Prepared for:
Tronox LLC
Henderson, Nevada

Quality Assurance Project Plan Tronox LLC Facility Henderson, Nevada

ENSR Corporation
Revised April 2008
Document No.: 04020-023-101

ENSR | AECOM

TRONOX

Susan Crowley
Staff Environmental Specialist

(702) 651-2234
Fax (405) 302-4607
Susan.crowley@tronox.com

April 7, 2008

Ms. Shannon Harbour, P.E.
Nevada Division of Environmental Protection
2030 East Flamingo Road, Suite 230
Las Vegas, Nevada 89119-0818

Subject: Quality Assurance Project Plan
Tronox LLC, Henderson, Nevada

Dear Ms. Harbour:

Enclosed is the *Quality Assurance Project Plan* for the Tronox LLC Henderson Facility in Henderson Nevada. The Nevada Division of Environmental Protection's October 11, 2006 letter and Tronox's annotated responses are included as an appendix in the report.

Please contact me at (702) 651-2234 if you have any comments or questions concerning this correspondence.

Sincerely,

SM Crowley

Susan M. Crowley
Staff Environmental Specialist

Overnight Mail

Attachment: As stated
CC: See attached Distribution List

Tronox Document Distribution List

Updated: 25-Mar-08

Document Name: **ECA General Docs** - addressee *

Name (Last, First)		Firm	Distribution		
			Hard	e-Copy	Cvr Only
Croft	Todd	NDEP		X	
King	Val	NDEP		X	
Najima	Jim	NDEP		X	
Rakvica	Brian	NDEP	X	X	
Sous	Nadir	NDEP			
Tinney	Al	NDEP		X	
Palm	Jon	NDEP		X	
Harbour*	Shannon	NDEP	X	X	
Black	Paul	Neptune	X	X	
Hackenberry	Paul	Hackenberry	X	X	
Copeland	Teri		X	X	
Otani-Fehling	Joanna		X	X	
Pohlmann	Brenda	COH		X	
Conaty	Barry	COH Counsel		X	
Mrowka	Rob	CCCP		X	
Mulroy	Pat	SNWA			
Goff	Mike	SNWA			
Liesing	Joe	SNWA			
Kaplan	Mitch	EPA, Reg 9		X	
Compliance Corrdonator		NDEP			
Compliance Coordinator		DAQEM			
Public Repository		Library	X	X	

Name (Last, First)		Firm	Distribution		
			Hard	e-Copy	Cvr Only
Corbett	Pat	Tronox		X	
Paque	Matt	Tronox Counsel		X	
Hatmaker	John	Tronox		X	
Reed	Tom	Tronox	X	X	
Stater	Rick	Tronox		X	
Crowley	Susan	Tronox	2	2	
			& Hard Data		
Bailey	Keith	Environ Answers	X	X	
Krish	Ed	ENSR	X	X	
Bilodeau	Sally	ENSR	X	X	
Flack	Mike	ENSR	X	X	
Ho	Brian	ENSR	X	X	
Kennedy	Robert	ENSR	X	X	
Bradley	Lisa	ENSR	X	X	
Lambeth	Jeff	Veolia			
Guerriero	Joe	AIG		X	
Giroux	Barry	GEI		X	
Stowers	Kirk	Broadbent			
Sahu	Rahnijit	BMI		X	
Crouse	George	Syngenta		X	
Erickson	Lee	Stauffer		X	
Kelly	Joe	Montrose			
Sundberg	Paul	Montrose		X	
Gibson	Jeff	AmPac			
Richards	Curt	Olin		X	
Bellotti	Michael	Olin		X	
Wilkinson	Craig	Timet		X	
Mack	Joel	Montrose Counsel			

Quality Assurance Project Plan
Tronox LLC
Henderson, Nevada

Responsible CEM for this project

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and, to the best of my knowledge, comply with all applicable federal, state, and local statutes, regulations, and ordinances.

SM Crowley 4-4-08

Susan M. Crowley, CEM 1428 exp. date 3/8/09
Staff Environmental Specialist
Tronox LLC

Individuals who provided input to this document

Robert Kennedy
Senior Project Chemist
ENSR

CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

%R	Percent recovery
AOC	Administrative Order on Consent
AP&CC	American Potash and Chemical Company
CCV	Continuing Calibration Verification
CEM	Certified Environmental Manager
CLP	Contract Laboratory Program
CVAAS	Cold Vapor Atomic Absorption Spectroscopy
DDT	Dichlorodiphenyltrichloroethane
DRO	Diesel Range Organics
ECA	Environmental Conditions Assessment
ECD	Electron capture detector
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
FSAP	Field Sampling and Analysis Plan
GC/MS	Gas chromatograph/mass spectrometer
GRO	Gasoline Range Organics
HCB	Hexachlorobenzene
ICP	Inductively coupled plasma
ICV	Initial Calibration Verification
IDC	Initial Demonstration of Capability
IX	Ion exchange
LCS	Laboratory control samples
LIMS	Laboratory information management system
LOU	Letter of Understanding
MS/MSD	Matrix spike/matrix spike duplicate
NDEP	Nevada Division of Environmental Protection
NELAP	National Environmental Laboratory Accreditation Program
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
ORO	Oil Range Organics
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated biphenyl
PCDDs/PCDFs	Polychlorinated dibenzodioxins/Polychlorinated dibenzofurans

ACRONYMS AND ABBREVIATIONS (Cont'd)

PCP	Pentachlorophenol
PE	Performance Evaluation
PID	Photoionization detector
PQL	Practical quantitation limit
QA/QC	Quality assurance/quality control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RL	Reporting Limit
RPD	Relative percent difference
SIM	Selected Ion Monitoring
SOP	Standard operating procedure
SVOC	Semivolatile Organic Compounds
TCDD	Tetrachlorodibenzodioxin
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
Tronox	Tronox LLC
TSA	technical surveillance audits
TSS	Total Suspended Solids
VOA	Volatile organic analysis
VOC	Volatile organic compound
WECCO	Western Electrochemical Company

A.0 PROJECT MANAGEMENT

A.1 Introduction

This Quality Assurance Project Plan (QAPP) presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with soil and groundwater sampling at the Tronox LLC (Tronox) facility, formerly Kerr-McGee Chemical LLC, located at 8000 West Lake Mead Parkway in Henderson, Nevada. The facility is owned and operated by Tronox. The work will be conducted by ENSR, Veolia and other subcontractors as needed on behalf of Tronox in response to requests by the Nevada Division of Environmental Protection (NDEP) or others. The sampling activities will support characterization, monitoring, and remediation as needed.

A Field Sampling and Analysis Plan (FSAP) has also been prepared for soil and groundwater sampling activities and is incorporated into this QAPP by reference. The FSAP includes the standard operating procedures (SOPs) to be used for sample collection and handling, field measurements and sample analysis, and is supported by specific work plans developed for characterization, monitoring, or remediation. These program-specific work plans will describe the specific objectives, sample locations and frequency, sample designations, analytical parameters, and test methods for the individual events. General SOPs are also available for use or reference under a separate cover.

This QAPP has been prepared using U.S. Environmental Protection Agency (EPA) QAPP guidance as presented in *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5, March 2001, and EPA QA/G6, December 2002). Additional guidance used in preparing this QAPP is presented in Section E.0. In a letter dated October 11, 2006, the NDEP provided comments on the QAPP. The document was revised to address these comments as indicated in the Tronox response to comments. Copies of NDEP and Tronox correspondence are included in Appendix A.

A.2 Project Schedule

The schedule for each groundwater or soil sampling program will be specified in the program-specific work plan.

A.3 Distribution List

Most of the data-intense tasks will be accomplished by Tronox and their consultants and subcontractors with oversight, review, and approval by the NDEP. Table A-1 presents a general distribution list for the project. Each document prepared will include a distribution list with an indication of how each document will be distributed. The QAPP, and any subsequent revisions, will be distributed to the personnel identified with an "X" on Table A-1.

A.4 Project/Task Organization

A project organization chart is provided on Figure A-1. The project organization defines the lines of communication and identifies key personnel assigned to various project activities. The activity-specific work plans will provide a description of the organizational structure and specific responsibilities of the individual positions for the respective project activities. The individuals participating in the project and their specific roles and responsibilities are discussed below.

A.4.1 Management Responsibilities

Tronox Project Manager

The Tronox Project Manager, Susan Crowley, is primarily responsible for project direction and decisions concerning technical issues and strategies, budget, and schedule. Ms. Crowley is a Nevada-Certified Environmental Manager (CEM # 1428, expiring March 8, 2009) and is the person who serves as the point of contact for regulatory and environmental issues pertinent to the Site. She is located at the Tronox Henderson Facility. Her telephone number is (702) 651-2234. Ms. Crowley will be supported by Tronox technical specialists Mr. Keith Bailey (engineer) and Mr. Tom Reed (hydrogeologist).

Consultant Project Manager

The Consultant Project Manager, - Mike Flack, has responsibility for technical, financial, and scheduling matters. Other duties, as necessary, include:

- Subcontractor procurement;
- Assignment of duties to project staff and orientation of the staff to the specific needs and requirements of the project;
- Ensuring that data assessment activities are conducted in accordance with the QAPP;
- Approval of project-specific procedures and internally prepared plans, drawings, and reports;
- Serving as the focus for coordination of all field and laboratory task activities, communication, reports, and technical reviews, and other support functions, and facilitating site activities with the technical requirements of the project; and
- Maintenance of the project files.

Document QA

The responsibilities for the document QA individual, Elizabeth Martinez, is to review the documents sent out for formatting, spelling, grammar, and references

A.4.2 Regulatory Agency

The NDEP is the oversight agency for the Tronox Environmental Conditions Assessment (ECA) activities. NDEP will provide regulatory oversight for all aspects of investigative and remedial activities at the site and offer direction on NDEP policy and environmental objectives. All field activities and reports will be supervised by a State of Nevada Certified Environmental Manager (CEM)

A.4.3 Quality Assurance Responsibilities

Project QA Officer

The Project QA Officer has overall responsibility for quality assurance oversight. The Project QA Officer communicates directly to the Consultant Project Manager. Specific responsibilities include:

- Preparing the QAPP;
- Reviewing and approving QA procedures, including any modifications to existing approved procedures;
- Ensuring that QA audits of the various phases of the project are conducted as required;
- Providing QA technical assistance to project staff;
- Ensuring that data validation/data assessment is conducted in accordance with the QAPP; and
- Reporting on the adequacy, status, and effectiveness of the QA program to the Consultant Project Manager.

Data Validator

The Data Validator reports to the Project QA Officer. The Data Validator is responsible for validating the analytical data in accordance with the QAPP.

A.4.4 Laboratory Responsibilities

Laboratories will perform chemical analyses of soil and groundwater. The individual laboratories that will be performing the analyses are identified in Section B. 4.

Laboratory Manager

The Laboratory Manager is ultimately responsible for the data produced by the laboratory. Specific responsibilities include:

- Implementing and adhering to the laboratory QA manual and all corporate policies and procedures within the laboratory,

- Approving the SOPs,
- Maintaining adequate staffing documented on organization charts, and
- Implementing internal/external audit findings corrective actions.

Laboratory QA Coordinator

The Laboratory QA Coordinator reports to the Laboratory Manager. Specific responsibilities include:

- Approving SOPs;
- Assessing and maintaining the laboratory QA manual implementation within the facility operations;
- Recommending resolutions for ongoing or recurrent nonconformances within the laboratory;
- Performing QA assessments; and
- Reviewing and approving corrective action plans for nonconformances, tracking trends of nonconformances to detect systematic problems, and initiating additional corrective actions as needed.

Laboratory Project Manager

The Laboratory Project Manager is the primary point of contact between the laboratory and ENSR. Specific responsibilities of the Laboratory Project Manager include:

- Monitoring analytical and QA project requirements for a specified project;
- Acting as a liaison between the client and the laboratory staff;
- Reviewing project data packages for completeness and compliance to client needs; and
- Monitoring, reviewing, and evaluating the progress and performance of projects.

A.4.5 Field Responsibilities

Consultant Field Team Leader

The Consultant Field Team Leader has overall responsibility for completion of all field activities in accordance with the FSAP and QAPP, and is the communication link between project management and the field team. Specific responsibilities of the Consultant Field Team Leader include:

- Coordinating activities at the site.
- Assigning specific duties to field team members.
- Mobilizing and demobilizing the field team and subcontractors to and from the site.

- Directing the activities of subcontractors on site.
- Resolving any logistical problems that could potentially hinder field activities, such as equipment malfunctions or availability, personnel conflicts, or weather-dependent working conditions.
- Implementing field QC, including:
  - issuance and tracking of measurement and test equipment;
  - the proper labeling, handling, storage, shipping, and chain-of-custody procedures used at the time of sampling; and
  - control and collection of all field documentation.

Field Staff

The field staff report directly to the Consultant Field Team Leader. The responsibilities of the field staff include:

- Collecting samples, conducting field measurements, and decontaminating equipment according to documented procedures stated in the FSAP and QAPP;
- Ensuring that field instruments are properly operated, calibrated, and maintained, and that adequate documentation is kept for all instruments;
- Collecting the required QC samples and thoroughly documenting QC sample collection;
- Ensuring that field documentation and data are complete and accurate; and
- Communicating any nonconformance or potential data quality issues to the Consultant Field Team Leader.

Sampling Consultant Project Manager

Tronox employs an on-site sampling consultant who is responsible for:

- Collecting samples, conducting field measurements, and decontaminating equipment according to documented procedures stated in the FSAP and QAPP;
- Ensuring that field instruments are properly operated, calibrated, and maintained, and that adequate documentation is kept for all instruments;
- Collecting the required QC samples and thoroughly documenting QC sample collection;
- Ensuring that field documentation and data are complete and accurate; and
- Providing a field report to the Tronox Project Manager that communicates any nonconformance or field quality issues.

A.5 Problem Definition and Background

A.5.1 Site Background and Description

The BMI complex has been the site of industrial operations since 1942 and was originally sited and operated by the U.S. government as a magnesium production plant in support of the World War II effort. Following the war, a portion of the complex was leased by Western Electrochemical Company (WECCO). By August 1952, WECCO had purchased several portions of the complex, including six of the large unit buildings, and produced manganese dioxide, sodium chlorate, and various perchlorates. In addition, in the early 1950s, pursuant to a contract with the U.S. Navy, WECCO constructed and operated a plant to produce ammonium perchlorate on land purchased by the Navy. In 1956, WECCO merged with American Potash and Chemical Company (AP&CC) and continued to operate the processes, with the Navy's continued involvement in the ammonium perchlorate process.

In 1962, AP&CC purchased the ammonium perchlorate plant from the Navy, but continued to supply the Navy, and its contractors, material from the operating process. AP&CC merged with Kerr-McGee Corporation (Kerr-McGee) in 1967. With this merger, boron production processes in California were moved to the Henderson facility. By the early 1970s, operations in Henderson included the production of elemental boron, boron trichloride, and boron tribromide.

In 1994 the boron tribromide process was shut down and dismantled. In 1997 the sodium chlorate process was shut down, and in 1998 production of commercial ammonium perchlorate ended as well. The ammonium perchlorate production equipment was used to reclaim perchlorate from impounded or stockpiled on-site materials until early 2002, when the equipment was permanently shut down. In 2005, Kerr-McGee Chemical LLC's name was changed to Tronox LLC. Processes currently operated by Tronox at the Henderson facility are for production of manganese dioxide, boron trichloride, and elemental boron. Additional companies operate within the BMI complex; details regarding ownership and leases within the BMI complex are described in the 1993 Phase I ECA report (Kleinfelder 1993).

During the 1970s, the EPA, the State of Nevada, and Clark County investigated potential environmental impacts from the BMI companies' operations including atmospheric emissions, groundwater and surface water discharges, and soil impacts (E&E 1982). From 1971 to 1976, Tronox (then Kerr-McGee) modified their manufacturing process and constructed lined surface impoundments to recycle and evaporate industrial wastewater. In 1976 the facility achieved zero discharge status regarding industrial wastewater management. In 1980 the EPA requested specific information from the BMI companies regarding their manufacturing processes and their waste management practices by issuing Section 308 (Clean Water Act) information request letters. In 1994 the NDEP issued a Letter of Understanding (LOU) to Kerr-McGee that identified 69 specific areas or items of interest on the site, and prescribed the level of environmental investigation they desired. In February 2004 NDEP directed that the environmental investigation be expanded beyond the LOU areas. The number of analytes was also significantly increased. The Site Related Chemical list was approved by NDEP on October 27, 2004 and March 9, 2006. The list was revised to include additional analytes during 2007 and 2008.

Tronox has undertaken environmental investigations to assess specific impacts on site and in the area as described below. A detailed discussion of the specific areas or items of interest identified in the LOU and summary of site conditions can be found in the Conceptual Site Model document (ENSR 2005). Tronox also completed an upgradient investigation (ENSR 2006) and the Phase A Source Area Investigation (ENSR 2007).

A.5.2 Problem Definition/Background

This QAPP has been prepared by Tronox to address QA and QC policies associated with the collection of environmental data for characterization activities at the site. The sampling and analysis activities will be conducted under the oversight of NDEP, pursuant to the Consent Agreement and Administrative Orders. This QAPP has been designed to support the data collection activities associated with the various sampling and analysis tasks pertaining to characterization and remediation activities conducted at the site.

This QAPP is an integral part of the project repository for the Tronox Facility and is to be incorporated by reference as the general guidance document for implementing QA/QC procedures for sampling and analysis programs conducted at the site. EPA policy requires a QAPP for environmental data collection projects mandated or supported by the EPA through regulations or other formalized means such as site characterization and risk assessment. The purpose of this QAPP is to identify the methods to be employed to establish technical accuracy, precision, and validity of data that are generated for decision-making purposes.

Numerous investigations have been conducted to evaluate the nature, extent, and movement of contaminants on site and in downgradient and cross-gradient areas. A Consent Order between Tronox and NDEP prepared in September 1986 stipulated additional groundwater characterization and the implementation of remedial activities to address chromium in the groundwater. As a result of the 1986 Consent Agreement, monitor wells, groundwater interceptor wells, a groundwater treatment system for chromium reduction, and two treated-groundwater injection trenches were installed and the treatment of groundwater began in mid-1987. This treatment is on-going today.

In April 1991, Tronox was one of six companies entering into a Consent Agreement with the NDEP to conduct environmental studies to assess site-specific environmental conditions, which are the result of past and present industrial operations and waste disposal practices. The six companies that entered into the Consent Agreement included those past or present entities that conducted business within the BMI complex. The Consent Agreement specified that, among other things, the companies identify, document, or address soil, surface water, groundwater, or air impacts and document measures that have been taken to address environmental impacts from their respective sites.

In April 1993, in compliance with the 1991 Consent Agreement, Tronox submitted the Phase I ECA to NDEP. The purpose of the report was to identify and document site-specific environmental impacts resulting from past or present industrial activities. The Phase I ECA included an assessment of the geologic and hydrologic setting, as well as historical manufacturing activities. In 1994, the NDEP issued a LOU that identified 69 data gap areas that needed additional information, either in the form of additional document research or field sampling of site conditions.

During the mid to late 1990s, Tronox collected additional data to fill the LOU-identified data gaps. This was done by investigating past operator records as well as through field sampling. Results of this work are described in the Phase II Written Response to the LOU (Kerr-McGee 1996b), the Phase II ECA (ENSR 1997), and the Supplemental Phase II ECA (ENSR 2001), the latter two of which were reports describing the results of field sampling of groundwater and soils. Through this effort, potential environmental impacts associated with the 69 LOU areas were evaluated.

In 1997 perchlorate was discovered in the Las Vegas Wash vicinity, and this aspect of the ECA was placed on a remedial fast-track. Impact characterization and treatment methodology evaluation was on-going in the late 1990s with installation of a water collection system and temporary ion exchange (IX) process for perchlorate removal. This remedial process began operation in November 1999. Tronox and NDEP entered into a 1999 Consent Agreement that defined remedial requirements and looked forward to a more permanent treatment process that would replace the temporary IX system. After considerable research and process development, a permanent treatment technology was developed. Tronox and NDEP entered into an October 2001 Administrative Order on Consent (AOC) defining the more permanent remedial requirements, which were installed and are operating today. To date, perchlorate remediation efforts have included the design, installation, and operation of groundwater extraction systems as well as surface water collection systems, along with development, design, installation, and operation of a permanent treatment process. These activities include:

- The on-site groundwater barrier wall together with an upgradient collection well field;
- The Athens Road groundwater collection well field;
- The seep area collection well field as well as a sump for collection of water in the area where groundwater surfaced; and
- A treatment system that removes chromium and perchlorate from the collected groundwater and then discharges the water in accordance with the limits set forth in the existing National Pollutant Discharge Elimination System (NPDES) permit.

The groundwater systems will continue to operate under the direction of the NDEP.

In February 2004, the NDEP provided a response to the Kerr-McGee Supplemental Phase II ECA. NDEP indicated that additional work would be required, including identification of all potential contaminants associated with the site, background sampling, assessment of site-specific action levels, and identification of data gaps.

In 2004 to 2008 Tronox developed and revised the Site Related Chemical list in cooperation with the NDEP.

In 2005 the conceptual site model was provided to the NDEP. The ugradient investigation was conducted in 2006 and included drilling and sampling six (6) boreholes in the southern portion of the Site. Four (4) of the boreholes were completed as groundwater monitoring wells. Soil and groundwater data were used tio characterize conditions within the alluvium and Muddy Creek Formation along the southern portion of the site (ENSR 2006). The Phase A source area investigation was conducted in 2006 and 27 soil borings were drilled and sampled for the chemicals contained on the site related chemical list. In addition 27 surface samples were collected for asbestos analysis. Groundwater samples were collected using low flow methods from 21 existing monitoring wells and one extraction well. Six additional groundwater samples were obtained from boreholes. The analytical data obtained were subject to data validation. The data are presented in the Phase A Source Area Investigation results (ENSR 2007).

A.6 Project/Task Description

Soil and groundwater sampling will be conducted to support characterization, monitoring, and remediation as needed. The specific objectives, sample locations and frequency, sample designations, analytical parameters, and test methods for the individual events will be described in the program-specific work plans.

A.7 Quality Objectives and Criteria for Measurement Data

A.7.1 Project Quality Objectives

The objective of the soil and groundwater sampling is to gather sufficient soil, soil gas and groundwater chemistry data to provide a more thorough understanding of conditions at the site, the effect of the remedial systems, and to support the development of a risk assessment. Therefore, sampling and analysis programs have been based on:

- Sampling protocols designed to obtain sufficient data to meet the objectives of the characterization, monitoring, or remediation programs;
- The use of sample collection and handling procedures that will ensure the representativeness and integrity of the samples; and
- An analytical program designed to generate definitive data of sufficient quality and sensitivity to meet the project objectives. Data deliverables will provide sufficient information to allow validation of the data.

A.7.2 Task Objectives

The tasks that will be implemented for each groundwater, soil gas, and soil sampling program will be defined in the program-specific work plans.

A.7.3 Data Quality Objectives for Measurement Data

Precision

Precision is a measure of the degree to which two or more measurements are in agreement. Field precision is assessed through the collection and measurement of field duplicates. Unless specified otherwise in the program-specific work plan, field duplicates will be collected at a frequency of one duplicate per ten analytical samples. Precision will be measured through the calculation of relative percent difference (RPD). The objectives for field precision RPDs are 30% RPD for aqueous samples and 50% RPD for solid and air samples.

Precision in the laboratory is assessed through the calculation of RPD for duplicate samples, either as matrix spike/matrix spike duplicates (MS/MSDs) or as laboratory duplicates, depending on the method. Precision control limits for laboratory analyses will be specified in the program-specific work plan or will be consistent with the current statistical limits used by the laboratory at the time of analyses.

Accuracy

Accuracy is the degree of agreement between the observed value and an accepted reference or true value. Accuracy in the field is assessed through the use of trip blanks and equipment blanks and through the adherence to all sample handling, preservation, and holding time requirements. The objective for trip blanks and equipment blanks is less than the laboratory reporting limit.

Laboratory accuracy is assessed through the analysis of MS/MSDs, laboratory control samples (LCSs), and surrogate compounds and the subsequent determination of percent recoveries (%Rs). Accuracy control limits for laboratory analyses will be specified in the program-specific work plan or will be consistent with the current statistical limits used by the laboratory at the time of analyses.

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. "Normal conditions" are defined as the conditions expected if the program-specific work plan was implemented as planned.

Field completeness is a measure of the amount of valid samples obtained during all sampling for the project. The field completeness objective is greater than 90 percent.

Laboratory completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The laboratory completeness objective is greater than 95 percent.

Sensitivity

Sensitivity of analytical data is demonstrated by laboratory reporting limits (RLs) based on quantitation limits (QLs), except for dioxins which are based on Estimated Detection Limits (EDLs). The target RLs for the compounds to be analyzed for Source Area Phase B work after April 2008 are presented in Table A-2. The analyte list and RLs summarized in Table A-2 are generalized and may be amended, as necessary, for future specific programs.

A.8 Special Training/Certification

A.8.1 Training

The groundwater and soil investigations are not expected to include any non-routine field sampling techniques, field analyses, laboratory analyses, or data validation. Specialized training is therefore not required. In the event that non-routine procedures are needed, training requirements will be outlined in the program-specific work plan.

Prior to starting soil or groundwater sampling activities, personnel will be given instruction specific to the project, covering the following areas:

- Organization and lines of communication and authority,
- Overview of the FSAP and program-specific work plan,
- QA/QC requirements,
- Documentation requirements, and
- Health and safety requirements.

Instructions will be provided by the Consultant Project Manager, Consultant Field Team Leader, and Project QA Officer.

A.8.2 Certifications

Laboratories utilized for routine chemical and radiochemical testing of soil or groundwater will be certified by the State of Nevada for the appropriate program of interest (i.e., RCRA, NPDES, etc.) and the parameters of interest. In the absence of Nevada certification, National Environmental Laboratory Accreditation Program (NELAP) accreditation may be considered acceptable until Nevada offers certification for the parameter of interest. The laboratories must submit the necessary initial demonstration of capability (IDC) and performance evaluation (PE) data to obtain certification from NDEP, Bureau of Water Quality Planning (BWQP) for all project parameters of interest and methods of interest that Nevada will certify.

Tronox has required that the laboratories performing sample analyses for the Henderson facility be either already certified in Nevada for each parameter/matrix combination or have submitted all the necessary IDC and PE data to obtain certification from BWQP, if the certification is available.

A.9 Documents and Records

A.9.1 Project Files

The project files will be the central repository for all documents that constitute evidence relevant to sampling and analysis activities as described in this QAPP. The project files for a particular investigation, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, and data reviews, should be maintained in a secured, limited access area and under custody of the Consultant Project Manager.

The project files will include at a minimum:

- Field logbooks
- Field data and data deliverables
- Photographs
- Drawings
- Laboratory data deliverables
- Reports (e.g., data validation, progress, quarterly, etc.)
- Chain-of-custody documentation

A.9.2 Field Records

Field logbooks provide the means of recording the data collecting activities performed during the investigation. As such, entries will be described in as much detail as possible so that persons going to the facility could reconstruct a particular situation without reliance on memory.

The title page of each logbook should contain the following:

- Person to whom the logbook is assigned,
- The logbook number,
- Project name and number,
- Project start date, and
- End date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of sampling team members present, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook.

Field logbooks may be supplemented by standardized field measurement and sample collection forms. All measurements made and samples collected will be recorded. All entries will be made in permanent ink, signed, and dated, and no erasures or obliterations will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, which is to be signed and dated by the sampler. Whenever a sample is collected, or a measurement is made, a detailed description of the sampling location, which includes compass and distance measurements, or latitude and longitude information (e.g., obtained by using a global positioning system) will be recorded. The number of photographs taken of the sampling location, if any, will be noted. All equipment used to make measurements will be identified, along with the date of calibration.

A.9.3 Laboratory Records and Deliverables

Laboratory data reduction procedures should be performed according to the following protocol. All information related to analysis will be documented in controlled laboratory logbooks, instrument printouts, or other approved forms. All entries that are not generated by an automated data system will be made neatly and legibly in permanent, waterproof ink. Information will not be erased or obliterated. Corrections will be made by drawing a single line through the error and entering the correct information adjacent to the cross-out. All changes will be initialed, dated, and, if appropriate, accompanied by a brief explanation. Unused pages or portions of pages will be crossed out to prevent future data entry. Analytical laboratory records will be reviewed by the supervisory personnel on a regular basis, and by the Laboratory QA Coordinator periodically, to verify adherence to documentation requirements.

Analytical data deliverables will be provided within a 28 day turnaround time from date of sample receipt at the laboratory, unless otherwise specified in the program-specific work plan. The laboratory will provide at least one hard copy report and one copy of an electronic data deliverable (EDD). The EDD will be provided in the Tronox-customized EQuIS® format. The hard copy data package may be a summary package, consisting of results and QC summary forms, or may be equivalent to a Contract Laboratory Program (CLP) deliverable (i.e., consisting of all the information presented in a CLP package, including CLP-like summary forms). The level of package will be determined based on the end use of the data and will be specified in the program-specific work plan.

Laboratory QA manuals for the laboratories currently performing work are included in Appendix B. When new or different laboratories are used, their manuals will be provided.

B.0 MEASUREMENT/DATA ACQUISITION

B.1 Sampling Process Design

The rationale for sample design will be provided in the program-specific work plans.

B.2 Sampling Methods

B.2.1 Field Measurements

Field measurements taken in conjunction with soil, soil gas, and groundwater sampling are addressed in Section 3.0 of the FSAP. SOPs are included in Attachment A of the FSAP.

B.2.2 Sampling Procedures

Soil, soil gas, and groundwater sampling procedures are discussed in Section 3.0 of the FSAP. SOPs are included as separate documents. Field filtration of water samples for metals and radiochemical analyses may be required on a work plan-specific basis; however, in general water samples will not be filtered prior to analysis. In general, field filtration may be required if the water is excessively cloudy or turbid, indicating the presence of suspended sediment. As indicated in the FSAP for the Source Area investigation, both filtered and non filtered samples will be collected for the groundwater grab samples because they are expected to be cloudy. Comparison of the filtered versus non-filtered analytical results will provide data relative to the effect of field filtering.

B.2.3 QC Sample Collection

QC samples may include trip blanks, equipment field blanks, field duplicates, and MS/MSDs as needed for the individual sampling program. These samples will be collected as described below unless otherwise noted in the program-specific work plans.

Trip blanks – Trip blanks will be included with each shipment of volatile organic compound (VOC) samples. Trip blanks associated with aqueous VOC samples will originate in the laboratory and will be prepared by filling two 40-mL volatile organic analysis (VOA) vials with laboratory deionized water and sealing the vials with septum-lined caps (allowing no headspace). Trip blanks associated with solid VOC samples will be prepared in soil jars. Trip blanks will accompany the sample bottles to the site and will remain (unopened) in the shipping container until the sample bottles are received back at the laboratory. Trip blanks will be analyzed for VOCs and other appropriate parameters as specified in the program-specific work plans.

Equipment blanks – Equipment blanks will be prepared by routing laboratory grade and organic free water (provided by the laboratory) through non-dedicated sampling equipment after equipment decontamination and before field sample collection. Equipment blanks will be collected for all aqueous and solid samples collected with non-dedicated equipment and will be analyzed for the same parameters as their associated samples unless otherwise specified in the program-specific workplans.

Field duplicates – Field duplicates will be collected at a frequency of one field duplicate for every 10 or less investigative samples. Field duplicates (non-VOC) will be collected by alternately filling two sets of identical sample containers from the interim container used to collect the sample. Sample containers for VOC field duplicates will be filled consecutively. All field duplicates will be analyzed for the same parameters as their associated samples.

MS/MSDs – MS/MSD (organics) and MS/duplicate or MS/MSD (inorganics) samples will be collected at a frequency of one for every 20 or less investigative samples. For those samples designated as MS/MSDs or MS/duplicates, sufficient additional volume (based on the individual laboratory's requirements) will be collected.

B.2.4 Equipment Decontamination

Decontamination of equipment in the field is described in Section 3.0 of the FSAP.

B.3 Sample Handling and Custody

B.3.1 Sample Containers, Preservation, and Holding Times

Sample bottles and chemical preservatives will be provided by the laboratory. The containers will be cleaned by the manufacturer to meet or exceed all analyte specifications established in the latest EPA Specifications and Guidance for Contaminant-Free Sample Containers. VOC vials with preservatives for soil field preservation will be supplied by the laboratory. Certificates of analysis will be provided with each lot of containers and maintained on file to document conformance to EPA specifications.

A summary of sample container, preservation, and holding time requirements is presented in Table B-1.

B.3.2 Sample Labeling

Immediately upon collection, each sample will be labeled with an adhesive label. Samples will be assigned unique sample identifications as described in the program-specific work plans.

Samples being designated for MS/MSD analysis will not include an identifier as part of the sample code, but will be identified on the chain-of-custody form.

B.3.3 Custody Procedures

Custody is one of several factors that are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in two parts: field sample collection and laboratory analysis.

A sample is considered to be under a person's custody if:

- the item is in the actual possession of a person,
- the item is in the view of the person after being in actual possession of the person, the item was in the actual physical possession of the person but is locked up to prevent tampering, or
- the item is in a designated secure area.

Field Custody Procedures

The field sampler is personally responsible for the care and custody of the samples until they are transferred or dispatched properly. Field procedures have been designed such that as few people as possible will handle the samples.

All sample containers will be identified by the use of sample labels with sample numbers, sampling locations, date/time of collection, and type of analysis. Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample tag because the pen would not function in freezing weather.

Samples will be accompanied by a properly completed chain-of-custody form. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage location. An example chain-of-custody form is presented as Figure B-1.

If split samples are co-located with a government agency, a separate sample receipt will be prepared for those samples and marked to indicate with whom the samples are being co-located. The person relinquishing the samples to the facility or agency should obtain the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses to sign, this is noted in the "Received By" space.

All sample shipments will be accompanied by the chain-of-custody record identifying the contents. The original record and a copy will accompany the shipment, and a copy will be retained by the sampler and placed in the project files.

Samples will be packaged on ice at 4°C (if thermal preservation is required) for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be locked and secured with strapping tape and, if required, custody seals for shipment to the laboratory. If required, the custody seals will be attached to the front right and back left of the cooler and covered with clear plastic tape after being signed by field personnel. The cooler will be strapped shut with strapping tape in at least two locations.

If the samples are sent by common carrier, the waybill will be used. Waybills will be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the custody forms since the custody forms will be sealed inside the sample cooler and the custody seals will remain intact.

Samples should be transported to the laboratory the same day the samples are collected in the field. Shipments of samples to be analyzed for parameters with holding times less than 48 hours must be coordinated with the laboratory to ensure the holding times are not exceeded.

Laboratory Custody Procedures

Samples will be received and logged in by a designated sample custodian or his/her designee. Upon sample receipt, the sample custodian will:

- Examine the shipping containers to verify that the custody tape is intact;
- Examine all sample containers for damage;
- Determine if the temperature required for the requested testing program has been maintained during shipment and document the temperature on the chain-of-custody form;
- Compare samples received against those listed on the chain-of-custody form;
- Verify that sample holding times have not been exceeded;
- Examine all shipping records for accuracy and completeness;
- Determine sample pH (if appropriate) and record on chain-of-custody or cooler receipt form;
- Sign and date the chain-of-custody immediately (if shipment is accepted) and attach the waybill;
- Note any problems associated with the coolers and/or samples on the cooler receipt form and notify the Laboratory Project Manager, who will contact the Consultant Project QA Officer;
- Attach laboratory sample container labels with unique laboratory identification and test; and
- Place the samples in the proper laboratory storage.

Following receipt, samples will be logged in according to the following procedure:

- The samples will be entered into the laboratory information management system (LIMS). At a minimum, the following information will be entered: project name or identification, unique sample numbers (both client and internal laboratory), type of sample, required tests, date and time of laboratory receipt of samples, and field ID provided by field personnel.
- The appropriate laboratory personnel will be notified of sample arrival.
- The completed chain-of-custody form, waybills, and any additional documentation will be placed in the project file.

Specific details of laboratory custody procedures for sample receiving, sample identification, sample control, and record retention are described in the laboratory SOPs.

B.4 Laboratories and Analytical Methods

Chemical analyses of soil, groundwater, or other water samples will be performed by contract laboratories listed below. Other laboratories may be added as needed.

Columbia Analytical Services, Inc. 1 Mustard Street, Suite 250 Rochester, NY 14609 (585)-288-5380	Columbia Analytical Services, Inc. 1317 13th Avenue Kelso, WA 98626 (360)-577-7222
Columbia Analytical Services, Inc. 2655 Park Center Drive, Ste. A Simi Valley, California 93065 Phone: (805) 526-7161	General Engineering Laboratories, LLC 2040 Savage Road Charleston, SC 29407 (843) 556-8171
EMSL Analytical, Inc. 107 Haddon Avenue Westmont, NJ 08108 (800) 220-3675	CAS-Houston 10655 Richmond Ave. Houston, TX 77042 (713) 266-1599
STL-St.Louis 13715 Rider Trial North Earth City, MO 63045 (314) 298-8566	STL-Richland 2800 G.W. Way Richland, WA 99354 (509) 375-3131
STL- Denver 4955 Yarrow Street Arvada, CO 80002 (303) 736-0100	STL Sacramento 880 Riverside Parkway West Sacramento, CA 95606 (916) 373-5600

The methods to be used are summarized in Table B-2. Target analytes and target detection limits are provided in Table A-2. Project specific method and analyte lists which are subsets of these tables may be included in project-specific work plans. Laboratory turnaround time is described in Section A.9.3. The delegation of analyses to particular laboratories will be addressed in the project-specific work plans.

B.5 Quality Control

B.5.1 Field

QC measurements for field measurements will be limited to the calibrations described in Section B.7.

Field QC samples will be collected during soil and groundwater sampling to assess the accuracy and precision of the data. These samples may include field duplicates, MS/MSDs, trip blanks, and equipment blanks as appropriate for the media and/or parameters being sampled. The collection of QC samples is described in Section B.2. Typical frequencies of collection and acceptance criteria are described in Section A.7. The QC samples specific to an individual sampling event will be identified in the program-specific work plan.

B.5.2 Laboratory

Each analytical laboratory has a QC program in place to ensure the reliability and validity of the analysis performed at the laboratory. All analytical procedures are documented in writing as SOPs and each SOP includes the minimum requirements for the procedure. The internal QC checks differ slightly for each individual procedure but in general the QC requirements include the following:

- Blanks (method, reagent/preparation, instrument)
- MS/MSDs
- Surrogate spikes
- Laboratory duplicates
- LCSs
- Internal standard areas (gas chromatograph/mass spectrometer [GC/MS] analysis)
- Endrin/DDT degradation checks (GC/electron capture detector [ECD] analysis)
- Second column confirmations (GC/ECD analysis)
- Interference checks (inductively coupled plasma [ICP] analysis)
- Serial dilutions (ICP analysis)

Table B-3 summarizes the essential QC for each method. Note some special requirements from the Tronox Laboratory Manual for Environmental Analytical Services are included in this table.

B.6 Instrument/Equipment Testing, Inspection, and Maintenance

The field equipment for this project may include, but not be limited to, electronic water level indicators, water quality meters, and photoionization detectors (PIDs). The Consultant Field Team Leader will be responsible for ensuring that instruments are properly functioning. At a minimum, this will entail checking the instrument prior to shipment to the field and performing daily operational checks and calibration as described in Section B.7. Routine maintenance and trouble-shooting procedures will be performed as described in the manufacturer's instructions.

Routine testing and preventive maintenance are performed by the laboratory as part of their QA program. Details on the type of checks, frequencies, and corrective actions are included in the individual laboratory QA manuals (Appendix B).

B.7 Instrument/Equipment Calibration and Frequency

Calibration of field measurement instruments will be performed according to the manufacturer's instructions and the SOPs included in Attachment A of the FSAP. All calibration procedures will be documented in the field records. Calibration records will include the date/time of calibration, name of the person performing the calibration, reference standard used, and the results of the calibration.

Calibration procedures for laboratory instruments will consist of initial calibrations, initial calibration verifications, and continuing calibration verification. The SOP for each analysis performed in the laboratory describes the calibration procedures, their frequency, acceptance criteria, and the conditions that will require recalibration. This information is summarized in Table B-4 for major instrumentation.

The laboratory maintains documentation for each instrument, which includes the following information: instrument identification, serial number, date of calibration, analyst, calibration solutions, and the samples associated with these calibrations.

B.8 Inspection/Acceptance of Supplies and Consumables

For this project, critical supplies for field activities will be tracked in the following manner.

Critical Supplies and Consumables	Inspection Requirements and Acceptance Criteria	Responsible Individual
Sample bottles	Visually inspected upon receipt for cracks, breakage, and cleanliness. Must be accompanied by certificate of analysis.	Consultant Field Team Leader
Chemicals and reagents	Visually inspected for proper labeling, expiration dates, and appropriate grade.	Consultant Field Team Leader
Field measurement equipment	Functional checks to ensure proper calibration and operating capacity.	Consultant Field Team Leader
Field test kits	Inspected for proper labeling, appropriate levels of calibration standards, and expiration dates.	Consultant Field Team Leader
Sampling equipment	Visually inspected for obvious defects, damage, and contamination.	Consultant Field Team Leader

Supplies and consumables not meeting acceptance criteria will initiate the appropriate corrective action. Corrective measures may include repair or replacement of measurement equipment, and/or notification of vendor and subsequent replacement of defective or inappropriate materials. All actions will be documented in the project files.

The laboratory system of inspection and acceptance of supplies and consumable is documented in the individual laboratory QA Manuals.

B.9 Non-Direct Measurements

Non-direct data (historical reports, maps, literature searches, previously collected analytical data) will be reviewed prior to use to determine its acceptability based on the end use of the data.

B.10 Data Management

Data management operations include data recording, validation, transformation, transmittal, reduction, analysis, tracking, storage, and retrieval.

The data will be entered into an EQuIS® database system. EDDs provided by the laboratories will be in the EQuIS® file format with project-specified valid values that will minimize manipulation of the data.

Upon receipt from the laboratory, the electronic data will be imported into the EQuIS® database system concurrent with the data validation process. Data qualifiers and reason codes generated during data validation will be entered manually. Data collected in the field will also be entered into the system and integrated with laboratory data.

As data are loaded into the system, a variety of quality checks are performed to ensure data integrity. These checks include:

- Audits to ensure that laboratories reported all requested analyses;
- Checks that all analytes are consistently and correctly identified;
- Reviews to ensure that units of measurement are provided and are consistent;
- Queries to determine that any codes used in the database are documented properly;
- Reports to review sample definitions (depths, dates, locations);
- Proofing manually entered data against the hard-copy original; and
- Reports to review groupings of sampling locations and coordinate systems.

Records of the checks are maintained on file.

At a minimum, the database will contain the following fields:

- Sample identifier,
- Sample location,
- Sample media type,
- Sampling date,
- Analysis date,
- Laboratory analysis identifier,
- Analyte name,
- Concentration value,
- Measurement units,
- Data qualifiers,
- Reason Codes
- Reporting Limit,
- Dilution Factor, and
- Reason Codes.

Data will be loaded into a "temporary" database until data validation is complete, at which time the database will be finalized. Any changes made to the database after finalization will be documented, including a description of the change, date of change, person responsible, and reason for change. Once all data quality checks are performed, the data will be exported to a variety of formats to meet project needs.

The project database will be maintained on a secure network drive that is backed up regularly. Access to the database will be limited to authorized users and will be controlled by password access. Data will be retained in accordance with the requirements stated in Section A.9.1 of this QAPP.

C.0 ASSESSMENT/OVERSIGHT

C.1 Assessment and Response Actions

C.1.1 Assessments

Assessments include technical surveillance audits (TSAs) of field and laboratory activities, data package audits, and data validation audits.

Field Activity TSA

The purpose of the field activity TSA is to ensure that the approved procedures documented in the FSAP and QAPP are being followed. No field activity TSA specific to this program proposed; however, field activity TSAs may be conducted at the discretion of the Tronox Project Manager. The field activity TSA will typically include observations of field procedures and/or examination of field sampling records; field measurement results; field instrument operating and calibration records; sample collection, handling, and packaging procedures; QA procedures; chain-of-custody; sample documentation; etc. If significant deficiencies are noted, follow-up audits may be conducted.

During the field activity TSA, the auditor will keep detailed notes of findings. Preliminary results of the field activity TSA will be reviewed with the Consultant Field Team Leader while on site to ensure that deficiencies adversely affecting data quality are immediately identified and corrective measures initiated. Upon completion of the audit, the Project QA Officer will prepare a written audit report, which summarizes the audit findings, identifies deficiencies and recommends corrective actions. This report will be submitted to the Consultant Project Manager, who will be responsible for ensuring that corrective measures are implemented and documented (Section C.1.2). The results of the audit process will be included in the QA reports to management, as described in Section C.2.

Laboratory TSA

The purpose of the laboratory TSA is to evaluate the laboratory's ability to perform the required analyses. No laboratory TSAs specific to this program are proposed; however, laboratory TSAs may be conducted at the discretion of the Tronox Project Manager. The laboratory TSA typically includes a review of the following areas:

- QA organization and procedures;
- Personnel training and qualifications;
- Sample log-in procedures;
- Sample storage facilities;
- Analyst technique;
- Adherence to laboratory SOPs and project QAPP;

- Compliance with QA/QC objectives;
- Instrument calibration and maintenance;
- Data recording, reduction, review, and reporting; and
- Cleanliness and housekeeping.

If conducted, preliminary results of the laboratory TSA will be discussed with the Laboratory Manager, Laboratory Project Manager, and Laboratory QA Coordinator. A written report that summarizes audit findings and recommends corrective actions will be prepared and submitted to the Laboratory Manager for response. The final report, including the laboratory's response, will be distributed to the Consultant Project Manager and Tronox Project Manager.

Data Package Audits

Audits of analytical data packages will be conducted for 100 percent of the packages received as part of the data validation process (Section D.1). The review will include an evaluation of the package to ensure that all required deliverables are provided and the package contains the information necessary to reproduce the reported results. Any deficiencies will be communicated to the laboratory and documented in the data validation reports.

Data Validation Audits

Each analytical data package will be validated as described in Section D.2. As part of the validation process, a review of each completed validation package will be conducted by a validator other than the one performing the validation. The review will verify that the analytical deliverable package was complete and that any missing information requested from the laboratory was supplied, that validation worksheets were filled out accurately and completely, that validation actions were consistent with the validation guidelines established for this program and/or best professional judgment, and that the validation reports and data qualifiers accurately reflect the validation actions as documented on the worksheets.

C.1.2 Response Actions

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out-of-limit QC performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment.

Field Corrective Action

Corrective action in the field may be needed when the sample network is changed (i.e., more/less samples, sampling locations other than those specified in the QAPP, etc.) or when sampling procedures and/or field analytical procedures require modification, etc., due to unexpected conditions. The field team may identify the need for corrective action. The Consultant Field Team Leader will approve the corrective action and notify the Consultant Project Manager and the specified Tronox representative. The Consultant Project

Manager and Tronox representative, in consultation with the Consultant Project QA Officer, will approve the corrective measure. The Consultant Field Team Leader will ensure that the corrective measure is implemented by the field team.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected due to unapproved or improper use of approved methods. The Project QA Officer will identify deficiencies and recommend corrective action to the Consultant Project Manager. Implementation of corrective actions will be performed by the Consultant Field Team Leader and field team. Corrective action will be documented in QA reports to the project management team (Section C.2).

Corrective actions will be implemented and documented in the field logbook. Documentation will include:

- A description of the circumstances that initiated the corrective action,
- The action taken in response,
- The final resolution, and
- Any necessary approvals.

Laboratory Corrective Action

Corrective action in the laboratory may occur prior to, during, and after initial analyses. A number of conditions such as broken sample containers, multiple phases, low/high pH readings, and potentially high concentration samples may be identified during sample log-in or analysis. Following consultation with laboratory analysts and supervisory personnel, it may be necessary for the Laboratory QA Coordinator to approve the implementation of corrective action. If the nonconformance causes project objectives not to be achieved, the Consultant Project Manager will be notified.

These corrective actions are performed prior to release of the data from the laboratory. The corrective action will be documented in both the laboratory's corrective action files and in the narrative data report sent from the laboratory to the Consultant Project Manager. If the corrective action does not rectify the situation, the laboratory will contact the Consultant Project Manager, who will determine the action to be taken and inform the appropriate personnel.

Corrective Action During Data Validation and Data Assessment

The need for corrective action may be identified during either data validation or data assessment. Potential types of corrective action may include resampling by the field team or reinjection/reanalysis of samples by the laboratory. These actions are dependent upon the ability to mobilize the field team and whether the data to be collected are necessary to meet the required QA objectives. If the data validator or data assessor identifies a corrective action situation, the Consultant Project Manager will be responsible for informing the appropriate personnel.

C.2 Reports to Management

QA reports will be submitted to the Consultant Project Manager to ensure that any problems identified during the sampling and analysis programs are investigated and the proper corrective measures taken in response. The QA reports will include:

- All results of field and laboratory audits;
- Problems noted during data validation and assessment; and
- Significant QA/QC problems, recommended corrective actions, and the outcome of corrective actions.

QA reports will be prepared by the Consultant Project QA Officer and submitted on an as-needed basis.

D.0 DATA VALIDATION/DATA USABILITY

D.1 Data Review, Verification, and Validation

D.1.1 Field Data

Field data will be reviewed periodically by the Consultant Field Team Leader or his designate to ensure that the records are complete, accurate, and legible, and to verify that the sampling procedures are in accordance with the protocols specified in the FSAP and QAPP.

D.1.2 Internal Laboratory Review

Prior to the release of any data from the laboratory, the data will be reviewed and approved by laboratory personnel. The review will consist of a tiered approach that will include reviews by the person performing the work, by a qualified peer, and by supervisory and/or QA personnel.

D.1.3 Validation of Analytical Data

Validation of the laboratory deliverables will be performed by ENSR or another qualified party independent of the laboratory. The level of validation will be determined based on the end use of the data and will consist of either a partial or comprehensive validation. Program-specific work plans will define the level of validation required. The EPA validation guidelines cited in Section D.2 will be used as the basis of the validation.

A partial review will be limited to QC summary information such as:

- Completeness of deliverable,
- Technical holding times and sample preservation,
- Sample integrity and cooler/sample temperature at the time of laboratory receipt,
- Laboratory and field blank contamination,
- Surrogate spike recoveries,
- MS/MSD recoveries and RPDs,
- Laboratory duplicate RPDs,
- LCS recoveries, and
- Initial and continuing calibrations.

The comprehensive validation will involve an in-depth review as per the validation guidelines, including reviewing compound identification and quantification, spot-checking calculations, and verifying summary data against the raw data.

D.2 Verification and Validation Methods

D.2.1 Field Data Verification

Field records will be reviewed by the Consultant Field Team Leader or designate to ensure that:

- Logbooks and standardized forms have been filled out completely and that the information recorded accurately reflects the activities that were performed.
- Records are legible and in accordance with good recordkeeping practices (e.g., entries are signed and dated; data are not obliterated; changes are initialed, dated, and explained).
- Sample collection, handling, preservation, and storage procedures were conducted in accordance with the protocols described in the FSAP or QAPP, and that any deviations were documented and approved by the appropriate personnel.

D.2.2 Laboratory Data Verification

Prior to being released as final, laboratory data will proceed through a tiered review process. Data verification starts with the analyst who performs a review of the data to ensure the work was done correctly the first time. Following the completion of the initial verification by the analyst performing the data reduction, a systematic check of the data will be performed by an experienced peer or supervisor. This check will be performed to ensure that initial review has been completed correctly and thoroughly, and typically includes a review to ensure the correct interpretation of chromatograms, mass spectra, etc.; accuracy of calculations; and acceptability of QC data.

A third-level review will be performed before results are submitted to clients. This review serves to verify the completeness of the data report and to ensure that project requirements are met for the analyses performed.

D.2.3 Validation of Analytical Deliverables

Validation will be performed as described in Section D.1.3 of the QAPP using EPA guidelines (EPA 1999, 2004) or equivalent regional EPA validation guidelines such as Region 9 Superfund Data Evaluation/ Validation Guidance, R9QA/006.1 (EPA 2001b) and the BMI Plant Site specific Guidance on Data Validation from NDEP (NDEP 2006). These guidelines, which were prepared for CLP data, will be adapted to reflect the analytical methods and measurement quality objectives established for the individual sampling events.

Upon completion of the validation, a report will be prepared. This report will summarize the samples reviewed, elements reviewed, any nonconformances with the established criteria, and validation actions (including application of data qualifiers). Data qualifiers employed will be consistent with the EPA guidelines and modified if necessary on a project specific basis.

D.2.4 Verification During Data Management

All manually entered data (e.g., field data) will be proofed 100 percent against the original. Electronic data will be checked 100 percent after loading against laboratory data sheets for completeness and spot checked for accuracy.

D.3 Reconciliation with User Requirements

D.3.1 Comparison to Measurement Objectives

The field and laboratory data collected during this investigation will be used to achieve the objectives identified in Section A.7 of this QAPP. The QC results associated with each analytical parameter for each matrix will be compared to the measurement objectives as defined in the program-specific work plans. Only data generated in association with QC results meeting the stated acceptance criteria (i.e., data determined to be valid) will be considered usable for decision-making purposes.

D.3.1.1 Accuracy Assessment

One measure of accuracy will be %R, which is calculated for matrix spikes, surrogates, and LCSs. Percent recoveries for MS/MSD results will be determined according to the following equation:

$$\%R = \frac{(Amount\ in\ Spiked\ Sample - Amount\ in\ Sample)}{Known\ Amount\ Added} x 100$$

Percent recoveries for LCS and surrogate compound results will be determined according to the following equation:

$$\%R = \frac{Experimental\ Concentration}{Known\ Amount\ Added} x 100$$

An additional measure of accuracy is blank contamination. The blanks associated with these sampling events include laboratory method blanks and field blanks (e.g., equipment rinsate blanks, trip blanks). The results of the laboratory and field blanks will be compared to the accuracy objectives as defined in the program-specific work plans. Failure to meet these objectives may indicate a systematic laboratory or field problem that should be investigated and resolved immediately. Associated data may be qualified and limitations placed on their use, depending on the magnitude of the problem.

D.3.1.2 Precision Assessment

The RPD between the matrix spike and matrix spike duplicate, or sample and sample duplicate in the case of some of the inorganic parameters, and field duplicate pair is calculated to compare to the precision objectives as defined in the program-specific work plans. The RPD will be calculated according to the following formula.

$$RPD = \frac{(Amount\ in\ Sample\ 1 - Amount\ in\ Sample\ 2)}{0.5\ (Amount\ in\ Sample\ 1 + Amount\ in\ Sample\ 2)} x\ 100$$

Failure to achieve precision objectives may result in the qualification of the associated data (Section D.2.3) and limitations placed upon their use.

D.3.1.3 Completeness Assessment

Completeness is the ratio of the number of valid sample results to the total number of samples analyzed with a specific matrix and/or analysis. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$Completeness = \frac{(number\ of\ valid\ measurements)}{(number\ of\ measurements\ planned)} x\ 100$$

Failure to meet the completeness objective will require an assessment to determine if the missing or invalid data are critical to achieving the project objectives. Corrective actions may include resampling or re-analysis, depending on the type of problem, logistical constraints, etc.

D.3.2 Comparison to Project Objectives

In addition to the comparison described in Section D.3.1, the data obtained will be both qualitatively and quantitatively assessed on a project-wide, matrix-specific, and parameter-specific basis. Factors to be considered in this assessment of field and laboratory data include, but are not necessarily limited to, the following:

- Conformance to the field methodologies and SOPs proposed in the FSAP and QAPP,
- Conformance to the analytical methodologies provided in the QAPP,
- Adherence to proposed sampling strategy,
- Presence of elevated detection limits due to matrix interferences or contaminants present at high concentrations,
- Presence of analytes not expected to be present at the facility,
- Unusable data sets (qualified as "R") based on the data validation results,
- Data sets identified as usable for limited purposes (qualified as "J") based on the data validation results,

- Effect of qualifiers applied as a result of data validation on the ability to implement the project decision rules, and
- Status of all issues requiring corrective action.

The effect of nonconformance (procedures or requirements) or noncompliant data on project objectives will be evaluated. Minor deviations from approved field and laboratory procedures and sampling approach will likely not affect the adequacy of the data as a whole in meeting the project objectives. Data that are estimated ("J" qualified) during the validation process will generally be considered usable, although any instances of extreme bias will be evaluated on a case-by-case basis to determine the limitations, if any, of the data usability. The direction of possible bias, if determined during validation, will be indicated with + and – signs appended to the data qualifiers. Missing or rejected data will be reviewed to determine whether the data are critical to attaining the project objectives. The assessment will also entail the identification of any remaining data gaps and need to reevaluate project decision rules.

E.0 REFERENCES

This QAPP was prepared using the following documents:

Ecology & Environment (E&E). 1982. Summary and Interpretation of Environmental Quality Data, BMI Industrial Complex, Henderson Nevada, November.

ENSR Corporation (ENSR). 1997. Phase II Environmental Conditions Assessment located at Kerr-McGee Chemical Corporation, Henderson Nevada, August 7.

__________. 2001. Supplemental Phase II Environmental Conditions Assessment, April.

__________. 2005. Conceptual Site Model, Kerr-McGee Facility, Henderson, Nevada, February 28.

__________. 2006a. Upgradient Workplan Addendum, Tronox Facility, Henderson Nevada, February.

__________. 2006b Ungradient Investigation Results, Tronox facility, Henderson Nevada October (Revised September 2007)

__________. 2006c Quality Assurance Project Plan, Tronox facility, HendersonNevada, December

__________. 2007 Phase A Source Area Investigation Results , Tronox Facility Henderson, Nevada September.

Kerr-McGee. 1996a. Phase II Work Plan, May.

__________. 1996b. Response to Letter of Understanding Henderson Nevada, October.

__________. 1998. Response to Phase II Report Comments and Supplemental Phase II Work Plan, November 9.

Kleinfelder. 1993. Environmental Conditions Assessment, Kerr-McGee Chemical Corporation, Henderson, Nevada Facility, April 15 (Final).

Nevada Division of Environmental Protection (NDEP). 2006. NDEP Guidance on Data Validation for the BMI Plant Sites and Common Areas Projects, Henderson Nevada. May.

U.S. Environmental Protection Agency (EPA). 1997. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846. Third Edition. May 1986, revised June 1997.

__________. 1999. Office of Solid Waste and Emergency Response. Contract Laboratory Program, National Functional Guidelines for Organic Data Review. October.

__________. 2001a. Quality Staff. EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5. March.

__________. 2001b Region 9 Superfund Data Evaluation/Validation Guidance, EPA R9QA/006.1

__________. 2002. Quality Staff. EPA Requirements for Quality Assurance Project Plans, EPA QA/G5. December.

__________. 2004. Office of Solid Waste and Emergency Response. Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review. October.

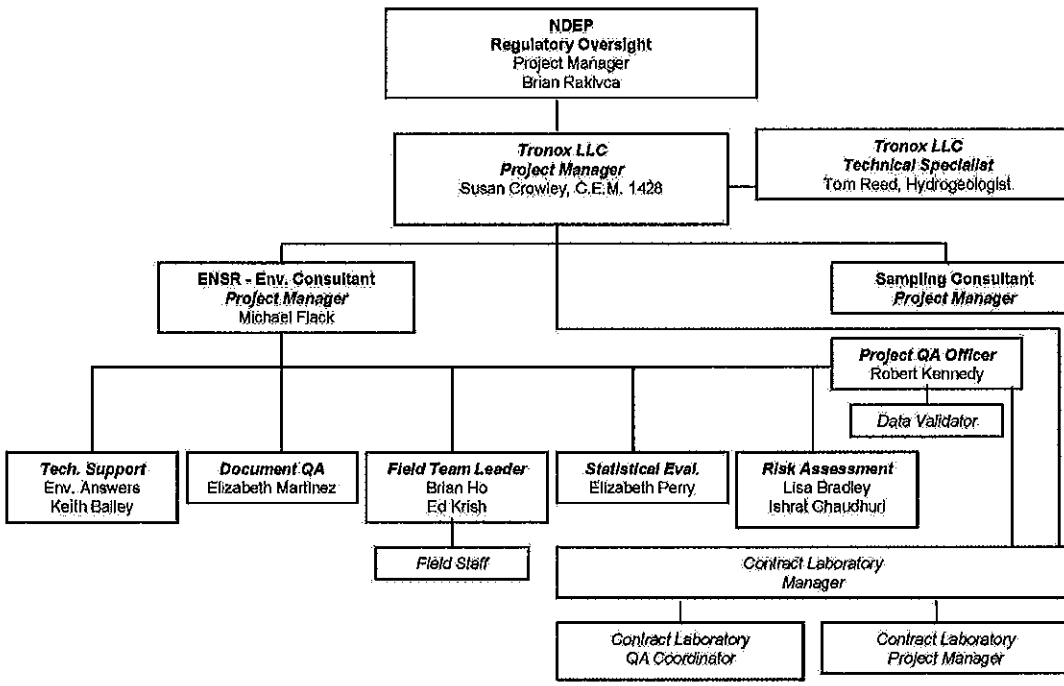

Figure A-1 Project Organization Chart

ENSR

CHAIN OF CUSTODY RECORD

Page ___ of ___

Client/Project Name:	Project Location:
Project Number:	Field Logbook No.:
Sampler: (Print Name) Affiliation:	Chain of Custody Tape No.:
Signature:	Send Results/Report to:

Field Sample No./ Identification	Date	Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid, Sludge, Etc.)	Preservative	Field Filtered	Analysis Requested						Lab I.D.	Remarks

Relinquished by: (Print Name) Signature:	Date: Time:	Received by: (Print Name) Signature:	Date: Time:
Relinquished by: (Print Name) Signature:	Date: Time:	Received by: (Print Name) Signature:	Date: Time:
Relinquished by: (Print Name) Signature:	Date: Time:	Received by: (Print Name) Signature:	Date: Time:

Analytical Laboratory (Destination):

ENSR
4303 W. LaPorte Ave.
Fort Collins, CO 80521
(970) 416-0916

Serial No.

Figure B-1 Example of Chain of Custody Form

Table A-1 Distribution List

Tronox Document Distribution List Updated: 25-Mar-08

Document Name: **ECA General Docs** - addressee *

Name (Last, First)		Firm	Distribution Hard	e-Copy	Cvr Only
Croft	Todd	NDEP		X	
King	Val	NDEP		X	
Najima	Jim	NDEP		X	
Rakvica	Brian	NDEP	X	X	
Sous	Nadir	NDEP			
Tinney	Al	NDEP		X	
Palm	Jon	NDEP		X	
Harbour*	Shannon	NDEP	X	X	
Black	Paul	Neptune	X	X	
Hackenberry	Paul	Hackenberry	X	X	
Copeland	Teri		X	X	
Olani-Fehling	Joanna		X	X	
Pohlmann	Brenda	COH		X	
Conaly	Barry	COH Counsel		X	
Mrowka	Rob	CCCP		X	
Mulroy	Pat	SNWA			
Goff	Mike	SNWA			
Liesing	Joe	SNWA			
Kaplan	Mitch	EPA, Reg 9		X	
Compliance Corrdonator		NDEP			
Compliance Coordinator		DAQEM			
Public Repository		Library	X	X	

Name (Last, First)		Firm	Distribution Hard	e-Copy	Cvr Only
Corbett	Pat	Tronox		X	
Paque	Matt	Tronox Counsel		X	
Hatmaker	John	Tronox		X	
Reed	Tom	Tronox	X	X	
Slater	Rick	Tronox		X	
Crowley	Susan	Tronox	2	2	
			& Hard Data		
Bailey	Keith	Environ Answers	X	X	
Krish	Ed	ENSR	X	X	
Bilodeau	Sally	ENSR	X	X	
Flack	Mike	ENSR	X	X	
Ho	Brian	ENSR	X	X	
Kennedy	Robert	ENSR	X	X	
Bradley	Lisa	ENSR	X	X	
Lambeth	Jeff	Veolia			
Guerriero	Joe	AIG		X	
Giroux	Barry	GEI		X	
Stowers	Kirk	Broadbent			
Sahu	Rahnijit	BMI		X	
Crouse	George	Syngenta		X	
Erickson	Lee	Stauffer		X	
Kelly	Joe	Montrose			
Sundberg	Paul	Montrose		X	
Gibson	Jeff	AmPac			
Richards	Curt	Olin		X	
Bellotti	Michael	Olin		X	
Wilkinson	Craig	Timet		X	
Mack	Joel	Montrose Counsel			

Table A-2 Analyte List and Reporting Limits
(April 2008)

Parameter	CAS No.	RL	
		Water	Soil
Volatile Organic Compounds (µg/L or µg/kg)			
1,1,1,2-Tetrachloroethane	630-20-6	1	5
1,1,1-Trichloroethane	71-55-6	1	5
1,1,2,2-Tetrachloroethane	79-34-5	1	5
1,1,2-Trichloroethane	79-00-5	1	5
1,1-Dichloroethane	75-34-3	1	5
1,1-Dichloroethene	75-35-4	1	5
1,1-Dichloropropene	563-58-6	2	5
1,2,3-Trichlorobenzene	120-82-1	2	5
1,2,3-Trichloropropane	96-18-4	2	5
1,2,4-Trichlorobenzene	120-82-1	2	5
1,2,4-Trimethylbenzene	95-63-6	2	5
1,2-Dibromo-3-chloropropane	96-12-8	5	5
1,2-Dibromoethane	106-93-4	1	5
1,2-Dichlorobenzene	95-50-1	2	5
1,2-Dichloroethane	107-06-2	1	5
1,2-Dichloropropane	78-87-5	1	5
1,3,5-Trimethylbenzene	108-67-8	2	5
1,3-Dichlorobenzene	541-73-1	2	5
1,3-Dichloropropane	142-28-9	2	5
1,4-Dichlorobenzene	106-46-7	2	5
2,2-Dichloropropane	594-20-7	52	5
2-Butanone	78-93-3	10	10
2-Chlorotoluene	95-49-8	5	5
2-Hexanone	591-78-6	10	10
4-Chlorotoluene	106-43-4	5	5
4-Methyl-2-pentanone	108-10-1	10	10
Acetone	67-64-1	1020	1020
Benzene	71-43-2	51	5
Bromobenzene	108-86-1	52	5
Bromochloromethane	74-97-5	52	5
Bromodichloromethane	75-27-4	51	5
Bromoform	75-25-2	51	5
Bromomethane	74-83-9	102	105

Table A-2 Analyte List and Reporting Limits (Cont'd)
(April 2008)

Parameter	CAS No.	RL	
		Water	Soil
Volatile Organic Compounds (µg/L or µg/kg)			
Chlorobenzene	108-90-7	1	5
Chloroethane	75-00-3	2	5
Chloroform	67-66-3	1	5
Chloromethane	74-87-3	2	5
cis-1,2-Dichloroethene	156-92-2	1	5
cis-1,3-Dichloropropene	10061-01-5	1	5
Dibromochloromethane	124-48-1	1	5
Dibromomethane	74-95-3	1	5
Dichlorodifluoromethane	75-71-8	1	5
Diisopropyl ether (DIPE)	108-20-3	1	5
Ethylbenzene	100-41-4	1	5
Ethyl-tert-butyl ether (ETBE)	637-92-3	1	5
Hexachlorobutadiene	87-68-3	5	5
Isopropyl Benzene	98-28-8	2	5
Xylenes (total)	1330-20-7	1	5
Methylene Chloride	75-09-2	2	5
Methyl-tert-butyl ether (MTBE)	1634-04-4	1	5
Naphthalene	91-20-3	2	5
n-Butylbenzene	104-51-8	2	5
n-Propylbenzene	103-65-1	2	5
p-Isopropyltoluene	99-87-6	2	5
sec-Butylbenzene	135-98-8	2	5
Styrene	100-42-5	1	5
tert-Amyl-methyl ether (TAME)	994-05-8	1	5
tert-Butyl alcohol (TBA)	75-65-0	100	100
tert-Butylbenzene	98-06-6	2	5
Tetrachloroethene	127-18-4	1	5
Toluene	108-88-3	1	5
trans-1,2-Dichloroethene	156-60-5	1	5
trans-1,3-Dichloropropene	10061-02-6	1	5
Trichloroethene	79-01-6	1	5
Trichlorofluoromethane	75-69-4	1	5
Vinyl Chloride	75-01-4	1	5

Table A-2 Analyte List and Reporting Limits (Cont'd)
(April 2008)

Parameter	CAS No.	RL	
		Water	Soil
Semivolatile Organic Compounds (µ/L or µg/kg)			
1,4-dioxane	123-91-1	2.0	66
2-Methylnaphthalene	91-57-6	0.2	66
Acenaphthene	83-32-9	0.2	66
Acenaphthylene	208-96-8	0.2	66
Anthracene	120-12-7	0.2	66
Benzo(a)anthracene	56-55-3	0.2	66
Benzo(a)pyrene	50-32-8	0.2	66
Benzo(b)fluoranthene	205-99-2	0.2	66
Benzo(g,h,i)perylene	191-24-2	0.2	66
Benzo(k)fluoranthene	207-08-9	0.2	66
Bis(2-ethylhexyl)phthalate	117-81-7	0.2	66
Butylbenzylphthalate	85-68-7	0.2	66
Chrysene	218-01-9	0.2	66
Dibenzo(a,h)anthracene	53-70-3	0.2	66
Diethylphthalate	84-66-2	0.2	66
Dimethylphthalate	131-11-3	0.2	66
Di-n-butylphthalate	84-74-2	0.2	66
Di-n-octylphthalate	117-84-0	0.2	66
Fluoranthene	206-44-0	0.2	66
Fluorene	86-73-7	0.2	66
Hexachlorobenzene	118-74-1	0.2	66
Indeno(1,2,3-cd)pyrene	193-39-5	0.2	66
Naphthalene	91-20-3	0.2	66
Nitrobenzene	98-95-3	0.2	66
Phenanthrene	85-01-8	0.2	66
Pyrene	129-00-0	0.2	66
Pyridine	110-86-1	2.0	66
Octachlorostyrene	29082-74-4	0.2	66
Organophosphorous Pesticides (µg/L or µg/kg)			
Azinphos-methyl	86-50-0	1	33
Bolstar	35400-43-2	1	33
Chlorpyrifos	2921-88-2	1	33
Coumaphos	56-72-4	1	33
Demeton-O	298-03-3	1	33

Table A-2 Analyte List and Reporting Limits (Cont'd)
(April 2008)

Parameter	CAS No.	RL	
		Water	**Soil**
Organophosphorous Pesticides (µg/L or µg/kg)			
Demeton-S	126-75-0	1	33
Diazinon	333-41-5	1	33
Dichlorvos	62-73-7	1	33
Dimethoate	60-51-5	1	66
Disulfoton	298-04-4	1	33
EPN	2104-65-5	1	33
Ethoprop	13194-48-4	1	33
Famphur	52-85-7	1	33
Fensulfothion	115-90-2	1	33
Fenthion	55-38-9	1	33
Malathion	121-75-5	1	33
Merphos	150-50-5	1	33
Mevinphos	7786-34-7	1	33
Naled	300-76-5	1	33
Parathion-ethyl	56-38-2	1	33
Parathion-methyl	298-00-0	1	33
Phorate	298-02-2	1	33
Ronnel	299-84-3	1	33
Stirphos	22248-79-9	1	33
Sulfotepp	3689-24-5	1	66
Thionazin	297-97-2	2	66
Tokuthion	34643-46-4	1	33
Trichloronate	327-98-0	1	33
Total Petroleum Hydrocarbons and Fuel Alcohols (µg/L or mg/kg)			
GRO (C6-C10)	na	na	0.05
DRO (C10-C28)	na	na	40
ORO (C28-C40)	na	na	40
Methanol	67-56-1	400	1
Ethanol	64-17-5	400	1
Ethylene glycol	107-21-1	5000	5

Table A-2 Analyte List and Reporting Limits (Cont'd)
(April 2008)

Parameter	CAS No.	RL	
		Water	**Soil**
Organochlorine Pesticides and PCBs (µg/L or µg/kg)			
4,4'-DDD	72-54-8	0.05	3.3
4,4'-DDE	72-55-9	0.05	3.3
4,4'-DDT	50-29-3	0.05	3.3
Aldrin	309-00-2	0.05	1.7
alpha-BHC	319-84-6	0.05	1.7
beta-BHC	319-85-7	0.05	1.7
Chlordane, technical	57-74-9	0.25	8.3
alpha-Chlordane	5103-71-9	0.05	1.7
gamma-Chlordane	5103-74-2	0.05	1.7
delta-BHC	319-86-8	0.05	1.7
Dieldrin	60-57-1	0.05	3.3
Endosulfan I	959-98-8	0.05	1.7
Endosulfan II	33213-65-9	0.05	3.3
Endosulfan sulfate	1031-07-8	0.05	3.3
Endrin	72-20-8	0.05	3.3
Endrin aldehyde	7421-93-4	0.05	3.3
Endrin Ketone	53494-70-5	0.05	3.3
gamma-BHC (Lindane)	58-89-9	0.05	1.7
Heptachlor	76-44-8	0.05	1.7
Heptachlor epoxide	1024-57-3	0.05	1.7
Hexachlorobenzene	118-74-1	0.05	1.7
Methoxychlor	72-43-5	0.05	17
Toxaphene	8001-35-2	1	33
Aroclor 1016	12674-11-2	0.2	33
Aroclor 1221	11104-28-2	0.4	67
Aroclor 1232	11141-16-5	0.2	33
Aroclor 1242	53469-21-9	0.2	33
Aroclor 1248	12672-29-6	0.2	33
Aroclor 1254	11097-69-1	0.2	33
Aroclor 1260	11096-82-5	0.2	33
Dioxins/Furans (pg/L or pg/g)			
1,2,3,4,6,7,8,9-Ocatchlorodibenzofuran	39001-02-0	na	0.59
1,2,3,4,6,7,8,9-Ocatchlorodibenzodioxin	3268-87-9	na	0.57

Table A-2 Analyte List and Reporting Limits (Cont'd)
(April 2008)

Parameter	CAS No.	RL	
		Water	Soil
Dioxins/Furans (pg/L or pg/g)			
1,2,3,4,6,7,8-Heptatchlorodibenzofuran	67562-39-4	na	0.22
1,2,3,4,6,7,8-Heptatchlorodibenzo-p-dioxin	35822-46-9	na	0.26
1,2,3,4,7,8,9-Heptatchlorodibenzofuran	55673-89-7	na	0.5
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	na	0.09
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	na	0.19
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	na	0.10
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	na	0.19
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	na	0.15
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	na	0.19
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	na	0.14
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	40321-76-4	na	0.15
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5	na	0.11
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-31-4	na	0.16
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	na	0.12
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	na	0.17
Metals (µg/L or mg/kg)			
Aluminum	7429-90-5	50	10
Antimony	7440-36-0	0.05	0.05
Arsenic	7440-38-2	0.5	0.5
Barium	7440-39-3	5	2
Beryllium	7440-41-7	0.02	0.02
Boron	7440-42-8	0.5	0.5
Cadmium	7440-43-9	0.02	0.02
Calcium	7440-70-2	50	10
Chromium (total)	7440-47-3	0.2	0.5
Chromium (hexavalent)	18540-29-9	10	0.5
Cobalt	7440-48-4	10	2
Copper	7440-50-8	10	2
Iron	7439-89-6	20	4
Lead	7439-92-1	0.02	0.05
Magnesium	7439-95-4	20	4
Manganese	7439-95-4	5	2
Mercury	7439-97-6	0.2	0.02
Molybdenum	7439-98-7	0.05	0.05

Table A-2 Analyte List and Reporting Limits (Cont'd)
(April 2008)

Parameter	CAS No.	RL	
		Water	Soil
Metals (µg/L or mg/kg)			
Nickel	7440-02-0	0.2	0.2
Platinum	7440-06-4	0.1	0.1
Potassium	7440-09-7	2000	200
Selenium	7782-49-2	1	1
Silver	7440-22-4	0.02	0.02
Sodium	7440-23-5	100	20
Strontium	7440-24-6	10	2
Tin	7440-31-5	50	10
Titanium	7440-32-6	10	2
Thallium	7440-28-0	0.02	0.02
Tungsten	7440-33-7	0.1	0.1
Uranium	7440-61-1	0.02	0.02
Vanadium	7440-62-2	0.2	0.2
Zinc	7440-66-6	10	2
Wet Chemistry and Misc. Analytes (µg/L or mg/kg)			
Alkalinity (total, CO_3^-,HCO_3^-)	na	2000	20
Ammonia	7664-41-7	50	5
Chloride	16887-00-6	200	2
Chlorate	7790-93-4	20	0.2
Cyanide (total)	57-12-5	10	1
Conductivity	na	na	na
Nitrate	7697-37-2	50	0.5
Nitrite	14797-65-0	50	0.5
Phosphate (total)	14265-44-2	50	0.5
Perchlorate	14797-73-0	1	0.1
Sulfate	14808-79-8	200	2
TDS	na	10000	na
TSS	na	10000	na
Surfactants (MBAS)	na	20	1
pH	na	na	na
Bromide	24959-67-9	100	1
Total Organic Carbon	7440-44-0	1000	300
Formaldehyde	50-00-0	8.0	1000

Table A-2 Analyte List and Reporting Limits (Cont'd)
(April 2008)

Parameter	CAS No.	RL	
		Water	Soil
Radiochemical Analytes (pCi/L or pCi/g)			
Radium 226	13982-63-3	1.0	0.5
Radium 228	15262-20-1	3.0	0.5
Thorium 228	14274-82-9	0.03	0.05
Thorium 230	14269-63-7	0.03	0.05
Thorium 232	7440-29-1	0.03	0.1
Uranium 234	13966-29-5	0.03	0.04
Uranium 235	15117-96-1	0.03	0.04
Uranium 238	7440-61-1	0.03	0.04

Table A-2 Analyte List and Reporting Limits (Cont'd) (April 2008)

Parameter	CAS No.	PQL
		Air
Soil Gas Analytes (µg/m^3)		
1,1,1-Trichloroethane	71-55-6	0.1
1,1,2,2-Tetrachloroethane	79-34-5	0.1
1,1,2-Trichloroethane	79-00-5	0.1
1,1-Dichloroethane	75-34-3	0.1
1,1-Dichloroethene	75-35-4	0.1
1,2,4-Trichlorobenzene	120-82-1	0.1
1,2,4-Trimethylbenzene	95-63-6	0.5
1,2-Dibromo-3-chloropropane	96-12-8	0.5
1,2-Dibromoethane	106-93-4	0.1
1,2-Dichlorobenzene	95-50-1	0.1
1,2-Dichloroethane	107-06-2	0.1
1,2-Dichloropropane	78-87-5	0.1
1,2-Dichloro-1,1,2,2-tetrafluoroethane(CFC 114)	75-71-8	0.5
1,3,5-Trimethylbenzene	108-67-8	0.5
1,3-Dichlorobenzene	541-73-1	0.1
1,4-Dichlorobenzene	106-46-7	0.1
1,4-Dioxane	123-91-1	0.5
2-Butanone (MEK)	78-93-3	0.5
2-Hexanone	591-78-6	0.5
4-Ethyltoluene	622-96-8	0.5
4-Methyl-2-pentanone	108-10-1	0.5
Acetone	67-64-1	5.0
Acrylonitrile	107-13-1	0.5
alpha-Methylstyrene	98-83-9	0.5
Allyl chloride	107-05-1	0.1
Benzene	71-43-2	0.1
Benzyl chloride	100-44-7	0.1
Bromodichloromethane	75-27-4	0.1
Bromoform	75-25-2	0.5
Bromomethane	74-83-9	0.1
Carbon disulfide	75-15-0	0.5

Table A-2 Analyte List and Reporting Limits (Cont'd)
(April 2008)

Parameter	CAS No.	PQL
		Air
Soil Gas Analytes (µg/m^3)		
Carbon Tetrachloride	56-23-5	0.1
Chlorobenzene	108-90-7	0.1
Chloroethane	75-00-3	0.1
Chloroform	67-66-3	0.1
Chloromethane	74-87-3	0.1
cis-1,2-Dichloroethene	156-59-2	0.1
cis-1,3-Dichloropropene	10061-01-5	0.5
Dibromochloromethane	124-48-1	0.1
Dichlorodifluoromethane (CFC 12)	75-71-8	0.5
Diisopropyl ether (DIPE)	108-20-3	0.5
Ethanol	64-17-5	5.0
Ethylbenzene	100-41-4	0.5
Ethyl-tert-butyl ether (ETBE)	637-92-3	0.5
Hexachlorobutadiene	87-68-3	0.1
Isopropyl benzene (Cumene)	98-82-8	0.5
Methyl tert-Butyl Ether	1634-04-4	0.1
Methylene Chloride	75-09-2	0.5
Methyl methacrylate	80-62-6	0.5
Naphthalene	91-20-3	0.2
n-Butylbenzene	104-51-8	0.5
n-Heptane	142-82-5	0.5
n-Propylbenzene	103-65-1	0.5
n-Octane	111-65-9	0.5
p-Isopropyltoluene	99-87-6	0.5
sec-Butylbenzene	135-98-8	0.5
Styrene	100-42-5	0.5
tert-Amyl-methyl ether (TAME)	994-05-8	0.5
tert-Butyl alcohol (TBA)	75-65-0	0.5
tert-Butylbenzene	98-06-6	0.5
Tetrachloroethene	127-18-4	0.1
Toluene	108-88-3	0.5

Table A-2 Analyte List and Reporting Limits (Cont'd)
(April 2008)

Parameter	CAS No.	PQL
		Air
Soil Gas Analytes (µg/m^3)		
trans-1,2-Dichloroethene	156-60-5	0.1
trans-1,3-Dichloropropene	10061-02-6	0.5
Trichloroethene	79-01-6	0.1
Trichlorofluoromethane	75-69-4	0.1
Trichlorotrifluoroethane (CFC 113)	76-13-1	0.1
Vinyl acetate	108-05-4	5.0
Vinyl Chloride	75-01-4	0.1
m,p-Xylenes	179601-23-1	0.5
o-Xylene	95-47-6	0.5
Asbestos (s/gPM10)		**Soil**
Amphibole Protocol Structures	na	3000000
Amphibole Protocol Structures	na	3000000

Table B-1 Sample Container, Preservation, and Holding Time Requirements

Parameter	Container [1, 2]	Preservation	Holding Time [3]
Aqueous			
VOCs	3-40 ml glass vials with Teflon-lined septum caps	HCl to pH<2; no headspace; cool 4°C	14 days
SVOCs	2-1 L amber glass with Teflon-lined lids	Cool 4°C	Extract within 7 days, analyze within 40 days
Dioxins/Furans	2-1 L amber glass with Teflon-lined lids	Cool 4°C	Extract within 30 days, analyze within 40 days
GRO	3-40 ml glass vials with Teflon-lined septum caps	HCl to pH<2; no headspace; cool 4°C	14 days
DRO/ORO	2-1 L amber glass with Teflon-lined lids	HCl to pH<2; no headspace; cool 4°C	Extract within 7 days, analyze within 40 days
Fuel Alcohols and Ethylene glycol	3-40 ml glass vials with Teflon-lined septum caps	Cool 4°C	14 days
Organochlorine Pesticides	2-1 L amber glass with Teflon-lined lids	Cool 4°C	Extract within 7 days, analyze within 40 days
Organophosphorous Pesticides	2-1 L amber glass with Teflon-lined lids	Cool 4°C	Extract within 7 days, analyze within 40 days
PCBs	2-1 L amber glass with Teflon-lined lids	Cool 4°C	Extract within 7 days, analyze within 40 days
Metals	1-500 mL plastic	HNO3 to pH <2; cool 4°C	Mercury - 28 days, other metals - 180 days
Hexavalent chromium	250 mL plastic	NH4SO4 buffer; cool 4°C; field filter	28 days to analysis if filtered and preserved properly
Alkalinity	500 mL plastic	Cool 4°C	14 days
Ammonia	500 mL plastic	H2SO4 to pH <2; cool 4°C	28 days
Bromide	125 mL plastic	Cool 4°C	28 days
Chlorate	125 mL plastic	Cool 4°C	28 days
Chloride	125 mL plastic	Cool 4°C	28 days
Cyanide	500 mL plastic	NaOH to pH>12	14 days
Conductivity	125 mL plastic	Cool 4°C	28 days
Nitrate	125 mL plastic	Cool 4°C	2 days
Nitrite	125 mL plastic	Cool 4°C	2 days

Table B-1 Sample Container, Preservation, and Holding Time Requirements (Cont'd)

Parameter	Container [1, 2]	Preservation	Holding Time [3]
Aqueous			
Phosphate (total)	125 mL plastic	Cool 4°C	2 days
Perchlorate	125 mL plastic	Cool 4°C	28 days
Sulfate	125 mL plastic	Cool 4°C	28 days
Surfactants	500 mL plastic	Cool 4°C	48 hours
TOC	1-1L glass	H2SO4 to pH <2; cool 4°C	28 days
TDS	1-1L plastic	Cool 4°C	7 days
TSS	1-1L plastic	Cool 4°C	7 days
Radium 226	1-1L plastic	HNO3 to pH <2; cool 4°C	6 months
Radium 228	1-1L plastic	HNO3 to pH <2; cool 4°C	6 months
Thorium (isotopic)	1-1L plastic	HNO3 to pH <2; cool 4°C	6 months
Uranium (isotopic)	1-1L plastic	HNO3 to pH <2; cool 4°C	6 months
Formaldehyde	2-1 L amber glass with Teflon-lined lids	Cool 4°C	3 days

Table B-1 Sample Container, Preservation, and Holding Time Requirements (Cont'd)

Parameter	Container [1,2]	Preservation	Holding Time [3]
Soil			
VOCs	3 40-ml VOA vials/ 2 with NaHSO4 and 1 with MeOH	Cool 4°C	14 days from field preservation to analysis
SVOCs	1-250 ml glass with Teflon-lined cap	Cool 4°C	14 days until extraction; 40 days from extraction to analysis
Dioxins/Furans	1-250 ml glass with Teflon-lined cap	Cool 4°C	30 days until extraction; 40 days from extraction to analysis
GRO	1 VOA vial with MeOH	Cool 4°C	14 days from field preservation to analysis
DRO/ORO	1-250 ml glass with Teflon-lined cap	Cool 4°C	14 days until extraction; 40 days from extraction to analysis
Fuel Alcohols and Ethylene glycol	1-250 ml glass with Teflon-lined cap	Cool 4°C	14 days
Pesticides and PCBs	1-250 or 500-ml glass with Teflon-lined cap	Cool 4°C	14 days until extraction; 40 days from extraction to analysis
Metals	1-250 ml glass with Teflon-lined cap	Cool 4°C	Mercury – 28 days, other metals – 180 days
Hexavalent chromium	1-250 ml glass with Teflon-lined cap	Cool 4°C	28 days to digestion, 4 days from digestion to analysis
TOC	1-250 ml glass with Teflon-lined cap	Cool 4°C	28 days
Asbestos	1-gallon plastic bag	None	None established for soil
Alkalinity	1-250 ml glass with Teflon-lined cap	Cool 4°C	None established for soil. Use water holding time for leachates
Ammonia	1-250 ml glass with Teflon-lined cap	Cool 4°C	None established for soil. Use water holding time for leachates
Anions (Br-,Cl-, ClO2-,ClO4-, , NO3-,NO2-,PO4--, SO4--, -)	1-250 ml glass with Teflon-lined cap	Cool 4°C	None established for soil. Use water holding time for leachates
Surfactants	1-250 ml glass with Teflon-lined cap	Cool 4°C	None established for soil. Use water holding time for leachates
TOC	1-250 ml glass with Teflon-lined cap	Cool 4°C	None established for soil

Table B-1 Sample Container, Preservation, and Holding Time Requirements (Cont'd)

Parameter	Container [1,2]	Preservation	Holding Time [3]
Soil			
Radiochemicals	1- 500-mL glass with Teflon lined cap	Cool 4°C	6 months
Formaldehyde	1-250 ml glass with Teflon-lined cap	Cool 4°C	14 days
Soil Gas			
VOCs by TO-15	SUMMA canister	None	30 days

Notes:

1 Additional volume will be collected for MS/MSD samples.

2 Laboratory may provide alternate containers as long as the containers meet the requirements of the method and allow the collection of sufficient volume to perform the analyses.

3 Holding time begins from date of sample collection.

Table B-2 Analytical Methodologies

Parameter	Methodology
Aqueous	
VOCs	EPA 5030/8260B
SVOCs	EPA 8270C
Organochlorine Pesticides	EPA 8081A
Organophosphorous Pesticides	EPA 8141A
PCBs	EPA 8082A
Gasoline Range Organics	EPA 8015B
Diesel Range Organics	EPA 8015B
Methanol	EPA 8015B
Ethanol	EPA 8015B
Ethylene glycol	EPA 8015B
Formaldehyde	EPA 8315A
Metals	EPA 6010B/6020
Mercury	EPA 7470
Hexavalent chromium	EPA 7199
Alkalinity	EPA 310.1
Ammonia	EPA 350.1
Bromide	EPA 9056
Chloride	EPA 9056
Chlorate	EPA 9056
Cyanide	EPA 9012/9014
Nitrate	EPA 9056
Phosphate (total)	EPA 365.1
Perchlorate	EPA 314.0
pH	EPA 9045C
Sulfate	EPA 9056
Surfactants	EPA 425.1
TDS	EPA 160.1
TSS	EPA 160.2

Table B-2 Analytical Methodologies (Cont'd)

Parameter	Methodology
Aqueous	
Total Organic Carbon	EPA 9060A
Radium 226	EPA 903.1
Radium 228	EPA 904.0
Thorium (isotopic)	EML HASL 300 Alpha Spec
Uranium (isotopic)	EML HASL 300 Alpha Spec
Soil	
% Solids	EPA 160.1
VOCs	EPA 5035A/8260B
SVOCs	EPA 8270C
Organochlorine Pesticides	EPA 8081A
Organophosphorous Pesticides	EPA 8141A
PCBs	EPA 8082A
Dioxins/Furans (PCDDs/PCDFs)	EPA 6890
Gasoline Range Organics	EPA 8015B
Diesel Range Organics	EPA 8015B
Methanol	EPA 8015B
Ethanol	EPA 8015B
Ethylene glycol	EPA 8015B
Formaldehyde	EPA 8315A
Metals	EPA 6010B/6020
Mercury	EPA 7470
Hexavalent chromium	EPA 218.6
Asbestos	EPA 600/R-93/116
Alkalinity	EPA 310.1
Ammonia	EPA 350.1
Bromide	EPA 9056
Chloride	EPA 9056
Chlorate	EPA 9056
Cyanide	EPA 9012
Nitrate	EPA 9056
Nitrite	EPA 9056
Phosphate (total)	EPA 365.2
Perchlorate	EPA 314.0
pH	EPA 9045C
Sulfate	EPA 9056
Surfactants	EPA 425.1
Total Organic Carbon	EPA Lloyd Kahn
Radium 226	EPA 9315 modified (alpha spectroscopy)

Table B-2 Analytical Methodologies (Cont'd)

Parameter	Methodology
Soil	
Radium 228	EPA 9320 modified (beta counting)
Thorium (isotopic)	EML HASL 300 (alpha spectroscopy)
Uranium (isotopic)	EML HASL 300 (alpha Spectroscopy)
Soil Gas (Air)	
VOCs	EPA TO-15

Table B-3 Internal QC Checks for Laboratory Analyses

Parameter	QC Check	Frequencies	Control Limits	Laboratory Corrective Actions
VOCs (soil and water)	Method blanks	One per 12 hour analytical shift of a similar matrix	No target analytes above MRL	Reextraction/reanalysis of entire batch
	Surrogate spikes	Every sample, blank, standard prior to extraction	70-130%R	Reextract or flag data
	MS/MSD samples	One pair per analytical batch- full analyte list	Per current laboratory limits.	Check LCS, reanalyze, flag results
	LCS	One per analytical batch- full analyte list	75-125%R (60-140%R SF)	Reextraction/reanalysis of entire batch
	GC/MS tuning	At beginning of each 12 hour shift	Control criteria listed in SOP	Recalibrate instrument until control criteria are met
	Internal standards	Every sample, blank, and standard	Area within 50-200% and RT within 0.5 min of IS in associated calibration standard	Reanalyze sample if no interference present
VOCs (air)	Method blanks	One per 24 hour analytical shift	No target analytes above MRL	Reanalysis of entire batch
	Surrogate spikes	Every sample, blank, and standard	70-130%R	Reanalysis
	LCS	One per analytical batch – full analyte list	Per current laboratory limits.	Check LCS, reanalyze, flag results
	GC/MS tuning	At beginning of each 24 hour shift	Per method criteria	Recalibrate instrument until control criteria are met
	Internal standards	Every sample, blank, and standard	Area within 60-140% and RT within 0.3 min of IS in associated CCV or ICAL mdipoint	Reanalyze sample if no interference present
SVOCs	Method blanks	One per analytical batch	No target analytes above MRL	Reextraction/reanalysis of entire batch
	Surrogate spikes	Every sample, blank, standard prior to extraction	Per current laboratory control limits.45-135%R (20-150% SF)	Reextract or flag data

Table B-3 Internal QC Checks for Laboratory Analyses (Cont'd)

Parameter	QC Check	Frequencies	Control Limits	Laboratory Corrective Actions
SVOCs (cont.)	MS/MSD samples	One pair per analytical batch – full analyte list	Per current laboratory limits.	Check LCS, reanalyze, flag results
	LCS	One per analytical batch – full analyte list	Per current laboratory limits.50-120%R (10-150%R SF)	Reextraction/reanalysis of entire batch
	GC/MS tuning	At beginning of each 12 hour shift	Control criteria listed in SOP	Recalibrate instrument until control criteria are met
	Internal standards	Every sample, blank, standard prior to analysis	Area within 50-200% and RT within 0.5 min of IS in associated calibration standard	Reanalyze sample if no interference present
Dioxins/Furans PCDDs/PCDFs	Method blanks	One per analytical batch	Must be analyzed between calibration and first sample	Reextraction/reanalysis of entire batch
	MS/MSD samples	One pair per analytical batch – full analyte list	Not required by method; use lab limits or 40-135%	If recovery of labeled standards is outside criteria, reextract to confirm matrix interferences
	LCS	One per analytical batch – full analyte list	70-130%R	Reextraction/reanalysis of entire batch
	Internal standards	Every sample, blank standard prior to analysis	40-135% for all 2,3,7,8-substituted internal standards	Evaluate matrix effects. If called for, reextract samples using smaller sample amount.
	Mass resolution check	At beginning and end of each 12 hour shift	Must meet 10,000 resolving power	Reanalysis of entire batch
	GC column performance check	At beginning of each 12 hour shift	2,3,7,8TCDD must be <25% other congeners	Cannot begin run until criteria are met

Table B-3 Internal QC Checks for Laboratory Analyses (Cont'd)

Parameter	QC Check	Frequencies	Control Limits	Laboratory Corrective Actions
Pesticides and PCBs	Method blanks	One per analytical batch	No target analytes above RL	Reextraction/reanalysis of entire batch
	Surrogate spikes	Every sample, blank, standard prior to extraction	40-140%R	Reextract or flag data
	MS/MSD samples	One pair per analytical batch – full analyte list	Per current laboratory limits.	Confirm with reanalysis, flag results
	LCS	One per analytical batch – full analyte list	50-130%R (30-150%R SF)	Reextraction/reanalysis of entire batch
	2nd column confirmation	Every sample per lab SOP	RPD <40	Flag date
Formaldehyde	Method blanks	One per analytical batch	No target analyte above MRL	Reextraction/reanalysis of entire batch
	MS/MSD samples	One pair per analytical batch	Per current laboratory limits.	Confirm with reanalysis, flag results
	LCS	One per analytical batch	Per current laboratory limits.	Reextraction/reanalysis of entire batch
General Chemistry	Reagent/prep blanks	One per analytical batch	No analytes above MRL	Repreparation/reanalysis of entire prep batch
	MS samples (where applicable)	One per analytical batch	Per current laboratory limits.	Check LCS, flag results
	Duplicate samples	One per analytical batch	Per current laboratory limits.	Check analytical system, flag results
	LCS	One per analytical batch	Per current laboratory limits.	Repreparation/reanalysis of entire prep batch

Table B-3 Internal QC Checks for Laboratory Analyses (Cont'd)

Parameter	QC Check	Frequencies	Control Limits	Laboratory Corrective Actions
Metals	Reagent/prep blanks	One per analytical batch	No analytes above MRL	Repreparation/reanalysis of entire prep batch
	MS samples	One per analytical batch	75-125%	Check LCS, flag results
	Duplicate samples	One per analytical batch	RPD ± 20% waters RPD ± 35% soils	Check analytical system, flag results
	LCS	One per analytical batch	80-120%R	Repreparation/reanalysis of entire prep batch
	Interference check (Method 6010/6020)	Beginning of each analytical run or each 12-h shift, whichever is more frequent	±10% R	Evaluate; reanalysis if necessary
	MS tuning (Method 6020)	Prior to each analytical sequence	Control criteria listed in method	Recalibrate instrument until control criteria are met
Ra-228 904.0 (water)	Reagent/prep blanks	One per preparation batch	Not detected above RL	Repreparation/reanalysis of entire batch
	Tracer	Added to all samples	70-120% R	Re-extract and reanalyze samples with tracer %Rs outside criteria
	MS samples	One per preparation batch	75-125% R	Check LCS, flag results
	Duplicate samples	One per preparation batch	RPD <20	Check analytical system, flag results
Ra-226 903.1 (water)	Reagent/prep blanks	One per preparation batch	Not detected above MRL	Repreparation/reanalysis of entire batch
	MS samples	One per preparation batch	75-125% R	Check LCS, flag results
	Duplicate samples	One per preparation batch	RPD <20	Check analytical system, flag results

Table B-3 Internal QC Checks for Laboratory Analyses (Cont'd)

Parameter	QC Check	Frequencies	Control Limits	Laboratory Corrective Actions
Ra-226 903.1 (cont.)	LCS	One per preparation batch	75-125% R	Represparation/reanalysis of entire batch
Alpha Spectroscopy: Isotopic Uranium Isotopic Thorium DOE HASL 300 (water and soil) Or Radium-226 EPA 9315 (soil) Or Radium-228 (Beta)	Reagent/prep blanks	One per preparation batch	Not detected above MRL	Repreparation/reanalysis of entire batch
	Digestion of soil samples	All samples	Total dissolution digestion with HF	Repreparation/reanalysis of entire batch
	Tracer	Added to all samples	70-120% R	Re-extract and reanalyze samples with tracer %Rs outside criteria
	MS samples	One per preparation batch	75-125% R	Check LCS, flag results
	Duplicate samples	One per preparation batch	RPD <20	Check analytical system, flag results
	LCS	One per preparation batch	75-125% R	Repreparation/reanalysis of entire batch

Note:
Analytical batch defined as maximum of 20 field samples of a similar matrix.
Key:
GC/MS = Gas Chromatography/Mass Spectrometry.
IS = Internal Standard.
LCS = Laboratory Control Standard.
MS/MSD = Matrix Spike/Matrix Spike Duplicate.
MRL = Method Reporting Limit
QC = Quality Control.
RL = Reporting Limit.
%R = Percent Recovery.
RPD = Relative Percent Difference.
RT = Retention Time.
SOP = Standard Operating Procedure.
SF = Sporadic Failure allowance

**Table B-4 Summary of Calibration Frequency and Criterion
Laboratory Analytical Instruments**

Instrument and Method	Calibration Frequency	Calibration Standards	Acceptance Criteria
GC/MS VOCs (water and soil)	Initial: As needed	Minimum 5 standards	CCC %RSD <30 SPCC RFs per method
	Verification: Daily, before sample analysis and every 12 hours	Mid-level standard	CCC %D <20 SPCC RF same as initial
GC/MS VOCs (air)	Initial: As needed	Minimum 5 standards	%RSD <30 (2 exceptions >30% but <40% allowed)
	Verification: Daily, before sample analysis and every 24 hours	Mid-level standard	CCV %D <30
GC/MS SVOCs	Initial: As needed	Minimum of 5 standards	CCC %RSD <30 SPCC RFs per method
	Continuing: Daily, before sample analysis and every 12 hours	Mid-level standard	CCC %D <20 SPCC RF same as initial
GC/ECD PCBs	Initial: As needed	Minimum of 5 standards for Aroclors 1016 and 1260. Minimum of one standard (mid-level) for each of remaining Aroclors.	%RSD ≤20
	Continuing: Before sample analysis, after every 10 samples, and at end of analytical sequence	Mid-level standard of Aroclors 1016 and 1260	%D <15
GC/ECD Chlorinated and Organophosphorous Pesticides	Initial: As needed	Minimum of 5 standards	%RSD ≤20

Table B-4 Summary of Calibration Frequency and Criterion Laboratory Analytical Instruments (Cont'd)

Instrument and Method	Calibration Frequency	Calibration Standards	Acceptance Criteria
GC/ECD Chlorinated and Organophosphorous Pesticides (cont.)	Continuing: Before sample analysis, after every 10 samples, and at end of analytical sequence	Mid-level standard	%D <15
ICP/AES and ICP/MS Metals	Initial: Daily	Initial: Per manufacturer's instructions. Minimum of one standard and calibration blank.	Initial: Per laboratory SOP
	Continuing: Before sample analysis, after every 10 samples, and at end of analytical sequence	Mid-level of each metal	±10% of true value
CVAAS Mercury	Initial: As needed	5 standards plus blank	ICV ±10% of true value r ≥ 0.995
	Continuing: Before sample analysis, after every 10 samples, and at end of analytical sequence	Mid-level	±20% of true value
Formaldehyde	Initial: As needed	5 standards plus blank	%RSD <20
	Continuing: Daily, before sample analysis and every 12 hours	Mid-level	±15% of true value

Table B-4 Summary of Calibration Frequency and Criterion Laboratory Analytical Instruments (Cont'd)

Instrument and Method	Calibration Frequency	Calibration Standards	Acceptance Criteria
Ion Chromatography Anions and Hexavalent Cr	Initial: As needed	Minimum of 3 standards plus blank	ICV ±10% of true value r ≥ 0.995
	Continuing: Beginning and every 10 samples and at the end of analytical sequence	Mid-level	±10% of true value
GC/MS Dioxins/Furans (PCDDs/PCDFs) by SW-846 Method 8290A	Initial: As needed	All 17 native congeners, 12 labeled congeners	RSD ≤20% native congeners RSD ≤30% labeled congeners
	WDM and CCAL at the beginning of the day	WDM: Per method	WDM: All spiked congeners must be present
		Check resolution: HRCC3 at midpoint	HRCC3: ≤20% D native standards: ≤30% D labeled standards
	HRCC3 at end of run or within 12 hours	HRCC3	HRCC3: ≤25% D native standards ≤35% D labeled standards
Ra-226 by Method 903.1	Initial: Efficiency calibration (annual or when daily check not within limits)	NIST Traceable Standards	Standard deviation < 10% of cell constant average
	Verification	NIST Traceable Standards	75-125%R
	Daily: Instrument Performance Check	NIST Traceable Source	Within 2-3 sigma of historical limits

Table B-4 Summary of Calibration Frequency and Criterion Laboratory Analytical Instruments (Cont'd)

Instrument and Method	Calibration Frequency	Calibration Standards	Acceptance Criteria
Ra-226 by Method 903.1 (cont.)	Background count for each Lucas cell to be used before every calibration and verification		Record count for each Lucas cell in a logbook, must be less than 0.267 cpm
Ra-228 by Method 904.0	Annual energy and efficiency calibration	NIST Traceable Standards	Minimum of 10,000 counts
	Daily efficiency calibration check	NIST Traceable Standards	Within 2-3 sigma control limits
	Weekly Background		Within 2-3 sigma control limits
Isotopic Uranium and Thorium by Method HASL 300	Daily Pulser Check (peak centroid, pulser count rate, peak FWHM)	NIST Traceable standards	
	Monthly Efficiency Calibration (energy and efficiency)	NIST Traceable standards	Within 2-3 sigma control limits
Alpha spectrometer Radionuclides by Method HASL 300 and EPA 9315	Daily Pulser Check (peak centroid, pulser count rate, peak FWHM)	NIST Traceable standards	
	Monthly Efficiency Calibration (energy and efficiency)	NIST Traceable standards	Within 2-3 sigma control limits

Table B-4 Summary of Calibration Frequency and Criterion Laboratory Analytical Instruments (Cont'd)

Instrument and Method	Calibration Frequency	Calibration Standards	Acceptance Criteria
Alpha spectrometer Radionuclides by Method HASL 300 and EPA 9315 (cont)	Weekly Background		Within 2-3 sigma control limits

Key:

CCAL = Continuing Calibration
CCC = Continuing Calibration Check
CCV = Continuing Calibration Verification
%D = Percent Difference
GC/ECD = Gas Chromatography/Electron Capture Detector
GC/MS = Gas Chromatography/Mass Spectrometry
HRCC = High Resolution Calibration Solution
ICP = Inductively Coupled Plasma spectrometry
ICV = Initial Calibration Verification
IS = Internal Standard.
LCS = Laboratory Control Standard.
MS/MSD = Matrix Spike/Matrix Spike Duplicate
NIST = National Institute of Standards and Technology
PCBs = Polychlorinated biphenyls
PQL = Practical Quantitation Limit.
QC = Quality Control.
r = correlation coefficient
RL = Reporting Limit
%R = Percent Recovery
%RSD = Percent Relative Standard Deviation
RPD = Relative Percent Difference
RT = Retention Time.
SD = Standard Deviation
SOP = Standard Operating Procedure
SPCC = System Performance Check Compound
TCDD = Tetrachlorodibenzodioxin