditions.		
Comparability	The use of standard published sampling and analytical methods, and the use of QC samples, will ensure data of known quality. These data can be compared to any other data of known quality.		

Notes:

CLP	Contract Laboratory Program
COPL	Chemical of potential concern
CRDL	Contract-required detection limit
CRQL	Contract-required quantitation limit
LCS	Laboratory control sample
MD	Matrix duplicate
MS	Matrix spike
MSD	Matrix spike duplicate
PCB	Polychlorinated biphenyl
QC	Quality control
RPD	Relative percent difference
SVOC	Semivolatile organic compound
VOC	Volatile organic compound

A8.3.1 Sensitivity

The QA objective for sensitivity is expressed in the form of the method detection limit (MDL) or quantitation limit for the analytical method selected. The RAC generic QAPP (PRC 1996a) presents the equation used to calculate the MDL. The required analyte quantitation limits are based on the method-specified practical quantitation limits (PQL). PQLs reflect the influences of the sample matrix on method sensitivity and are typically higher than detection limits. The required PQLs for investigation sample analysis are equal to the CRQLs for SVOCs, VOCs, and pesticide/PCBs and the CRDLs for total metals analysis as provided in the EPA CLP protocols (EPA 1999a, 2000b, 2000d, and 2001b).

A8.3.2 Accuracy and Precision

Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy is typically expressed as percent recovery from spiked samples or bias with respect to a reference standard. The use of spiked samples permits a constant check on method accuracy and provides an indication of the degree of matrix effect. The RAC generic QAPP (PRC 1996a) presents equations used to calculate accuracy in terms of percent recovery.

Establishing a sound sampling strategy and following appropriate SOPs will increase accuracy for field sampling. Field QC samples that are collected to measure accuracy include trip blanks, field duplicates, and equipment rinsate blanks. Other QC samples, such as matrix spike (MS), matrix spike duplicate (MSD), and laboratory duplicate samples, are laboratory QC samples. Accuracy for laboratory analyses will be assessed by collecting and analyzing the types of QC samples presented in Table A8-3 and evaluating the results against the criteria listed there.

Precision measures the variability of a measurement system. It is estimated typically by using duplicate and replicate measurements, and is expressed in terms of relative percent difference (RPD). The RAC generic QAPP (PRC 1996a) presents equations used to calculate RPD. For field sampling, precision is increased by following SOPs and by using identical sampling procedures to collect all samples. Field QC samples that are collected to measure precision include duplicate field samples and collocated samples.

Precision for laboratory analyses will be measured by collecting and analyzing the types of samples presented in Table A8-3 and evaluating the results against the criteria listed there.

A8.3.3 Completeness, Representativeness, and Comparability

Completeness is measured by comparing the amount of valid data obtained to the total number of measurements needed to achieve a specified level of confidence in decision-making. After analytical testing, the percent completeness will be calculated by using the equation presented in the generic RAC QAPP (PRC 1996a). The completeness objective for field and laboratory data is 90 percent.

Representativeness expresses the degree to which data accurately and precisely represent (1) a characteristic of a population, (2) parameter variations at a sampling point, (3) a process condition, or (4) an environmental condition. Representativeness is a qualitative parameter that depends on the proper design of the sampling program and proper laboratory protocol. Each sample collected from the site is expected to be representative of the population or environmental condition from which it was collected. During development of the sampling network, the following were considered: (1) past waste disposal practices, (2) existing analytical data, (3) current and former on-site physical setting and processes, and (4) construction requirements. Representativeness will be satisfied by (1) ensuring that the project-specific QAPP is followed, (2) ensuring that samples are collected in accordance with appropriate SOPs or ensuring that proper sampling techniques are used when SOPs are not available, (3) following proper analytical procedures, and (4) ensuring that required holding times are not exceeded in the laboratory.

Comparability expresses the confidence with which one portion or set of data can be compared to another. Generally, comparability will be attained by achieving the QA objectives, presented in this SAP, for sensitivity, accuracy, precision, completeness, and representativeness. Comparability of data will also be attained by following field and laboratory procedures consistently for individual sites. EPA-approved standard field procedures will be used to the maximum extent possible. EPA-approved laboratory methods will be used to increase the comparability of laboratory analytical data.

A9 SPECIAL TRAINING REQUIREMENTS OR CERTIFICATION

The main training requirements for Tetra Tech personnel engaged in field activities are the emergency response and hazardous waste operations training requirements that are defined in Title 29 of the Code of Federal Regulations Part 1910.120. Tetra Tech personnel meet the specialized training and certification requirements for completing the environmental data collection tasks that are described in this SAP. Further information about Tetra Tech's training program is contained in Section 4.0 of the QMP for the EPA Region 6 RAC program (PRC 1996b).

A10 DOCUMENTATION AND RECORDS

This section describes the data reporting requirements for Tetra Tech field personnel and laboratories (Region 2 Laboratory or subcontracted) that submit field and laboratory measurement data under the EPA Region 6 RAC program. The EPA-approved laboratory will analyze soil samples for VOCs, SVOCs, metals, pesticide/PCBs, and dioxins.

Tetra Tech will require fixed off-site laboratories to prepare and submit data packages in accordance with the EPA CLP protocols (EPA 1999a, 2000b, 2000d, and 2001b) for hardcopy and electronic deliverable format of VOCs, SVOCs, pesticides/PCBs, dioxins, and total metals data. Data packages will include all applicable documentation for independent validation of data and verification of the DQOs. The following documentation will be required for full data validation, if applicable:

- Case narratives, which will describe all QC nonconformances that are encountered during the analysis of samples in addition to any corrective actions that are taken
  - Statement of samples received
  - Description of any deviations from the specified analytical method
  - Explanations of data qualifiers that are applied to the data
  - Any other significant problems that were encountered during analysis
- Tables that cross-reference field and laboratory sample numbers
- Chain-of-custody forms, which pertain to each sample delivery group or sample batch that is analyzed
- Laboratory reports, which must show traceability to the sample analyzed and must contain specified information
  - Project identification
  - Field sample number
  - Laboratory sample number
  - Sample matrix description
  - Dates and times of sample collection, receipt at the laboratory, preparation, and analysis
  - Description of analytical method and reference citation

  - Results of individual parameters, with concentration units, including second column results, second detector results, and other confirmatory results, where appropriate
  - Quantitation limits achieved
  - Dilution or concentration factors

- Data summary forms and QC summary forms showing analytical results, if applicable

  - Samples
  - Surrogates
  - Blanks
  - Field QC samples
  - Laboratory control samples (LCS)
  - Initial and continuing calibrations
  - Other QC samples

- Laboratory control charts

  - Raw data
  - Instrument printouts
  - Laboratory bench sheets for preparation of samples

- MDL study results

Tetra Tech's project manager, in cooperation with the QA officer, will define site-specific requirements for data reporting. Requests for analytical services (discussed in Section B4) clearly define these requirements, the turnaround time for receipt of the data deliverables specified, and any requirements for retaining samples and laboratory records. Laboratory QA managers are responsible for ensuring that all laboratory data reporting requirements in the QAPP are met.

B1 SAMPLING PROCESS DESIGN

For the Woodbrook project and this SAP, the main elements of the sampling design include (1) the numbers and types of samples to be collected, (2) sampling locations, (3) sampling frequencies, and (4) sample matrices. The EPA WAM has established the criteria for selecting the samples that will be split. Tetra Tech will modify the approach and plan, as necessary, on the basis of input from the WAM and as authorized by EPA. At EPA's request, this FSP will be made available to regional, state, and local authorities.

For sampling design purposes, the site includes the following sampling activities:

- Test Pits (including subsurface soil)
- Surface Soil
- Groundwater
- Surface Water/Sediment (Bound Brook, Main Tributary, and wetland upstream of Second Tributary)

B1.1 COLLECTION OF TEST PIT/SUBSURFACE SOIL SAMPLES

As directed by the EPA WAM, Tetra Tech will provide oversight during the excavation of the test pits and the collection of subsurface soil samples. The excavation of 25 test pits is proposed to visually assess the nature and extent of buried wastes and evaluate underlying soil conditions by sample collection and analysis (TRC 2003). Proposed test pit and sampling locations are provided on Figure 6 of the PRP Work Plan. Test pits will be excavated using a backhoe, through debris into native material. These test pits are anticipated to be to a maximum of 4.5 feet deep.

During excavation, Tetra Tech will visually inspect the soils for evidence of contamination. Observations and sketches of the test pits will be included in the Tetra Tech field logbook. TRC will screen the wastes and soils in the field using a PID. Samples will be collected from the surface and in native soils at depths below the fill/native soil interface of 0.0 to 0.5 foot below ground surface (bgs), 2.0 to 2.5 feet bgs, and 4.0 to 4.5 feet bgs. Sample parameters will include VOCs, SVOCs, metals, and pesticide/PCBs.

Additionally, one subsurface soil sample will be analyzed for dioxin and dioxin-like compounds, as proposed in the PRP's FSP.

Tetra Tech will split approximately five of the test pit/subsurface soil samples. A summary of the data collection plan for test pit/subsurface soil samples is provided as Table A7-1. Soil samples will be collected following procedures outlined in Tetra Tech's SOP for soil sampling. Soil samples submitted for analyses by off-site laboratories will be shipped using next day delivery. The handling and shipping procedures for the samples are described in Section B3 of this report. The split soil samples will be analyzed for VOCs, SVOCs, metals, and pesticide/PCBs.

B1.2 COLLECTION OF SURFACE SOIL SAMPLES

As directed by the EPA WAM, Tetra Tech will provide oversight during the collection of surface soil samples. The collection of 49 surface soil samples is proposed to further delineate observed exceedances of the NJDEP's Most Stringent Soil Cleanup Criteria (MSSCC) and address data gaps from previous investigations (TRC 2003c). Proposed sampling locations are provided on Figure 6 of the PRP Draft RI/FS Work Plan (TRC 2003c).

During soil sample collection, Tetra Tech will visually inspect the soils for evidence of contamination. Observations and sketches of the test pits will be included in the Tetra Tech field logbook. TRC will field screen the soils using a PID. TRC will collect the required surface soil samples following SOPs prepared for the site. These SOPs are included in the PRP's site-specific FSP (TRC 2003a) prepared for the Woodbrook site. Sample parameters will include VOCs, SVOCs, metals, pesticide/PCBs, and dioxins.

One surface soil sample collected on the western portion of the site will be analyzed for dioxin and dioxin-like compounds, as proposed in the PRP's FSP. Five samples will be collected from areas suspected of being impacted, and five samples will be collected from areas suspected to represent background conditions.

Tetra Tech proposes to split approximately seven of the surface soil samples collected. At least one of the split samples will be analyzed for dioxin and dioxin-like compounds. A summary of the data collection

plan for surface soil samples is provided as Table A7-1. Soil samples will be collected following procedures outlined in Tetra Tech's SOP for soil sampling. Soil samples submitted for analyses by off-site laboratories will be shipped using next day delivery. The handling and shipping procedures for the samples are described in Section B3 of this report. All surface soil samples will be analyzed for VOCs, SVOCs, metals, and pesticide/PCBs; two of the surface soil samples will be analyzed for dioxins.

B1.3 COLLECTION OF GROUNDWATER SAMPLES

TRC will install 13 monitoring wells throughout the Woodbrook site to define groundwater flow conditions and assess groundwater quality. The locations of these monitoring wells is provided on Figure 4 of the PRP's Draft RI/FS Work Plan (TRC 2003c).

TRC will collect groundwater samples from the 13 newly installed monitoring wells using low-flow sampling techniques. TRC will conduct primary monitoring well purging and sampling following SOPs prepared for the site as described in its FSP (TRC 2003a).

Tetra Tech will collect two replicate groundwater quality samples as detailed in the Tetra Tech SOP for groundwater sampling. A summary of the data collection plan for groundwater samples is provided as Table A7-1. Replicate samples will be collected at the same time that TRC collects primary samples, in order to decrease the potential for chemical volatility. TRC field personnel will collect replicate VOC samples into sample containers supplied by Tetra Tech immediately following TRC's collection of the same sample aliquot. The same procedure will then be followed for the collection of SVOC samples, and so on.

Tetra Tech personnel will prepare all sample documentation prior to shipping the samples to the selected laboratory certified to analyze the groundwater samples. All samples will be analyzed for VOCs, SVOCs, metals, and pesticide/PCBs using Standard EPA Test Methods. Further details concerning sampling methodologies are provided in Section B3 of this report.

B1.4 COLLECTION OF SURFACE WATER/SEDIMENT SAMPLES

Based on a review of the existing surface water and sediment data, and the November 4, 2003 RI/FS scoping meeting, additional surface water and sediment samples are necessary to fill data gaps identified in the existing data set. Surface water and sediment sampling will be performed along Bound Brook, Main Tributary, and within the emergent and open water wetland area that is upstream of the Secondary Tributary.

The PRP sampling regimen indicates that the collection of 30 sediment and 13 surface water samples will be collected from four transects on Bound Brook and the Main Tributary, and from nine locations in the open water wetland area to the west of the area of concern one disposal area, which is a headwater of the Second Tributary to Bound Brook. Each of the four stream transects will include one surface water sample and three sediment samples. The proposed transects and sample locations are presented on Figure 5 of the PRP's Draft RI/FS Work Plan (TRC 2003c).

Tetra Tech will collect two surface water and five sediment split samples from the samples TRC collects. Tetra Tech will follow SOPs as documented in Tetra Tech SOP for sediment collection and Tetra Tech SOP for surface water sampling.

The surface water samples will be analyzed for VOCs, SVOCs, metals, and pesticide/PCBs. The sediment samples will be analyzed for VOCs, SVOCs, metals, and pesticide/PCBs. A summary of the data collection plan for sediment and surface water samples is provided as Table A7-1. Tetra Tech personnel will prepare all sample documentation prior to shipping the samples to the selected certified laboratory. The method requirements, including sample preservation, handling, and custody documentation, are discussed in the following section.

B2 SAMPLING METHODS REQUIREMENTS

Sampling for the Woodbrook project will be conducted by the PRP. This section discusses the (1) selection and requirements of sampling methods; (2) requirements for containers, volumes, and preservation methods; and (3) holding times, sample handling, and custody requirements. Section B5 discusses the requirements for collecting QC samples.

B2.1 SAMPLING METHODS

Sampling methods and equipment were selected to meet project objectives. The field sampling team will collect samples in accordance with methods described in Section B-1. Tetra Tech will rely on EPA-approved methods for this project.

The PRP will be responsible for addressing failures in the field sampling or measurement systems and will implement corrective actions in these situations. In general, corrective actions for field sampling and measurement failures include recalibration of instruments, replacement of malfunctioning measurement instruments or sampling equipment, and repeated collection of samples or repetition of measurements.

B2.2 SAMPLE CONTAINER, VOLUME, PRESERVATION, HOLDING TIME REQUIREMENTS, AND DETECTION LIMITS

Table B2-1 specifies the required sample volume, container type, preservation technique, and holding time for each analysis that is to be conducted on each sample matrix that is to be analyzed. The table addresses all sample matrices and provides information for organic and inorganic parameters in each matrix.

Required containers, preservation techniques, and holding times for field QC samples, such as field duplicates, field blanks, trip blanks, and MS/MSD samples, will be the same as for field samples.

TABLE B2-1

REQUIRED SAMPLE VOLUME, CONTAINERS, PRESERVATIVES, AND HOLDING TIMES WOODBROOK ROAD DUMP SITE, SOUTH PLAINFIELD, NEW JERSEY

Parameter	Analysis	Volume and Container	Preservatives	Holding Time[a] Extraction/Analysis
Investigative Soil Samples				
TAL metals	CLP ILM04.1 [b] or CLP ILM05.2 [c]	One 8-ounce glass jar with Teflon™-lined cap	Store at 4±2°C	180 days for analysis (28 days for mercury analysis)
TCL SVOCs	CLP OLM04.2 [ed]	One 8-ounce glass jar with Teflon™-lined cap	Store at 4±2°C	14 days/40 days
TCL VOCs	CLP OLM04.2 [ed]	Two 4-ounce glass jars with Teflon™-lined cap	Store at 4±2°C	14 days for analysis
Pesticide/PCBs	CLP OLM04.2 [ed]	One 8-ounce glass jar with Teflon™-lined cap	Store at 4±2°C	14 days/40 days
Dioxin	CLP DLM01.4 [e]	One 8-ounce glass jar with Teflon™-lined cap or plastic resealable bag	Store at 4±2°C	NA
pH	SW-846 9045C [df]	One 8-ounce glass jar with Teflon™-lined cap	Store at 4±2°C	NA/3 days
Particle size	ASTM D 421 and D 422 [g]	One 8-ounce glass jar	None	28 days
Permeability	ASTM D 5084 [g]	Core	None	28 days
Investigative Aqueous Samples				
TCL SVOCs	CLP OLM04.2 [ed] or CLP OLC03.2 [fh]	Two 1,000-mL amber glass bottles with Teflon™-lined caps	Store at 4±2°C	NA/14 days
TCL VOC	CLP OLM04.2 [ed] or CLP OLC03.2 [fh]	Two 40-mL glass vials with Teflon™-lined caps	HCl to pH < 2; Store at 4±2°C	NA/14 days
TAL metals	CLP ILM04.1 [b] or CLP ILM05.2 [c]	One 1,000-mL polyethylene bottle	HNO_3 to pH < 2; Store at 4±2°C	NA/180 days (mercury 28 days)
Pesticide/PCBs	CLP OLM04.2 [ed]	One 8-ounce glass jar with Teflon™-lined cap	Store at 4±2°C	7 days/40 days

TABLE B2-1 (Continued)

REQUIRED SAMPLE VOLUME, CONTAINERS, PRESERVATIVES, AND HOLDING TIMES
WOODBROOK ROAD DUMP SITE, SOUTH PLAINFIELD, NEW JERSEY

Notes:

[a]	Holding time is measured from the time of sample collection to the time of sample extraction and analysis.
[b]	EPA 2000b
[c]	EPA 2001c
[d]	EPA 1999a
[e]	EPA 2002
[f]	EPA 1996
[g]	ASTM 1998
[h]	EPA 2000d

ASTM	American Society for Testing and Materials
CLP	Contract Laboratory Program
EPA	U.S. Environmental Protection Agency
HCl	Hydrochloric acid
HNO_3	Nitric acid
mL	Milliliter
NA	Not applicable
PCB	Polychlorinated biphenyl
SVOC	Semivolatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
VOC	Volatile organic compound

B3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Each sample collected by the PRP (and the split samples collected by Tetra Tech) will be traceable from the point of collection through analysis and final disposition to ensure sample integrity. Sample integrity helps to ensure the legal defensibility of the analytical data and subsequent conclusions. These procedures, which are discussed in detail in the generic RAC QAPP (PRC 1996a), are as follows:

- Field chain-of-custody procedures
  - Field procedures
  - Field logbooks
- Laboratory chain-of-custody procedures

Tetra Tech will use EPA's data management system known as "Forms II Lite" to produce all chain-of-custody records in the field.

B4 ANALYTICAL METHODS REQUIREMENTS

The source of analytical services to be provided will be determined in part by DQOs and the intended use of the resulting data. Tetra Tech will use EPA-approved methods for laboratory analyses of the samples.

Tetra Tech will follow the analytical services request procedures that are outlined in the generic RAC QAPP (PRC 1996a). If an analytical system fails, the QA officer will be notified, and corrective action will be taken. In general, corrective actions will include stopping the analysis, examining instrument performance and sample preparation information, and determining the need to re-prepare and reanalyze the samples.

Laboratories that are subcontracted by Tetra Tech will conduct definitive laboratory analysis of samples. Table A8-1 lists the laboratory analytical methods for this project. In all cases, appropriate methods of sample preparation, cleanup, and analyses are based on specific analytical parameters of interest, sample matrices, and required quantitation limits. The following subsections briefly discuss each analytical method and any required modifications for definitive investigative analyses, PID screening, and water quality measurements.

Modifications to analytical methods that may be required to handle atypical matrices or to achieve low quantitation limits are presented in this section. Decisions regarding the use and type of method modifications will be made during the procurement of laboratories, since different laboratories have equipment and SOPs that produce varying quantitation limits.

B4.1 FIELD ANALYTICAL METHODS

Field analysis will be performed during this sampling effort for natural attenuation parameters. Table B2-1 identifies the sample methods, containers, preservation, and holding times for all target constituents in groundwater samples.

B4.2 LABORATORY ANALYTICAL METHODS

The EPA Region 2 laboratory or a subcontracted laboratory will conduct laboratory analyses of field samples. Table A8-1 lists the laboratory analytical methods for this project. In all cases, appropriate methods of sample preparation, cleanup, and analyses are based on specific analytical parameters of interest, sample matrices, and required detection limits.

B5 QUALITY CONTROL REQUIREMENTS

Various field and laboratory QC samples and measurements will be used to verify that analytical data meet the QA objectives. Field QC samples and measurements will be collected to assess the influence of sampling activities and measurements on data quality. Similarly, laboratory QC samples will be used to assess how the laboratory's analytical program influences data quality. This section describes the QC samples that are to be analyzed during the investigation for (1) each field and laboratory environmental measurement method and (2) each sample matrix type. Table A8-3 shows the acceptance criteria for each type of QC samples, and Table B5-1 presents the frequency of QC samples to be collected at the site.

B5.1 FIELD QUALITY CONTROL REQUIREMENTS

Field QC samples will be collected and analyzed to assess the quality of data that are generated by sampling activities. These samples will include laboratory QC samples collected in the field, field duplicates, equipment rinsates, trip blanks, MS/MSDs, and temperature blanks. QC samples collected in the field for fixed-laboratory analysis are presented in Table B5-1.

QC checks for field screening analysis will consist of calibration checks of field instrumentation to a QC standard to determine the accuracy of the measurement analyzed at the beginning of each day of analysis and subsequently after every 10 sample measurements. Taking replicate measurements every 10 samples will check the precision of field measurements.

Trip blanks are used to assess the potential for sample contamination during handling, shipment, and storage. Trip blanks for liquid samples are bottles that are filled with organic-free water. The trip blanks are (1) sealed and transported to the field, (2) stored with empty sample bottles and then with the investigative samples throughout the field effort, and (3) returned to the laboratory with the investigative samples for analysis. Trip blanks are never opened in the field. One trip blank is included in every shipping cooler of aqueous samples sent to the analytical laboratory to be analyzed for VOCs as listed in Table B5-1.

TABLE B5-1

FREQUENCY OF FIELD QUALITY CONTROL SAMPLES
WOODBROOK ROAD DUMP SITE, SOUTH PLAINFIELD, NEW JERSEY

Field Quality Control Sample	Frequency[a]	
	Aqueous Matrix	Solid Matrix[b]
Trip blank	1 per cooler containing samples to be analyzed for VOCs	None
Field duplicate	1 per 10 samples (for investigative analyses only)	1 per 10 samples (for investigative analyses only)
Equipment rinsate blank	1 per nondedicated equipment type per day or 1 per 20 samples	1 per nondedicated equipment type per day or 1 per 20 samples
Matrix spike/matrix spike duplicate[c] (organics only)	1 per 20 samples	1 per 20 samples
Matrix spike/matrix duplicate[c] (inorganics only)	1 per 20 samples	1 per 20 samples
Temperature blank	1 per cooler	1 per cooler

Notes:

[a] The quality control sample collection frequency applies to samples collected for field analysis, Contract Laboratory Program analysis, and SW-846 method analysis (EPA 1996).
[b] Solid matrices include soil and sediment samples.
[c] Matrix spike, matrix spike duplicate, and matrix duplicate analyses are technically not field QC samples; however, they generally require that the field personnel collect additional volume of sample, and are therefore included on this table for easy reference.

EPA U.S. Environmental Protection Agency
QC Quality control
VOC Volatile organic compound

Field duplicates are independent samples that are collected as close as possible, in space and time, to the original investigative sample. Field duplicates can measure the influence of sampling and field procedures on the precision of an environmental measurement. They can also provide information on the heterogeneity of a sampling location. Field duplicates will be collected at a frequency of one for every 10 investigative samples of the same matrix type. Immediately following collection of the original sample, the field duplicates are collected using the same collection method. Field duplicates will be collected at a frequency as listed in Table B5 1.

Equipment rinsate blanks are collected when nondedicated or nondisposable sampling equipment is used to collect samples and put the samples into containers. These blanks assess the cleanliness of the sampling equipment and the effectiveness of equipment decontamination. Equipment rinsate blanks are collected by pouring analyte-free water over the decontaminated surfaces of sampling equipment that contacts sampling media. Equipment rinsate blanks are collected after sampling equipment has been decontaminated, but before the equipment is reused for sampling. If nondedicated or nondisposable equipment is used, equipment rinsate blanks will be collected at a frequency as listed in Table B5-1.

MS, MSD, and matrix duplicate (MD) samples are laboratory QC samples that are collected for organic methods. MS and laboratory duplicate samples are typically collected for analysis of inorganics. For solid matrices, MS/MSD samples require no extra volume. For aqueous samples, MS/MSDs require double or triple the normal sample volume, depending on analytical laboratory specifications. Each MS and laboratory duplicate sample is one sample, usually collected from one location at double the normal sample volume. In the laboratory, MS/MSDs and MSs are split and spiked with known amounts of analytes. Analytical results for MS/MSDs and MSs and laboratory duplicate samples are used to measure the precision and accuracy of the laboratory's organic and inorganic analytical programs, respectively. Each of these QC samples will be collected and analyzed at a frequency of one for every 10 investigative samples per matrix.

Temperature blanks are containers of deionized or distilled water that are placed in each cooler shipped to the laboratory. Their purpose is to provide a container to test the temperature of the samples in the respective cooler.

B5.2 LABORATORY QUALITY CONTROL REQUIREMENTS

All laboratories that perform analytical work under this project must adhere to a QA program that is used to monitor and control all laboratory QC activities. Each laboratory must have a written QA manual that describes the QA program in detail. The laboratory QA manager is responsible for ensuring that all laboratory internal QC checks are conducted in accordance with EPA methods and protocols, the laboratory's QA manual, and the requirements of this SAP.

Many of the laboratory QC procedures and requirements are described in EPA-approved analytical methods, laboratory method SOPs, and method guidance documents.

The EPA methods specify the preparation and analysis of QC samples, and may include, but are not limited to, the following types: (1) laboratory control samples (LCS), (2) method blanks, (3) MS and MSD samples, (4) matrix duplicate samples, (5) surrogate spikes, and (6) standard reference materials or independent check standards. The following subsections discuss the QC checks that will be required for this project.

B5.2.1 Laboratory Control Samples

LCSs are thoroughly characterized, laboratory-generated samples that are used to monitor the laboratory's day-to-day performance of analytical methods. The results of laboratory control sample analyses are compared to well-defined laboratory control limits to determine whether the laboratory system is in control for the particular method. If the system is not in control, corrective action will be implemented. Appropriate corrective actions will include (1) stopping the analysis, (2) examining instrument performance or sample preparation and analysis information, and (3) determining whether samples should be re-prepared or reanalyzed. The CLP does not currently require LCS analysis under CLP OLM04.2.

B5.2.2 Method Blanks

Method blanks, which are also known as preparation blanks, are analyzed to assess the level of background interference or contamination in the analytical system and the level that may lead to elevated concentration levels or false-positive data. Method blanks will be required for all laboratory analyses and will be prepared and analyzed at a frequency of one method blank per every 20 samples or one method blank per batch, if the batches consist of fewer than 20 samples.

A method blank consists of reagents that are specific to the analytical method and are carried through every aspect of the analytical procedure, including sample preparation, cleanup, and analysis. The results of the method blank analysis will be evaluated in conjunction with other QC information to determine the acceptability of the data generated for that batch of samples. Ideally, the concentration of a target analyte in the method blank will be below the reporting limit for that analyte. For some common laboratory contaminants, a higher concentration may be allowed.

If the method blank for any analysis is beyond control limits, the source of contamination must be investigated, and appropriate corrective action must be taken and documented. This investigation includes an evaluation of the data to determine the extent of the contamination and its effect on sampling results. If a method blank is within control limits but analysis indicates a concentration of analytes that is above the reporting limit, an investigation should be conducted to determine whether any corrective action could eliminate an ongoing source of target analytes.

For organic and inorganic analyses, the concentration of target analytes in the method blank must be below the reporting limit for that analyte for the blank to be considered acceptable. An exception may be made for common laboratory contaminants (such as methylene chloride, acetone, 2-butanone, and phthalate esters) that may be present in the blank at up to five times the reporting limit. These compounds are frequently detected at low levels in method blanks from materials that are used to collect, prepare, and analyze samples for organic parameters.

B5.2.3 Matrix Spikes and Matrix Spike Duplicates

MSs and MSDs are aliquots of an environmental sample to which known concentrations of target analytes and compounds have been added. The MS is used to evaluate the effect of the sample matrix on the accuracy of the analysis. If there are many target analytes, they will be divided into two to three spike standard solutions. Each spike standard solution will be used alternately. The MS, in addition to an unspiked aliquot, will be taken through the entire analytical procedure, and the recovery of the analytes will be calculated. Results will be expressed in terms of percent recoveries and RPD. The percent recoveries of the target analytes and compounds are calculated and used to determine the effects of the matrix on the precision and accuracy of the method. The RPD between the MS and MSD results is used to evaluate method precision.

The MS/MSD is divided into three separate aliquots, two of which are spiked with known concentrations of target analytes. The two spiked aliquots, in addition to an unspiked sample aliquot, are analyzed separately, and the results are compared to determine the effects of the matrix on the precision and accuracy of the analysis. Results will be expressed as RPD and percent recovery and compared to control limits that have been established for each analyte. If results fall outside control limits, corrective action will be performed.

B5.2.4 Laboratory (Matrix) Duplicates

MDs, which are also called laboratory duplicates, are prepared and analyzed for inorganic analyses to assess method precision. Two aliquots of sample material are taken from the sample and processed simultaneously without adding spiking compounds. The MD and the original sample aliquot are taken through the entire analytical procedure, and the RPD of the duplicate result is calculated. Results are expressed as RPD and are compared to control limits that have been established for each analyte.

B5.2.5 Surrogate Spikes

Surrogates are organic compounds that are similar to the analytes of interest in chemical properties but are not normally found in environmental samples. Surrogates are added to field and QC samples, before the samples are extracted, to assess the efficacy of the extraction procedure and to assess the bias that is introduced by the sample matrix. Results are reported in terms of percent recovery. Individual analytical methods may require sample reanalysis based on surrogate criteria.

The laboratory will use surrogate recoveries mainly to assess matrix effects on sample analysis. Obvious problems with sample preparation and analysis (such as evaporation to dryness or a leaking septum) that can lead to poor surrogate spike recoveries must be eliminated before low surrogate recoveries can be attributed to matrix effects.

B5.3 COMMON DATA QUALITY INDICATORS

This section describes how QA objectives for precision, accuracy, completeness, and sensitivity are measured, calculated, and reported, and provides equations for these objectives.

B5.3.1 Precision

Precision of many analyses is assessed by comparing analytical results of MS and MSD sample pairs for organic analyses, field duplicate samples, laboratory duplicate samples, MDs, and field replicate measurements. If precision is calculated from two measurements, it is normally measured as RPD (equation provided in the RAC generic QAPP [PRC 1996a]). If precision is calculated from three or more replicates, relative standard deviation (RSD) is calculated (equation provided in the RAC generic QAPP [PRC 1996a]).

For field measurements, such as pH, for which the absolute variation is more appropriate, precision is reported as the absolute range of duplicate measurements (equation provided in RAC the generic QAPP [PRC 1996a]).

B5.3.2 Accuracy

The accuracy of many analytical methods is assessed by using the results of MS and MSD samples for organic analyses, MS samples for inorganic analyses, surrogate spike samples, LCSs, standard reference materials, independent check standards, and measurements of instrument responses against zero and span gases.

For measurements in which spikes are used, percent recovery is calculated by the equation provided in the RAC generic QAPP (PRC 1996a) as a measure of accuracy. For field measurements, such as pH, accuracy is often expressed in terms of bias calculated by the equation provided in the RAC generic QAPP (PRC 1996a).

B5.3.3 Completeness

Completeness is defined as the percentage of measurements judged to be valid. The validity of sample results is determined through the data validation process. All rejected sample results are considered to be incomplete. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set (equation provided in RAC the generic QAPP [PRC 1996a]).

B5.3.4 Sensitivity

The achievement of MDLs depends on instrument sensitivity and matrix effects. Therefore, it is important to monitor the instrument sensitivity to ensure data quality and to ensure that analyses meet the QA objectives that have been established for sensitivity (Section A8.3.1). Method sensitivity is typically evaluated in terms of the MDL and, for many measurements, is calculated by the equation provided in the RAC generic QAPP (PRC 1996a).

B6 INSTRUMENT AND EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

This section outlines testing, inspection, and maintenance procedures for field equipment and instruments and for laboratory instruments. The PRP will lease all field equipment through equipment supply vendors. This section discusses general and specific requirements that apply to field and laboratory equipment.

B6.1 GENERAL REQUIREMENTS

Testing, inspection, and maintenance methods and frequency will be based on (1) the type of instrument; (2) the instrument's stability characteristics; (3) the required accuracy, sensitivity, and precision of the instrument; (4) the instrument's intended use, considering project-specific DQOs; (5) manufacturer's recommendations; and (6) other conditions that affect measurement or operational control. For most instruments, preventive maintenance is performed in accordance with procedures and schedules recommended in (1) the instrument manufacturer's literature or operating manual or (2) SOPs associated with particular applications of the instrument.

In some cases, testing, inspection, and maintenance procedures and schedules will differ from the manufacturer's specifications or SOPs. This can occur when a field instrument is used to make critical measurements or when the analytical methods that are associated with a laboratory instrument require more frequent testing, inspection, and maintenance.

B6.2 FIELD EQUIPMENT AND INSTRUMENTS

Tetra Tech will conduct oversight of the field activities. The PRP will use leased field equipment and instruments to conduct field activities. The vendor will be responsible for thoroughly checking and calibrating field equipment and instruments before they are shipped or transported to the field. Copies of testing, inspection, and maintenance procedures will be shipped to the field with the equipment and instruments.

After the field equipment and instruments arrive in the field, they will be inspected for damage. Damaged equipment and instruments will be replaced or repaired immediately. Battery-operated equipment will be checked to ensure full operating capacity; if needed, batteries will be recharged or replaced. Critical spare parts will be kept on site to minimize equipment downtime. Examples of critical spare parts are tape, paper, pH probes, electrodes, and batteries. Delays in the field schedule should be prevented by having back-up instruments and equipment available on site or available for shipment to the site within one day.

Following use, field equipment will be decontaminated properly before it is returned to its source. When the equipment is returned, copies of any field notes regarding equipment problems will be included so that problems are not overlooked and any necessary equipment repairs are performed.

B6.3 LABORATORY INSTRUMENTS

All laboratories that analyze samples collected under the EPA Region 6 RAC program must have a preventive maintenance program that addresses (1) testing, inspection, and maintenance procedures and (2) the maintenance schedule for each measurement system and required support activity. This program is usually documented by an SOP for each analytical instrument that is to be used. Typically, the program will be laboratory-specific; however, it should follow requirements outlined in EPA-approved guidelines. Some of the basic requirements and components of such a program are as follows:

- As a part of its QA/QC program, each laboratory will conduct a routine preventive maintenance program to minimize instrument failure and other system malfunction.

- An internal group of qualified personnel will maintain and repair instruments, equipment, tools, and gauges. Alternatively, manufacturers' representatives may provide scheduled instrument maintenance and emergency repair under a repair and maintenance contract.

- The laboratory will perform instrument maintenance on a regularly scheduled basis. The scheduled service of critical items should minimize the downtime of the measurement system. The laboratory will prepare a list of critical spare parts for each instrument. The laboratory will request the spare parts from the manufacturer and will store the parts.

- Testing, inspection, and maintenance procedures described in laboratory SOPs will be performed in accordance with manufacturer's specifications and the requirements of the specific analytical methods that are used.

- All maintenance and service must be documented in service logbooks to provide a history of maintenance records. A separate service logbook should be kept for each instrument. All maintenance records will be traceable to the specific instrument, equipment, tool, or gauge.

- The laboratory will maintain and file records that are produced as a result of tests, inspections, or maintenance of laboratory instruments. These records will be available for review by internal and external laboratory system audits that are conducted under the EPA Region 6 RAC program.

B7 INSTRUMENT CALIBRATION AND FREQUENCY

This section describes the procedures for maintaining the accuracy of field equipment and laboratory instruments that are used for field tests and laboratory analyses. The equipment and instruments should be calibrated before each use or, when not in use, on a scheduled periodic basis.

B7.1 FIELD EQUIPMENT

Equipment that is used by the PRP to collect field samples or take field measurements under the EPA Region 6 RAC program will be maintained and calibrated with sufficient frequency and in such a manner that the accuracy and reproducibility of results are consistent with the manufacturer's specifications and with project-specific DQOs.

Upon arrival of the field sampling and measurement equipment, the site manager will examine it to verify that it is in good working condition. The manufacturer's operating manual and instructions that accompany the equipment will be consulted to ensure that all calibration procedures are followed. Measuring and testing equipment may be calibrated either internally—by using in-house reference standards—or externally—by agencies, manufacturers, or commercial laboratories. Calibration records will contain a reference identifying the source of the procedure and, where feasible, the actual procedure. Each piece of measuring and testing equipment will also be accompanied by an equipment use log. The equipment use log will be kept current and may contain the following information: (1) date of use, (2) times of use, (3) operating and assisting technicians, (4) calibration status, and (5) comments. The Tetra Tech SOPs include those covering calibration procedures, frequency standards, control limits, and corrective actions.

B7.2 LABORATORY INSTRUMENTS

All laboratory equipment that is used to analyze samples collected under the EPA Region 6 RAC program will be calibrated on the basis of written SOPs that are maintained by the laboratory. Calibration records (including the dates and times of calibration and the names of the personnel performing the calibration) will be filed at the location at which the analytical work was performed and maintained by the laboratory

personnel who performed QC activities. Subcontractor laboratories may conduct laboratory work under the EPA Region 6 RAC program. The laboratory QA manager is responsible for ensuring that all laboratory instruments are calibrated in accordance with the requirements of this QAPP.

The laboratories will follow the method-specific calibration procedures and requirements for laboratory measurements. Calibration procedures and requirements will also be provided, as appropriate, for laboratory support equipment, such as balances, mercury thermometers, pH meters, and other equipment that is used to take chemical and physical measurements.

B8 REQUIREMENTS FOR INSPECTION AND ACCEPTANCE OF SUPPLIES AND CONSUMABLES

The Tetra Tech project manager is responsible for identifying the types and quantities of supplies and consumables that are needed for collecting the split samples for this project. The project manager is also responsible for determining acceptance criteria for these items. Supplies and consumables can be received at either an equipment distribution center or a site. When supplies are received, the Tetra Tech site manager will sort the supplies according to vendor, check packing slips against purchase orders, and inspect the condition of all supplies before the supplies are accepted for use on a project. If the supplies do not meet the acceptance criteria, deficiencies will be noted on the packing slip and purchase order. In addition, a form will be completed describing the problem and circumstances, and noting the purchase order number of the item. Afterward, the item will be returned to the vendor for replacement or repair.

B9 DATA ACQUISITION REQUIREMENTS (NONDIRECT MEASUREMENTS)

For this project, Tetra Tech anticipates acquiring data from nondirect measurements such as databases, spreadsheets, and literature files. If such data acquisition is required, the procedures are described in the generic RAC QAPP (PRC 1996a).

B10 DATA MANAGEMENT

Data for this project will be obtained from a combination of sources, including field measurements and Regional and subcontracted laboratories. The data-gathering process requires a coordinated effort and will be conducted by project staff members in conjunction with all potential data producers. The data will be obtained from the analytical service provider, when appropriate, in the form of an electronic data deliverable, in addition to the required hard copy analytical data package. Formal verification (or validation) of data will be conducted before associated results are presented or are used in subsequent activities.

Data tracking is essential to ensure timely, cost-effective, and high-quality results. Data tracking begins with sample chain of custody. When the analytical service provider receives custody of the samples, the provider will send a sample acknowledgment to Tetra Tech. The sample acknowledgment will confirm sample receipt, condition, and required analyses. The EPA tracking software (Forms II Lite) will contain all pertinent information about each sample and can track the data at each phase of the process. The tracking software carries the data through completion of the data validation.

Tetra Tech will validate 10 percent of the investigative analytical data received from subcontract laboratories (other than the EPA Region 2 Edison laboratory) to ensure that the confirmatory data are accurate and defensible, as described in Section D2 of this QAPP. A cursory review will be conducted on the remaining 90 percent of the data received from subcontract laboratories. All data will be evaluated for usability by Tetra Tech.

As a part of the data validation process, electronic data deliverables will be reviewed against hard copy deliverables to ensure accurate transfer of data. In addition, the hard copy will be evaluated for errors in the calculation of results. After the data validation, qualifiers can be placed on the data to indicate the usability of the data. These qualifiers will be placed into an electronic data file. Upon approval of the data set with the appropriate data qualifiers, the electronic data will be released to the project manager for reporting. Sections D1 and D2 of the generic RAC QAPP contain a complete discussion of Tetra Tech's data validation procedures (PRC 1996a).

C1 ASSESSMENT AND RESPONSE ACTIONS

Under the EPA Region 6 RAC program, performance and system audits of field and laboratory activities may be conducted to verify that sampling and analysis are performed in accordance with the procedures and requirements established in the generic RAC QAPP. This includes the following:

- Performance and system audits
  - Audit personnel
  - Audit scope of work
  - Audit frequencies
  - Audit reports
- Corrective action
  - Sample collection and field measurements
  - Laboratory analyses

Nonconforming items and activities are those that do not meet the project requirements, procurement document criteria, and approved work procedures. Nonconformance may be detected and identified by the following personnel:

- Project personnel—During field operations, supervision of subcontractors, and field inspections
- Testing personnel—During preparation for and performance of tests, equipment calibration, and QC activities
- QA personnel—During the performance of audits, surveillance, and other QA activities

Each nonconformance that affects quality will be documented by the person who identifies or originates the nonconformance. Documentation of nonconformance will include the following components:

- Description of nonconformance
- Identification of personnel who are responsible for correcting the nonconformance and, if verification is required, for verifying satisfactory resolution

- Method(s) for correcting the nonconformance (corrective action) or description of the variance granted
- Proposed schedule for completing corrective action and the corrective action taken

Nonconformance documentation will be made available to the project manager, QA manager, and subcontractor management personnel, as appropriate.

The field manager and QA personnel, as appropriate, are responsible for notifying the project manager and the QA manager of the nonconformance. In addition, the project manager and the site manager, as appropriate, will be notified of significant nonconformances that could affect the results of the work. The project manager is responsible for determining whether notification of EPA is required.

The completion of corrective actions for significant nonconformances will be documented by QA personnel during future auditing activities. Any significant recurring nonconformance will be evaluated by project and QA personnel, as appropriate, to determine its cause. Appropriate changes will be instituted, under corporate or project procedures, to prevent recurrence. When such an evaluation is performed, the results will be documented.

C2 REPORTS TO MANAGEMENT

Effective management of environmental data collection operations requires timely assessment and review of measurement activities. It is essential that open communication, interaction, and feedback be maintained among all project participants, including (1) the Tetra Tech QA manager, program manager, project manager, technical staff, and laboratory subcontractors and (2) the EPA Region 6 project officer, QA officer, and the EPA Region 2 WAM. Tetra Tech prepares monthly progress reports for each work assignment that is conducted under the EPA Region 6 RAC program. These reports address any QA issues that are specific to the work assignment and facilitate timely communication of such issues.

At the program level, the QA manager prepares quarterly status reports of QA issues that are related to Tetra Tech's work on the EPA Region 6 RAC program. These reports are distributed to Tetra Tech's president, corporate QA manager, RAC program manager, and, upon request, the EPA Region 6 project officer. QA status reports address the following areas:

- Results of QA audits and other inspections, including any quality improvement opportunities that have been identified for further action
- Instrument, equipment, or procedural problems that affect QA
- Subcontractor performance issues
- Corrective actions
- Status of previously reported activities and continuous quality improvement initiatives
- Work planned for the next reporting period

D1 DATA REVIEW AND REDUCTION REQUIREMENTS

This section focuses on data review and reduction requirements for work conducted under the EPA Region 6 RAC program. Section D2 addresses data validation and verification requirements. Section D3 addresses reconciliation with DQOs.

Data reduction and review are essential functions for preparing data that can be used effectively to support project decisions and DQOs. These functions must be performed accurately and in accordance with EPA-approved procedures and techniques. Data reduction includes all computations and data manipulations that produce the final results that are used during the investigation. Data review includes all procedures that field or laboratory personnel conduct to ensure that measurement results are correct and acceptable in accordance with the QA objectives that are stated in this QAPP. Field and laboratory measurement data reduction and review procedures and requirements are specified in previously discussed field and laboratory methods, SOPs, and guidance documents.

Field personnel will record, in a field logbook and/or on the appropriate field form, all raw data from chemical and physical field measurements. The field manager has the primary responsibility for (1) verifying that field measurements were made correctly, (2) confirming that sample collection and handling procedures specified in the project-specific QAPP were followed, and (3) ensuring that all field data reduction and review procedures requirements are followed. The field project manager is also responsible for assessing preliminary data quality and for advising the data user of any potential QA/QC problems with field data. If field data are used in a project report, data reduction methods will be fully documented in the report.

The Region 2 and subcontracted laboratories will complete data reduction for chemical and physical laboratory measurements and will complete an in-house review of all laboratory analytical results. The laboratory QA manager will be responsible for ensuring that all laboratory data reduction and review procedures follow the requirements that are stated in this SAP. The laboratory QA manager will also be

responsible for assessing data quality and for advising the Tetra Tech QA manager of possible QA/QC problems with laboratory data.

D2 VALIDATION AND VERIFICATION METHODS

All data that are used to support activities under the EPA Region 6 RAC program must be valid for their intended purposes. This section outlines the basic data validation procedures that will be followed for all field and laboratory measurements. The following subsections identify personnel who are responsible for data validation and the general data validation process and EPA data validation guidance that will be followed.

D2.1 DATA VALIDATION RESPONSIBILITIES

When analytical services are provided by Tetra Tech subcontracted laboratories, Tetra Tech is responsible for data validation. The QA manager has primary responsibility for coordinating Tetra Tech's data validation activities. Tetra Tech will validate 10 percent of all subcontracted laboratory data for investigation samples. Data validation and review will be completed by one or more experienced data reviewers. When data are generated by the EPA Region 2 laboratory in Edison, New Jersey, it will be used as received from the laboratory, with no further validation.

D2.2 DATA VALIDATION PROCEDURES

The validity of a data set is determined by comparing the data with a predetermined set of QC limits. Tetra Tech data reviewers will conduct a systematic review of the data for compliance with established QC limits (such as sensitivity, precision, and accuracy), on the basis of spike, duplicate, and blank sampling results that are provided by the laboratory. The data review will identify any out-of-control data points or omissions. Tetra Tech data reviewers will evaluate laboratory data for compliance with the following information:

- Method and project-specific analytical service requests
- Holding times
- Initial and continuing calibration acceptance criteria

- Field, trip, and method blank acceptance criteria
- Surrogate recovery
- Field duplicates and MS and MSD acceptance criteria
- MD precision
- LCS accuracy
- Other laboratory QC criteria specified by the method or on the project-specific analytical service request form
- Compound identification and quantitation
- Overall assessment of data, in accordance with project-specific objectives

Tetra Tech will follow the most current EPA CLP guidelines (EPA 1999b and 2002b) for completing data validation for all applicable test methods. General procedures in the CLP guidelines will be modified, as necessary, to fit the specific analytical method that is used to produce the data. In all cases, data validation requirements will depend on (1) DQO levels that are defined in Section A8, (2) reporting requirements that are defined in Section A10, and (3) data deliverables that are requested from the laboratory, as discussed in Section A10.

D3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

The main purpose of a QA system is to define a process for collecting data that are of known quality, are scientifically valid, are legally defensible, and fully support any decisions that will be based on the data. To achieve this purpose, the QAPP requires that DQOs be fully defined (Section A8). All other parts of the QA system must then be planned and implemented in a manner that is consistent with the DQOs. QA system components that follow directly from the DQOs include (1) documentation and reporting requirements (Section A10); (2) sample process design and sampling methods requirements (Sections B1 and B2); (3) analytical methods and analytical service requests (Section B4); (4) QC requirements (Section B5); and (5) data reduction and validation and reporting methods (Sections D1 and D2).

After environmental data have been collected, reviewed, and validated, the data will undergo a final validation to determine whether the DQOs specified in the QAPP have been met. Tetra Tech will follow EPA's data quality assessment (DQA) process to verify that the type, quality, and quantity of data that are collected are appropriate for their intended use (EPA 2000c).

The DQA process involves (1) verifying that the data have met the assumptions under which the data collection design and DQOs were developed, (2) taking appropriate corrective action if the assumptions have not been met, and (3) evaluating the extent to which the data support the decision that must be made so that scientifically valid and meaningful conclusions can be drawn from the data. To the extent possible, Tetra Tech will follow DQA methods and procedures that have been outlined by EPA (2000c).

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