FINAL

Quality Assurance Project Plan

San Gabriel Valley/San Fernando Valley Cleanup Program
California Regional Water Quality Control Board
Los Angeles Region
Groundwater Division
Remediation Section

USEPA Cooperative Agreement No. V96983901

Prepared for

California Regional Water Quality Control Board
Los Angeles Region

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Updated February 2015 by

Los Angeles Regional Water Quality Control Board

Disclaimer

The California Regional Water Quality Control Board, Los Angeles Region (RWQCB) Quality Assurance Project Plan (QAPP) is provided as a reference and guidance for RWQCB staff, Facilities within the San Gabriel Valley and San Fernando Valley Superfund Sites, and other interested parties who are performing sampling and analysis activities within RWQCB's jurisdiction. The QAPP does not impose binding requirements and may not apply to every situation or circumstance. RWQCB retains the discretion to adopt technical and quality approaches on a case-by-case basis that differ from this guidance as appropriate and necessary. For RWQCB to consider sites for closure, facilities will need to demonstrate that project work was conducted in accordance with the guidance presented in this QAPP. There may be situations where the QAPP does not provide sufficient technical guidance to meet the project goals. In these cases, project planning will include complete descriptions of all technical approaches and analytical methodologies. The level of detail provided must be equivalent to the level of detail provided in this QAPP. Every planning document shall receive appropriate approvals from RWQCB prior to implementation of field activities. This document is intended to be a living document that will be updated periodically to incorporate new information or technologies as they become available. The most current copy of the QAPP will be maintained at RWQCB's Web site at http://www.waterboards.ca.gov/losangeles/. Users should ensure that they are using the most recent version of the QAPP by checking the link provided for updated materials.

February 2015 Update

This February 2015 version of the QAPP was updated by RWQCB to include the most up-to-date references and guidelines available.

California Regional Water Quality Control Board, Los Angeles Region

Project Title:	Quality Assurance Project Plan (QAPP) for San Fernando Valley/San Gabriel Valley Cleanup Program		
Site Name:	San Fernando Valley and San Gabriel Valley Superfund Sites		
Anticipated Project Dates:	March 2015 through February 2017		
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Contents

Tables

Figures

Appendices

Acronyms and Abbreviations

µg/L	micrograms per liter
CDPH	California Department of Public Health
CFR	Code of Federal Regulations
CrVI	Hexavalent Chromium
CSM	Conceptual Site Model
CUQ	Chemical Use Questionnaire
CWC	California Water Code
DQO	data quality objectives
DTSC	California Department of Toxic Substances Control
ELAP	Environmental Laboratory Accreditation Program
GC/MS	gas chromatography/mass spectrometry
HASP	Health and Safety Plan
ICS	interference check sample
LCS	laboratory control sample
MCL	maximum contaminant level
MDL	method detection limit
MQO	measurement quality objective
MS/MSD	matrix spike/matrix spike duplicate
MTBE	methyl tertiary butyl ether
NDMA	N-nitrosodimethylamine
NPL	National Priority List
PARCC	precision, accuracy, representativeness, comparability, completeness
PCE	tetrachloroethene
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
RPD	relative percent difference

RSD	relative standard deviation
RWQCB	California Regional Water Quality Control Board, Los Angeles Region
SFV	San Fernando Valley
SGV	San Gabriel Valley
SOP	standard operating procedure
SRM	standard reference material
SVOC	semivolatile organic compound
TCE	trichloroethene
TCP	trichloropropane
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WIP	Well Investigation Program

1.0 Introduction

CH2M HILL prepared this Quality Assurance Project Plan (QAPP) for the San Gabriel Valley (SGV) and San Fernando Valley (SFV) Well Investigation Program (WIP) of the California Regional Water Quality Control Board, Los Angeles Region (RWQCB) in September 2008 and was updated by RWQCB in February 2015. As recommended in Title 48 Code of Federal Regulations (CFR) Part 46 and Title 40 CFR Parts 30, 31, and 35, this QAPP was prepared in accordance with the United States Environmental Protection Agency (USEPA) guidelines found in:

- *Guidance for Quality Assurance Project Plans (QA/G-5)*, EPA/240/R-02/009 (USEPA, 2002a).
- *Guidance on Environmental Data Verification and Data Validation (QA/G-8)*, EPA/240/R-02/004 (USEPA, 2002b).
- *Guidance on Systematic Planning Using the Data Quality Objectives Process (QA/G-4)*, EPA/240/B-06/001 (USEPA, 2006a).
- *Uniform Federal Policy for Quality Assurance Project Plans*, A-4A-0095 (USEPA, 2007a).

In addition, the guidance in the following RWQCB documents are included by reference and shall be used as companion documents with this QAPP:

- *Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties* (RWQCB, 2014).
- *Guidance for VOC-Impacted Sites: Soil Screening Levels* (RWQCB, 1996a).
- *Requirements for Groundwater Investigation (*RWQCB, 2000a).
- *Requirements for Subsurface Soil Investigations, (*RWQCB, 2000b).
- *Interim Site Assessment and Cleanup Guidebook* (RWQCB, 1996b).
- *Laboratory Requirements for Soil and Water Sample Analyses* (RWQCB, 2001a).
- *Laboratory QA/QC Requirements for Metal Analyses* (RWQCB, 2001b).
- *Advisory for Active Soil Gas Investigations* (DTSC and RWQCB, 2012).

A description of the QAPP elements in terms of the groupings defined in *Guidance for Quality Assurance Project Plans* (USEPA, 2002a) is presented in Table 1-1. Appendix A contains a series of worksheets that may be used for QAPP planning, preparation, and implementation. The purpose of this QAPP is to present the SGV/SFV WIP guidance for the collection of environmental measurement data within SGV/SFV. The specific objectives of the QAPP are to:

- Identify the purpose of the activities being conducted under RWQCB jurisdiction; define the project quality objectives; and outline the sampling, analytical, and quality

assurance / quality control (QA / QC) activities that will be used to support environmental decisions.

- Identify key project personnel to aid in communication.
- Provide the criteria for the assessment of project implementation and for quality assurance oversight.
- Establish recommended quality levels for each analytical system based on project objectives.
- Establish planning processes to avoid deficiencies that may adversely impact the quality of analytical data produced.
- Provide guidance for data verification, review, validation, and evaluation.
- Define documentation requirements to verify the quality of collected data.

The QAPP provides a basis for project planning, evaluation, and reporting. The QAPP is intended for use by every data collector including RWQCB, facilities, and consultants collecting and reporting environmental data within the SGV / SFV. For the purposes of this QAPP, facilities are defined as dischargers and / or property owners.

TABLE 1-1
Elements of the Quality Assurance Project Plan
Quality Assurance Project Plan, February 2015

Group A Project Management/Data Quality Objectives	QAPP Section	Group B Measurement Data Acquisition	QAPP Section	Group C Assessment/ Oversight	QAPP Section	Group D Data Validation and Usability	QAPP Section
A1 Title and Approval Sheet	Title and Approval Sheet	B1 Sampling Process Design (Experimental Design	Section 3.1	C1 Assessments and Response Actions	Sections 4.1, 4.2	D1 Data Review, Verification, and Validation	Section 5.1
A2 Table of Contents	Table of Contents	B2 Sampling Methods	Section 3.2	C2 Reports to management	Section 4.3	D2 Verification and Validation Methods	Section 5.2
A3 Distribution List	Distribution List	B3 Sample Handling and Custody	Section 3.3			D3 Reconciliation with User Requirements	Section 5.3
A4 Project Task Organization	Section 2.5	B4 Analytical Methods	Section 3.4				
A5 Problem Definition and Background	Sections 2.6, 2.7	B5 Quality Control	Section 3.5				
A6 Project/Task Description	Section 2.8	B6 Instrument/ Equipment Testing, Inspection, and Maintenance	Section 3.6				
A7 Quality Objectives and Criteria	Section 2.9	B7 Instrument/ Equipment Calibration and Frequency	Section 3.6.2				
A8 Special Training/ Certifications	Section 2.10	B8 Inspection/ Acceptance of Supplies and Consumables	Section 3.7				
A9 Documentation and Records	Section 2.11	B9 Non-Direct Measurements	Section 3.8				
		B10 Data Management	Section 3.9				

Source: From *Guidance for Quality Assurance Project Plans* (*EPA QA/G-5*) (USEPA, 2002).

2.0 Project Management

The following sections present the required Group A elements as defined in *Guidance for Quality Assurance Project Plans* (EPA QA/G-5) (USEPA, 2002a). These elements are designated as A1 through A9 and are associated with Sections 2.1 through 2.11.

2.1 QAPP Implementation

This QAPP has been developed to provide a resource for facilities defined as dischargers and property owners for developing work plans that meet RWQCB data quality objectives (DQOs). To aide in the implementation of the QAPP procedures and to streamline the development of acceptable facility work plans, worksheets are included in Appendix A. The intent of these worksheets is to define the minimum information required to develop an acceptable quality plan and should be adapted as necessary to support specific project objectives. The following describes the individual worksheets:

- **Worksheet #1: Title Page, Approval Sheet, and Distribution List:** If a stand-alone QAPP is developed, the QAPP must have a title and approval page with the relevant review and approval signatures. If the QAPP is included as a subsection of the work plan without a separate title page, the title page must include the stamp of a California-registered geologist, or a California-registered civil engineer with at least 5 years of hydrogeologic experience.
- **Worksheet #2: Project Organization and Worksheet #3: Key Personnel, Responsibilities, Qualifications, Contact Information:** Quality planning must have as an output a description of the project organization in the form of an organization chart. The organization chart must show lines of authority and communication for the key stakeholders and project personnel.
- **Worksheet #4: Project Description And Rationale For Sample Collection and Analysis:** This worksheet provides the minimum documentation requirements for the organization of the site background information and the rationale behind the proposed sampling and analysis activities. This worksheet is intended to provide the outputs from the DQO process as supported by the information in QAPP Sections 2.9.1, 3.0, and QAPP Table 2-2.
- **Worksheet # 5: Sample Collection Matrix: T**he sample collection matrix represents a summary of the proposed sampling locations, the general basis for the selection of the proposed locations, and the number and type of samples to be collected.
- **Worksheet #6: Detailed Sampling Plan:** The detailed sampling plan is a listing of each sample to be collected by matrix, analytical method, and sampling method. It serves to summarize the containers, methods, method holding times, field quality control samples including blanks and duplicates, and planned laboratory quality control samples. Supporting information for completing this worksheet may be found in QAPP Section 3.0.

- **Worksheet #7: Required Reporting Limits:** For each analytical method, the target analytes, required reporting limits, and screening levels must be listed. Every effort to achieve reporting limits below the applicable screening levels must be made. Soil samples must be reported on a dry-weight basis, and the effect of dry-weight corrections must be taken into account when setting required reporting limits. An evaluation of the reporting limits compared to the screening levels must be made and documented. For analytes for which there are no methods able to achieve the screening levels, a discussion of the effect of possible data gaps (non-detect results above the screening level) must be presented in the work plan. QAPP Appendix C presents target analyte lists, groundwater screening levels, and suggested reporting limits.
- **Worksheet #8: Test Methods And Data Quality Indicators:** This worksheet organizes the essential project required data quality indicators by analytical method. QAPP Section 2.9.2 and QAPP Appendices B and F present supporting information for the selection of test methods and development of data quality indicators.
- **Worksheet #9: Field Quality Control:** Worksheet 9 summarizes the field quality control samples to be collected. QAPP Section 3.5.1 presents a description of the types of field quality control samples that may be required and the required collection frequency.
- **Worksheet #10: Data Management:** This worksheet presents the required elements to adequately manage field and laboratory information. QAPP Sections 3.3 and 3.9 present supporting information, and Table 3-8 presents the requirements for laboratory data deliverables.
- **Worksheet #11 Data Usability Assessment Procedure:** This worksheet presents the steps that are required to assess the usability and limitations of the collected data. The planning process should include a specific procedure for identifying and resolving suspect data in terms of the project objectives.
- **Worksheet #12 Project Completeness Worksheet:** This worksheet presents quantitative options for calculating project completeness. The work plan must define how project completeness will be calculated and identify the project completeness goal to ensure that sufficient data are available for decision-making.

The worksheets in Appendix A present the minimum elements needed to complete a quality plan and are designed as a guide for preparing a project QAPP or the QAPP section of a facility work plan. The worksheets are not intended to be comprehensive and do not include all required QAPP elements. The QAPP worksheets are limited to elements from Groups A, B, and D (USEPA, 2002a) (see Table 1-1*)* and are focused on those QAPP elements that address sample collection, chemical analysis, data management, and data assessment. Additional worksheets and/or adaptation of these worksheets to meet the needs of specific projects may be required to complete an acceptable planning document.

2.2 Title Page and Approval Sheet

The title page and approval sheet for this document are found on pages i and v, respectively. QAPPs prepared by RWQCB, facilities, and consultants will contain a similar title page with signature blocks for required approvals.

2.3 Table of Contents

The table of contents for this document is found on pages ix through xi of this document. A table of contents is required for every plan prepared and submitted to RWQCB and USEPA.

2.4 Distribution List

The distribution list for this document is presented on page vii. Every planning document prepared by RWQCB, facilities, and consultants shall include a distribution list that includes key stakeholders.

2.5 Project/Task Organization

The following sections provide a description of key project personnel and roles and responsibilities.

2.5.1 Data Collectors and Users

RWQCB, in cooperation with USEPA, has responsibility for implementing state groundwater monitoring and cleanup programs and for protecting the groundwater of California, including the SGV/SFV basins. This QAPP represents a uniform quality system that may be applied to the data collection activities within SGV/SFV. The relationship between data collectors and data users is illustrated in Figure 2-1. (All figures are included at the end of this section).

2.5.2 Project Staff

The project organization chart is presented in Figure-2 2. Each data collection organization is expected to have a documented project organization structure and defined lines of authority. The level of authority given to each key member of the project team, including the authority to initiate and approve corrective actions, should be presented in the facility-specific work plan. The following list presents general descriptions of key USEPA and RWQCB personnel roles and responsibilities for the source investigation activities:

- **USEPA Remedial Project Manager:** The USEPA Remedial Project Manager provides technical input and coordinates with RWQCB's Unit Chief, Project Manager, and Quality Assurance Manager (QAM). Moreover, the USEPA Remedial Project Manager provides support to RWQCB Site Cleanup and Well Investigation Programs in a facility or discharger's site investigation process.
- **RWQCB Unit Chief:** The RWQCB Unit Chief manages and ensures implementation of RWQCB Site Cleanup Program for SGV/SFV Superfund sites. The RWQCB Unit Chief oversees site investigation and corrective actions.
- **RWQCB Project Manager:** The RWQCB Project Manager works closely with RWQCB Unit Chief and is responsible for project planning and project implementation. The RWQCB Project Manager is responsible for managing day-to-day RWQCB activities, including performing site inspections; reviewing technical reports (i.e., site assessment work plans, final reports, remedial action plans, etc.); ensuring that each site-specific site assessment work plan, remedial action plan, etc. has a project Health and Safety Plan

(HASP); incorporating the appropriate and applicable elements of this QAPP prior to the execution of the field activities; and performing overall task coordination. The RWQCB Project Manager has the responsibility for approving facility work plans and for ensuring that facility investigations are conducted in accordance with the approved work plan. RWQCB has the authority to issue a notice of violation, issue stop-work orders, initiate corrective action requests, and approve corrective actions.

- **Facility Project Manager**: The facility Project Manager is responsible for the facility's field activities, including those of consultants. The facility Project Manager will ensure that a facility-specific work plan is prepared that meets the requirements of this QAPP and that the field activities are conducted in accordance with the approved plans.
- **Quality Assurance Manager:** Both RWQCB and the facilities shall identify a QAM who will have responsibility for participating in the planning process, reviewing project plans, and ensuring that the applicable requirements of this QAPP, as supplemented by the facility-specific work plan, are implemented. Historically, the RWQCB QAM is the Project Case Manager. The QAM has the authority to issue stop-work orders, initiate corrective action requests, and approve corrective actions.

2.6 San Gabriel Valley Study Areas

The following sections present a description of the physical characteristics of the study areas, summary of historical investigations conducted within the study areas, and regulatory framework within which further investigations will occur. Figure 2-3 presents the general area locations of the SGV and SFV study areas.

2.6.1 Physical Setting

The SGV study area is located approximately 25 miles from the Pacific Coast in eastern Los Angeles County. The SGV has been the subject of environmental investigation since 1979, when groundwater contaminated with volatile organic compounds (VOCs) was first identified. In May 1984, four areas of contamination within the basin were listed as San Gabriel Areas 1 through 4 on USEPA's National Priorities List (NPL). USEPA subsequently divided the basin into seven hydrogeologic units to assist in identification of contaminant distribution and the planning of future remedial activities. The following sections present a summary of the basin's background, location, physiography, and geology. Figure 2-4 presents a map of the SGV study area with groundwater production and monitoring wells.

The SGV study area encompasses approximately 170 square miles and includes multiple areas of contaminated groundwater. The contaminated areas underlie significant portions of the cities of Alhambra, Arcadia, Azusa, Baldwin Park, Industry, Irwindale, El Monte, La Puente, Monrovia, Rosemead, South El Monte, and West Covina. The groundwater contamination was first detected in 1979. Following this discovery, the California Department of Public Health (CDPH) initiated a well sampling program to assess the extent of contamination. By 1984, when USEPA added four areas of contamination to the NPL, 59 wells were known to be contaminated with VOCs. Four areas of groundwater contamination have been listed in the NPL: San Gabriel Valley Area 1, San Gabriel Valley Area 2, San Gabriel Valley Area 3, and San Gabriel Valley Area 4. Each of the individual areas are divided into Operable Units:

- Area 1 includes the El Monte, Richwood, South El Monte, Suburban Water Systems, and Whittier Narrows Operable Units.
- Area 2 includes the Baldwin Park Operable Unit.
- Area 3 includes the Alhambra Operable Unit.
- Area 4 includes the Puente Valley Operable Unit.

2.6.2 Site Location and Physiography

The SGV consists of several physiographic features. The key feature is the San Gabriel Basin, a broad piedmont plain that slopes gradually to the southwest at a gradient of approximately 65 feet per mile. This structure basin is a natural groundwater reservoir that collects rainfall on the valley floor and run-off from the surrounding highlands, recharging the groundwater aquifers.

2.6.3 Geology

The main San Gabriel Basin is filled with alluvial deposits, primarily of Quaternary age, which overlie relatively impermeable rock. These deposits are 2,000 to 4,000 feet thick over the center of the basin. The deposits are approximately 250 to 800 feet thick at the basin outlet in Whittier Narrows. The sediments distribution and deposition in the basin is controlled by the distance from the sediment source and the position relative to river and tributary courses. Across the Main San Gabriel Basin, the alluvial deposits show a high degree of variability in sediment type both vertically and laterally. This may be a result of the continuous shifting of river and stream courses over distances as great as a few miles.

2.6.4 Hydrogeology

The main San Gabriel Basin comprises approximately 167 square miles of water-bearing valley land. The maximum depth of alluvial fill is unknown, although it is expected to be between 2,000 and 4,000 feet. The estimated total storage capacity of the main San Gabriel Basin is 10.44 million acre-feet; however, because of the great depth of the basin and the subsequent inaccessibility of much of the groundwater, the available supply of the basin is much less. The majority of natural inflow to the main San Gabriel Basin is in the form of surface water, originating as precipitation and entering through stream channels or as overland flow. Subsurface flow crosses into the SGV from the Raymond Ground Water Basin, across the Raymond fault on the northwest, and from the Chino Groundwater Basin on the east.

2.6.5 History

Contamination of the groundwater by VOCs was first detected in 1979 when Aerojet Electrosystems in Azusa sampled wells in the valley County Water District. Following this discovery, CDPH initiated a well sampling program to assess the extent of the contamination. By 1984, 59 wells were found to be contaminated with high levels of various VOCs. The sources of the contamination could be the hundreds of individual sites located throughout the basin. These sites could be potential contributors to the contamination through improper handling and disposal practices. Analyses indicated that many wells within the area did not meet USEPA standards for water quality. The basin's groundwater provides approximately 90 percent of the domestic water supply for over 1 million people

who live in the valley. Over 400 water supply wells are used in the basin to extract groundwater for industrial, business, agricultural, and domestic uses. Forty-five different suppliers of water operate in the basin and provide drinking water to more than 1 million people.

2.7 San Fernando Valley Study Area

The following sections present a summary of the site's physical setting, physiography, geology and hydrogeology. Figure 2-5 presents a map of the SFV study area and groundwater production and monitoring wells.

2.7.1 Physical Setting

The SFV study area is located in Los Angeles County, California and includes the following Areas: Area 1, North Hollywood and Burbank; Area 2, Crystal Springs; Area 3, Verdugo; and Area 4, Pollock. The study area consists of mixed land use, including residential, commercial, industrial, and recreational uses. The majority of the area underlain by contaminated groundwater in the SFV study area is in the industrial corridor that generally follows the Golden State Freeway (I-5) and the railroad rights of way. The population within the SFV study area, based on 2003 census data, is estimated to be approximately 1.1 million.

2.7.2 Site Location and Physiography

The SFV is an inland alluvial valley bordered by high mountain ranges within the South Coastal Basin of California. Permeable alluvial deposits are the predominant valley-fill throughout the SFV study area. The valleys are underlain and surrounded by relatively impermeable rock, forming a structural basin. A complex buildup of coalescing alluvial fans deposited by streams that drain the surrounding mountains and hills is present in the valley fill. Rainfall on the valley floor and runoff from the surrounding high terrain provide the native groundwater recharge that makes the structural basin a natural groundwater reservoir.

The SFV study area is approximately 23 miles long in an east-west direction and approximately half as wide from north to south. Mountains and hills surrounding the valley rise abruptly at the valley edges, while the valley floor slopes gently to the southeast. The change in ground surface elevation is approximately 50 feet per mile in a nearly due south direction.

2.7.3 Geology

The SFV study area is located in the Transverse Ranges province. North-south compression along the San Andreas Fault system has produced trough-shaped basins that are elongated in an east-west direction. The rapid uplift of the mountains relative to the basins has generated sediment that has been deposited in the adjacent basins as alluvial fans. A number of alluvial fans have accumulated at the base of the uplifts surrounding the SFV. Along the western boundary of the SFV, the relatively gentle structural relief of the mountains has resulted in subdued topography and low stream profiles. In comparison, the higher elevations and deeply eroded bedrock of the uplifted mountains along the eastern boundary of the SFV have resulted in steeper stream profiles that contributed relatively coarse-grained sediment to the alluvial fans in the eastern portion of the SFV study area.

Bedrock underlies the valley fill and outcrops in the mountains. It includes pre-Tertiary basement complex igneous and metamorphic rocks and Tertiary and Cretaceous sedimentary rocks. The top of the bedrock is considered the base of the valley fill.

2.7.4 Hydrogeology

The Upper Los Angeles River Area encompasses the entire watershed of the Los Angeles River and its tributaries and comprises four distinct groundwater basins. These four groundwater basins, of which the SFV basin is the largest, are the San Fernando, Sylmar, Verdugo, and Eagle Rock basins. The SFV Basin consists of 112,000 acres and comprises 91.2 percent of the total valley fill. It is bounded on the east and northeast by the San Rafael Hills, Verdugo Mountains, and San Gabriel Mountains; on the north by the San Gabriel Mountains and the eroded south limb of the Little Tujunga Syncline; on the northwest and west by the Santa Susana Mountains and the Simi Hills; and on the south by the Santa Monica Mountains.

Surface and subsurface flow originates as runoff from the hills and mountains, runoff from impervious areas of the valley, industrial and sanitary waste discharges, domestic irrigation runoff, and rising groundwater. Precipitation varies considerably throughout the SFV basin depending on topography and elevation. The mean seasonal precipitation ranges from about 14 inches at the western end of the basin to over 33 inches in the San Gabriel Mountains, with an average of about 17 inches. Approximately 80 percent of the annual rainfall occurs from December through March.

Water-bearing units in the eastern part of the SFV basin are all Quaternary deposits. Tertiary and older units are relatively impermeable compared to the Quaternary units and are considered non-water bearing. Across the study area, the regional topography and the approximate depth to groundwater both slope gradually from the northwest (North Hollywood area) to the southeast (Los Angeles River narrows area). However, the slope of the topography has a steeper gradient compared to the slope of the groundwater, which causes the depth to the water table to be greater in the northern portion of the study area (greater than 200 feet below ground surface in places). In the southeastern portion of the study area, depths to water may be approximately 30 feet below ground surface or less.

2.7.5 History

In 1980, after finding organic chemical contamination in the groundwater of the SFV, the CDPH requested that the major groundwater users conduct tests for the presence of certain industrial chemicals in the water they were serving. The results of the testing revealed VOC contamination in the groundwater beneath large areas of the SFV. The primary contaminants of concern were the solvents trichloroethene (TCE) and tetrachloroethene (PCE), widely used in variety of industries including aerospace and defense, metal plating, machinery degreasing, and dry cleaning.

TCE and PCE have been detected in a large number of production wells at levels that are above the federal maximum contaminant level (MCL), which is 5 micrograms per liter (µg/L) for each of these VOCs. The state of California MCL is also 5 µg/L for TCE and PCE. MCLs are drinking water standards. Other VOC contaminants in the SFV have also been detected above the federal and/or state MCLs. As a result of the groundwater contamination, many production wells have been removed from service. Nitrate, an

inorganic contaminant, has also been detected in the groundwater in the SFV consistently at levels in excess of the MCL of 45 parts per million. Nitrate contamination may be the result of past agricultural practices and/or septic system or ammonia releases.

State and local agencies acted to provide alternative water supplies and to investigate and clean up potential sources. USEPA and other agencies became involved in coordinating efforts to address the large-scale contamination. In 1984, USEPA proposed four sites for inclusion on the Superfund NPL: Burbank and North Hollywood, Glendale/Crystal Springs, Verdugo, and Pollock/Los Angeles. The original boundaries of the sites were based on drinking water well fields that were known to be contaminated by VOCs in 1984. In 1986, the four sites were included on the NPL. USEPA manages the four sites and the adjacent areas where contamination has (or may have) migrated as one large site. USEPA has pursued a more comprehensive approach for the investigation and cleanup of the contamination.

In 1987, USEPA and Los Angeles Department of Water and Power signed a Cooperative Agreement that provided federal funds to perform a remedial investigation of groundwater contamination in the SFV. Since completion of the remedial investigation for the SFV in 1992, USEPA has continued to monitor groundwater contamination through its Basinwide Monitoring Program. The monitoring program consists of quarterly sampling of over 500 groundwater wells located throughout the eastern portion of the valley. Data generated from these sampling events are used to map the extent of TCE, PCE, and nitrate contamination in groundwater as well as chromium contamination.

2.8 Project Task Description

Groundwater cleanup in the SGV/SFV is a partnership between USEPA, RWQCB, the California Department of Toxic Substances Control (DTSC), and CDPH. Under the Superfund program, USEPA must attempt to identify potentially responsible parties to assume responsibility for identification and cleanup of source areas. To meet the ultimate goal of regional groundwater cleanup, existing sources of contamination must be identified and mitigated. Assembly Bill 1803, passed in 1983, required the CDPH to direct the major groundwater users within SGV/SFV to collect samples for VOC analyses. The RWQCB WIP was an extension of the activities mandated in Assembly Bill 1803. The objectives of the WIP were to:

- Identify the sources of chemical contamination in groundwater.
- Assist USEPA with the identification of potentially responsible parties.
- Oversee the cleanup of contaminant sources.

In the late 1980s, RWQCB and USEPA entered into Cooperative Agreements for the SGV and SFV (the SGV agreement ended in 2010). The goals of the agreements were to:

- Accelerate the identification, assessment, and mitigation of groundwater contamination sources in the SFV and SGV Superfund sites.
- Augment the RWQCB's existing source identification program.
- Coordinate and encourage local entities' efforts to identify, assess, and mitigate sources of groundwater pollution.

The WIP has been merged into the Site Cleanup Program. Therefore, the former WIP cases and the RWQCB and USEPA Cooperative Agreement are managed in the Site Cleanup Program.

2.9 Quality Objectives and Criteria for Measurement Data

The following sections provide a description of the development of DQOs and guidance on data quality indicators for measurement data. RWQCB site investigations are tiered and potentially include evaluation of all environmental media. The two types of data that may be collected include:

- Screening level data, which may be used for information on nature and extent of contamination, preliminary investigations, and site characterization.
- Definitive level data, which may be used for all purposes, including site closure and risk assessment.

2.9.1 Data Quality Objectives

The DQO process is the application of systematic planning to generate performance and acceptance criteria for collecting environmental data. The output of the DQO process is a set of qualitative and quantitative statements that describes a data collection activity. Adherence to the DQO process ensures that data of known and appropriate quality support project decisions.

The DQO planning process is the formalization of the normal process of planning, designing, and implementing environmental data collection activities. The output of the DQO process is a detailed sampling and analysis strategy. The relationship between the DQO process and the normal project lifecycle is illustrated in Table 2-1. (All tables appear at the end of this section.) The DQO process consists of determining what information is needed, why it is needed, how it will be used, and who will use it. The DQO process:

- Evaluates different sampling approaches based on cost and resource constraints.
- Selects the most cost-effective monitoring approach that will meet the needs of the ultimate data user.
- Determines specific sampling and laboratory methodology requirements.

The DQO process will facilitate data collection activities and will yield data meeting the needs of the user as defined in *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, EPA/240/B-06/001 (USEPA, 2006a).

As defined in the above reference, the DQO process includes the following steps:

- Define Problem Statement.
- Identify the Goal of the Study.
- Identify Information Inputs.
- Define the Boundaries of the Study.
- Develop Analytic Approach.
- Specify Performance or Acceptance Criteria.
- Develop the Detailed Plan for Obtaining Data.

Additional guidance that may be helpful in developing project specific DQOs includes *Systematic Planning: A Case Study for Hazardous Waste Site Investigations*, EPA/240/B-06/004 (USEPA, 2006b).

Development of project DQOs is an iterative process and should reflect a common-sense approach to environmental data collection and analysis. RWQCB anticipates that the general types of activities or steps that will be conducted using this QAPP will include, but will not be limited to:

- Initial site investigation.
- Site characterization.
- Remedial actions and site cleanup.
- Site closure.

Figure 2-6 illustrates the outputs of the DQO process as it relates to site cleanup within RWQCB jurisdiction. Table 2-2 presents considerations for the development of DQOs for RWQCB data collection activities. Project-specific DQOs following the guidance contained in this QAPP, and associated references must be included in project-specific planning documents for review and approval by RWQCB.

2.9.2 Data Quality Indicators

The QAPP includes data quality indicators for identified chemicals of potential concern and for emerging chemicals of concern. The overall quality assurance objective for sampling data is to ensure that the data generated are of sufficient quality for the intended data end uses. To achieve these objectives, data will be:

- Representative of actual site physical and chemical conditions.
- Comparable to other studies, where appropriate.
- Complete to quantitative statistical significance in terms of precision and accuracy, at levels appropriate for each stated data use for the project.

Data quality is assessed based on comparability and representativeness and the quantitative parameters precision, accuracy, completeness, and sensitivity.

The data quality indicators presented in this QAPP are designed to be the minimum standard for assessment of precision, accuracy, representativeness, comparability, completeness (collectively known as the PARCC parameters) and sensitivity. Descriptions of these characteristics are provided in Table 2-3, and definitions of the quantitative PARCC parameters are presented in Section 5.3. Worksheet #8 in Appendix A should be used to capture laboratory quality control requirements for each project. Tabulated precision and accuracy requirements presented in Appendix B should be observed unless otherwise defined by a project-specific QAPP.

In addition to the PARCC parameters, sensitivity is essential to the production of usable and defensible environmental data. Sensitivity is established by the determination of the method detection limit (MDL), which is the minimum amount of material the method is capable of distinguishing from inherent system noise.

The MDL is formally defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The MDL shall be determined by the analysis of a blank matrix containing a known amount of target analyte at a concentration no greater than five times the expected MDL. A minimum of seven replicates are analyzed, and the standard deviation of the replicate measurements is calculated as follows:

$$S = \sqrt{\frac{\sum_{i=1}^{n}\left(X_i - \overline{X}\right)^2}{n-1}} \qquad (1)$$

where:

i = 1…n
n = 7

To obtain the MDL using seven replicate analyses, the standard deviation is multiplied by the t-value of 3.143 for seven replicates at the 99 percent confidence level.

Once the MDL has been established, the practical quantification limit may be calculated. The practical quantification limit is the lowest concentration that can be accurately quantitated within specified limits of precision and accuracy during routine laboratory operating conditions. Generally, the practical quantification limit should be established as two to five times the MDL. In addition, to the extent possible, required reporting limits must be below the applicable screening levels, which may include MCLs, preliminary remediation goals (USEPA, 2004a), or other media-specific limits.

The list of target analytes presented in this QAPP is intended to be comprehensive based on current knowledge but is not to be considered exhaustive. If other chemicals of concern are identified in the future, the data collectors are expected to develop, apply, and document an equivalent set of data quality indicators for each project target analyte.

Sample collection and analysis will use standard methodologies described in this QAPP. The sources of methods include, but are not limited to, the documents listed in Sections 2.9.2.1 and 2.9.2.2.

2.9.2.1 Sample Collection Guidance Documents

- *Practical Guide for Groundwater Sampling* (USEPA, 1985).
- *RCRA Groundwater Monitoring Technical Enforcement Guidance Document* (USEPA, 1992a).
- *Guidance for Performing Site Inspections under CERCLA* (USEPA, 1992b).
- *Guidance for VOC-Impacted Sites: Soil Screening Levels* (RWQCB, 1996a).
- *Interim Site Assessment & Cleanup Guidebook* (RWQCB, 1996b).
- *Soil Screening Guidance: User's Guide* (USEPA, 1996c)
- *Requirement for Groundwater Investigation (*RWQCB, 2000a).
- *Requirement for Subsurface Soil Investigations (*RWQCB, 2000b).

- *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (USEPA, 2002)
- *Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties* (Cal/EPA, 2005).
- *Guidance for The Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (DTSC and Cal/EPA, 2011).
- *Advisory - Active Soil Gas Investigations* (DTSC and RWQCB, 2012).

2.9.2.2 Sources of Analytical Methods

- *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, (USEPA, 1983)
- *Compendium of Method for the Determination of Toxic Organic Compounds in Ambient Air*, Second Edition, EPA 625/R-96/010b (USEPA, 1999)
- *Requirements for Groundwater Investigations* (RWQCB, 2000a)
- *Requirements for Subsurface Soil Investigation* (RWQCB, 2000b)
- *Requirements for Subsurface Investigations* (RWQCB, 2000c)
- *Laboratory Requirements for Soil and Water Analyses (*RWQCB, 2001a)
- *Laboratory QA/QC Requirements for Metal Analyses* (RWQCB, 2001b)
- *General Laboratory Testing Requirements for Petroleum Hydrocarbon Impact Sites* (RWQCB, 2006a)
- *Standard Methods for Examination of Water and Wastewater,* 21st Edition (APHA/AWWA/WPCF, 2006b)
- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, EPA SW-846, *3rd Edition, Office of Solid Waste and Emergency Response Revision 6* (USEPA, 2007)

A discussion of analytical methods is presented in Section 3.4. Appendix C presents the sensitivity requirements for selected analytical methods. Facility-specific work plans shall provide the same level of detail for every proposed analytical test method. Alternative methods and/or data quality indicators may be proposed in the facility-specific Work Plan, subject to review and approval by the responsible entity. Unless otherwise specified, the default project completeness goal is 90 percent; that is, 90 percent of the information planned must be collected and must be usable based on the planned specifications for the completeness goal to be satisfied.

2.10 Special Training Needs/Certification

In addition to the training provided by equipment manufacturers, appropriate personnel working in the field or in the laboratory will hold current certifications that indicate that they have received training in accordance with requirements specified in Title 29 CFR 1910.120 (Occupational Safety and Health Administration), or other regulatory specified training/certification requirements. Training records for these personnel will be kept and be submitted upon request by RWQCB or USEPA.

A site-specific HASP should be prepared by the facility and should be available onsite during fieldwork. The HASP will define the project's minimum health and safety requirements and will designate protocols to be followed for the field operation to comply with state and federal health and safety requirements. Each facility's health and safety personnel will maintain documentation and records that verify training and/or certification for their employees and contractor/consultant employees working at each facility. These records will be made available upon request.

2.11 Documentation and Records

The types of documentation and records that will be produced and managed according to the specification in this QAPP include:

- Field documentation.
- Analytical data.
- Facility-specific work plans.
- Reports of data collection activities.

Project records must be maintained by data collectors in an organized, auditable, legally defensible manner. The requirements for field documentation are presented in Sections 3.3.2 and 3.3.3, and analytical data reports are presented in Section 3.4. The following sections present the requirements for control of project records and for the contents of facility-specific work plans.

2.11.1 Documentation Control

Project documentation must be controlled in a manner to ensure use of the most current version of plans and associated instructions, such as standard operating procedures (SOPs). Maintaining document control procedures is the responsibility of each data collector. An established system to track revisions to documentation is required to ensure that the most recent version of a project plan is used. Each work plan will include a description of how revisions to the project planning documents will be tracked and how original and revised documents will be distributed to appropriate project personnel. Depending on the project, documents that may require systematic tracking may include safety equipment, logbooks, field data records, correspondence, sample tags, graphs, chain-of-custody records, field and laboratory bench sheets, photographs, and other project-specific information. The current version of this QAPP will be maintained on the RWQCB Web site at the following link: http://www.waterboards.ca.gov/losangeles/. Data collectors using this QAPP are expected to verify that they are using the most recent version of the QAPP.

2.11.2 Facility-specific Work Plan

The facility-specific work plan will contain sufficient QA/QC specifications to ensure that the information collected meets the project objectives. Table 2-4 presents the quality elements to be included in the facility-specific work plan. As required by Resolution No. 92-49, under California Water Code (CWC) Section 13304 and the California Business and Professions Code Sections 6735, 7835, and 7835.1, facility-specific work plans must be signed and stamped by a registered professional.

TABLE 2-1
Relationship between Project Lifecycle and Data Quality Objectives
Quality Assurance Project Plan, February 2015

General Project Planning	Related DQO	QAPP Element
Assemble the project team.	Step 1: Define the problem.	Part A: Project Organization
Identify project schedule, resources, milestones, and requirements.	Step 1: Define the problem.	
Describe project goal and objectives.	Step 2: Identify goal of the study.	
Identify types of data needed.	Step 3: Identify information needed for the study.	
Identify the physical, logistical, schedule-driven, or monetary obstacles to project implementation and completion.	Step 4: Define the boundaries of the study.	
Determine the number and type of samples that will attain the project goal.	Step 5: Develop the analytical approach. Step 6: Specify performance or acceptance criteria. Step 7: Develop a plan for obtaining data.	Part B: Data Generation and Acquisition Part C: Assessment and Oversight
Describe the methods for data analysis, evaluation, and assessment against the intended use of the data.		Part D: Data Validation and Usability

TABLE 2-2
Data Quality Objectives
Quality Assurance Project Plan, February 2015

Data Quality Objective	General Considerations	DQO Statement
Problem Statement	Describe the problem, develop a conceptual site model (CSM) of the environmental hazard to be investigated, and identify data gaps.	Groundwater contamination has been detected within SGV and SFV Superfund sites that pose a risk to human health and the environment. The objectives of this project are to identify sources of VOCs, chromium, hexavalent chromium, heavy metals, and emergent chemicals that are or may contribute to further degradation of human health and groundwater quality. Information, including chemical data, that may be collected includes: • Historical and current chemical usage within SGV and SFV Superfund sites. • Facility inspection reports and action recommendations. • Preliminary facility source investigations. • Further investigations, remediation, and site closure activities.
	Establish a planning team and identify the team decision-makers.	The primary decision makers are RWQCB in cooperation with USEPA, Region 9. Included in the planning team are the subject facilities, DTSC, CDPH, and the Office of Environmental Health Hazard Assessment.
	Discuss alternative approaches to investigating and solving the problem.	The approach to resolving the fundamental problem of soil and groundwater contamination within the SGV and SFV is complex and requires individualized solutions applicable to specific sources as each source is identified. The generalized approach, as implemented by RWQCB, is to submit a chemical use questionnaire (CUQ), and based on the CUQ information, perform a site inspection, determine if source(s) may exist and, if so, implement an investigation. If no source is identified, sites may be closed, otherwise, the results of the investigation will dictate follow-up actions. Follow-up actions include: • Evaluation of subsurface contamination through collection of soil and soil vapor samples. • Remediation and source removal. • Further evaluation of soil-vapor intrusion including evaluation of risk. • Evaluation of impact to groundwater by installation and sampling of source area groundwater monitoring wells. • Evaluation of nature and extent of groundwater by installation and sampling of facility-specific groundwater monitoring wells.
	Identify available resources, constraints, and deadlines associated with planning, data collection, and data assessment.	These issues will be itemized in the DQOs prepared by the facility and documented in the facility-specific Work Plan. The facilities are expected to adopt the requirements of this QAPP as appropriate; where the requirements negatively impact resources, deadlines, and/or technical project considerations, alternate approaches may be proposed and must be detailed in the facility-specific work plan for approval by RWQCB.

TABLE 2-2
Data Quality Objectives
Quality Assurance Project Plan, February 2015

Data Quality Objective	General Considerations	DQO Statement
Identify the Goal of the Study	Identify principle study question and define alternative actions that may be taken based upon the range of possible outcomes that result from answering the principle study question.	The principle study question: is a source present at a facility? The outcomes from answering the study questions range from no action to remediation and continued monitoring. Site closure is the ultimate goal of the RWQCB source identification program.
	Use the principle study question and alternative actions to make either a decision statement or estimation statement.	The principle study question that the RWQCB source identification program seeks to answer is: • Does a source exist? • Does the source pose a threat to human health and the environment? • Is there an immediate negative impact to groundwater? The identification of a source and the evaluation of potential impact will be made based on comparison of measurement data with a fixed reference. Applicable reference standards include but are not limited to state and federal MCLs, preliminary remediation goals, environmental screening levels, and California Human Health Screening Levels.
	Prioritize multiple decisions.	The organization of multiple decisions is illustrated in Figure 2-6.
Identify Information Inputs	Identify types and sources of information.	The types of information that are needed include but are not limited to: • Historical records of chemical usage and environmental reports. • Chemical use questionnaire. • Visual site inspections. • Soil-vapor survey results. • Additional analytical results from previous investigations, remediation activities, monitoring, and site closure activities.
	Identify the basis of information that will guide or support choices to be made.	Decisions will be made on the basis of information that meets the specifications of the QAPP and the project-specific facility work plans. In general, decisions will be made using data of known and documented quality and that meet the project goals in terms of sensitivity. Data that are determined to be suspect and/or are determined to contain significant bias leading to false positives or false negatives will not be used.
	Select appropriate sampling and analysis methods for generating the information.	Common sampling and analysis methods are presented in this QAPP. Other USEPA-approved methods may be used as needed but must be documented in the facility-specific work plan. Furthermore, facilities that propose the use of non-standard, alternative methods must submit such a proposal in writing on the requestor's letterhead to the RWQCB's Executive Officer for review and approval prior to using the methods.

TABLE 2-2
Data Quality Objectives
Quality Assurance Project Plan, February 2015

Data Quality Objective	General Considerations	DQO Statement
Define the Boundaries of the Study Develop Analytic Approach	Define target population of interest and relevant spatial boundaries.	The target populations of interest are soil gas, soil, and groundwater. The spatial boundaries are the boundaries of the subject facilities. (Note: if contamination is determined to have migrated offsite, then a facility will be required to complete offsite assessment and remediation to the satisfaction of RWQCB.) Vertically, the boundaries extend from ground surface to underlying or first encountered groundwater.
	Define what constitutes a sampling unit.	A sampling unit is a discreet matrix specific sample collected at a single x, y, and z coordinate.
	Specify temporal boundaries and other practical constraints associated with sample/data collection.	The temporal boundaries and other practical constraints associated with sample/data collection will be specified in the site specific work plans.
	Specify smallest unit on which decisions will be made.	Decisions will be made on individual sample results.
	Specify the value that will be used for decision making (e.g., mean or discreet sample value).	Because individual facilities generally cover limited areas and a relatively small number of samples will be collected, decisions will generally be made based on individual sample results. For small data sets, maximum values may be used for decision-making. Where sufficient data are available, average concentrations may be used for decision making. The type of information that will be used for decision making will be detailed in the facility-specific work plan.
	Generate an “If…then…” statement.	If, based on the information available regarding the usage and presence of chemicals at a facility, there exists a potential threat to human health and groundwater, RWQCB will require development of investigation, monitoring, remediation, and/or closure strategies as appropriate.

TABLE 2-2
Data Quality Objectives
Quality Assurance Project Plan, February 2015

Data Quality Objective	General Considerations	DQO Statement
Specify Performance or Acceptance Criteria	Determine the baseline condition, the alternative hypotheses, and estimate the acceptable error.	The baseline condition is represented by a facility where there is no potential threat to human health or impact to groundwater quality based on past or present chemical usage. If this baseline condition is fulfilled, no further action can be recommended. The alternative hypothesis is represented by a facility where there is a potential threat to human health or impact to groundwater quality based on past or present chemical usage, and further investigation is required. An estimate of acceptable error will be documented in the facility specific work plan. In general, the most serious type of error is accepting a false negative result (Type II error); that is, concluding that the site is free of contamination when it is not. The chance of making this type of error is mitigated by establishing analytical reporting limits below the project screening levels. The less critical error is accepting false positive results (Type I error); that is, concluding contamination is present when in fact it is not. Accepting a false positive result may result in increased clean-up costs, but will support conservative decisions that are protective of human health and the environment. In all cases, data should be scrutinized, for error or bias especially when unanticipated results, either detects or non-detects, are obtained.
Develop the Detailed Plan for Obtaining Data	Compile information developed in Steps 1-6.	The plan for obtaining data including sampling rationale, identification of target analytes, and matrix is facility specific and will be presented in the site-specific work plan, as described in Section 3.0 of this QAPP. Each facility-specific work plan will be reviewed by RWQCB. RWQCB is responsible for approval of acceptable work plans following review.
	Identify the possible sampling designs that meet the project requirements.	
	Select and justify the most appropriate sampling design.	

TABLE 2-3
Description of PARCC Parameters
Quality Assurance Project Plan, February 2015

Parameter	Evaluation Criteria
Qualitative PARCC Parameters	
Comparability	Expression of the measure of confidence that one data set can be compared to another and that the two data sets may be combined for a decision to be made.
Representativeness	The degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition (ANSI/ASQC, 1995).
Quantitative PARCC Parameter	
Precision	The measure of agreement between replicated measurements of the same property under identical or nearly identical conditions.
Accuracy	The degree to which a measurement agrees with a true value.
Completeness	The amount of valid usable data (in terms of project objectives) compared to the total amount of data collected or planned.

TABLE 2-4
Quality Elements to be Included in Facility-specific Work Plan
Quality Assurance Project Plan, February 2015

Element	Description
Introduction	Includes the purpose of the data collection activity, a description of the facility, the type of data collection activity, the regulatory basis and/or involvement, description of historical chemical usage.
Summary of Previous Investigations	Describes previous investigations, the primary data collectors, how the results of these investigations support the need for further investigation, and includes a summary of historical results by media.
Data Quality Objectives	See QAPP Sections 2.9 and 5.0.
Data Quality Indicators	Includes qualitative and quantitative descriptions of precision, accuracy, representativeness, comparability, and completeness. See QAPP Section 2.9.
Pre-mobilization and Mobilization Activities	Includes information on permitting, traffic control, hazardous/investigation derived waste management plan, as appropriate; provides an overall schedule for the project.
Sampling Rationale by Media	Describes and presents the technical rationale for each sample collection location (including depth) and the type of sampling methodology to be used; describes how data will be used to support environmental decisions; includes a summary table of sample by type, matrix, and frequency; the target analyte class, and location along with detailed tables of individual planned samples.
Field Methods	Includes applicable construction details, field screening methods, equipment decontamination procedures, well installation etc. Additionally, soil boring logs will be described and how soil samples will be logged and examples of field method sheets and logs.
Sampling Collection Methods	Presents sample naming convention; includes media specific collection techniques for primary and duplicate samples. An example of the field chain of custody will be discussed and presented.
Laboratory Requirements	Includes requirements for laboratory certifications and identification of proposed subcontract laboratories. An example of the laboratory report and how laboratory data will be flagged and the protocol for analyses that are determined to be suspect (i.e., sample analyzed outside of a method's hold time).
Analytical Methods	Lists the preparation and analytical methods with holding times and container and preservation requirements; lists the target analytes with reporting limits and required data quality indicators; includes calibration and corrective action requirements for each method.
Data Verification	Provides a description of the review process for field documentation; provides requirements for laboratory data review and reporting; provides requirements for project level data review, verification, and reconciliation with project objectives; describes the procedure for flagging results that do not meet the project objectives.
Data Management	Provides a description of the flow of project information from sample collection to final report submission.
Reporting	Includes a description of the contents of the Final Report.
References	List of references cited in plan

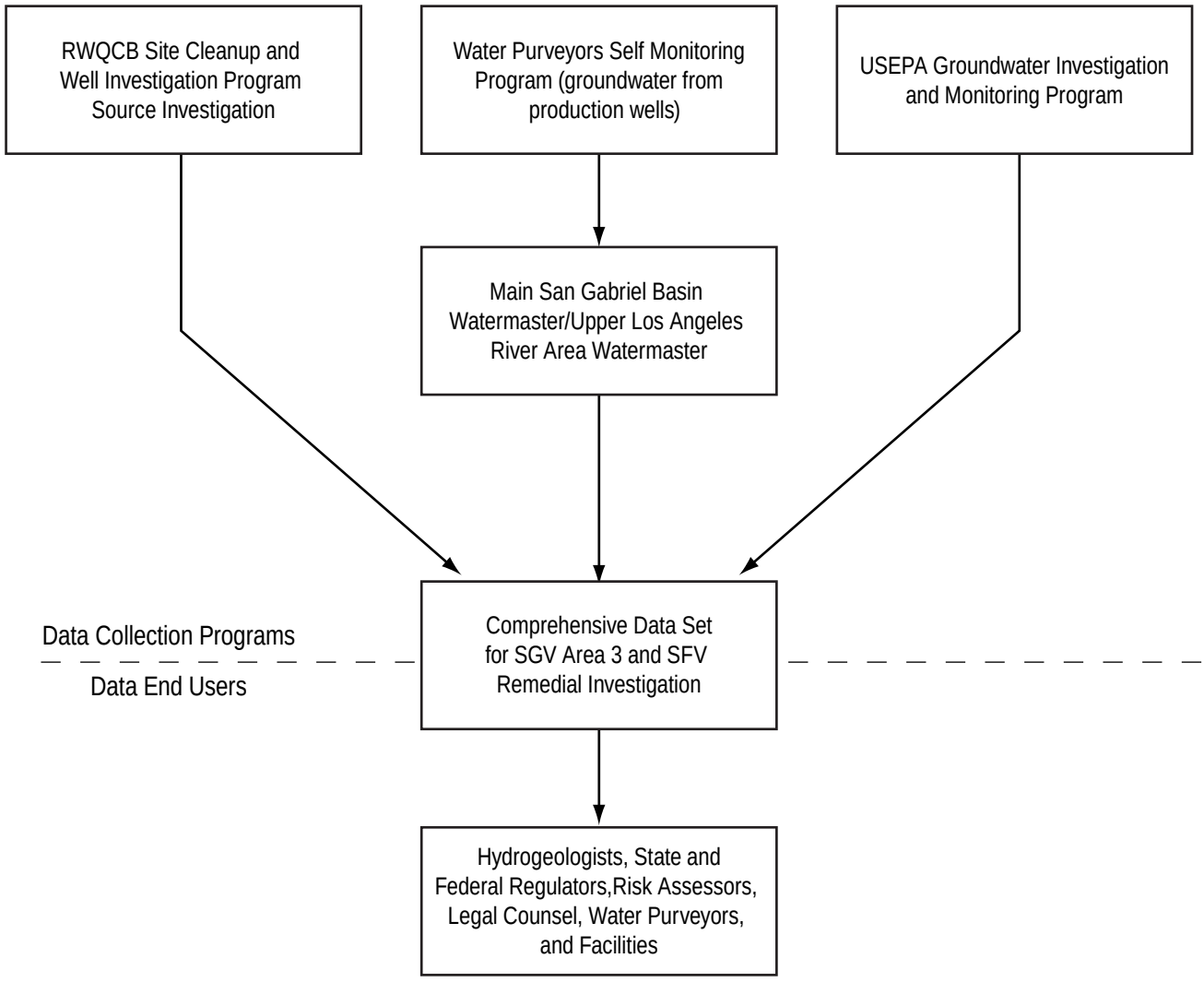


FIGURE 2-1
Data Collectors and Users
RWQCB Quality Assurance Project Plan
September 2008

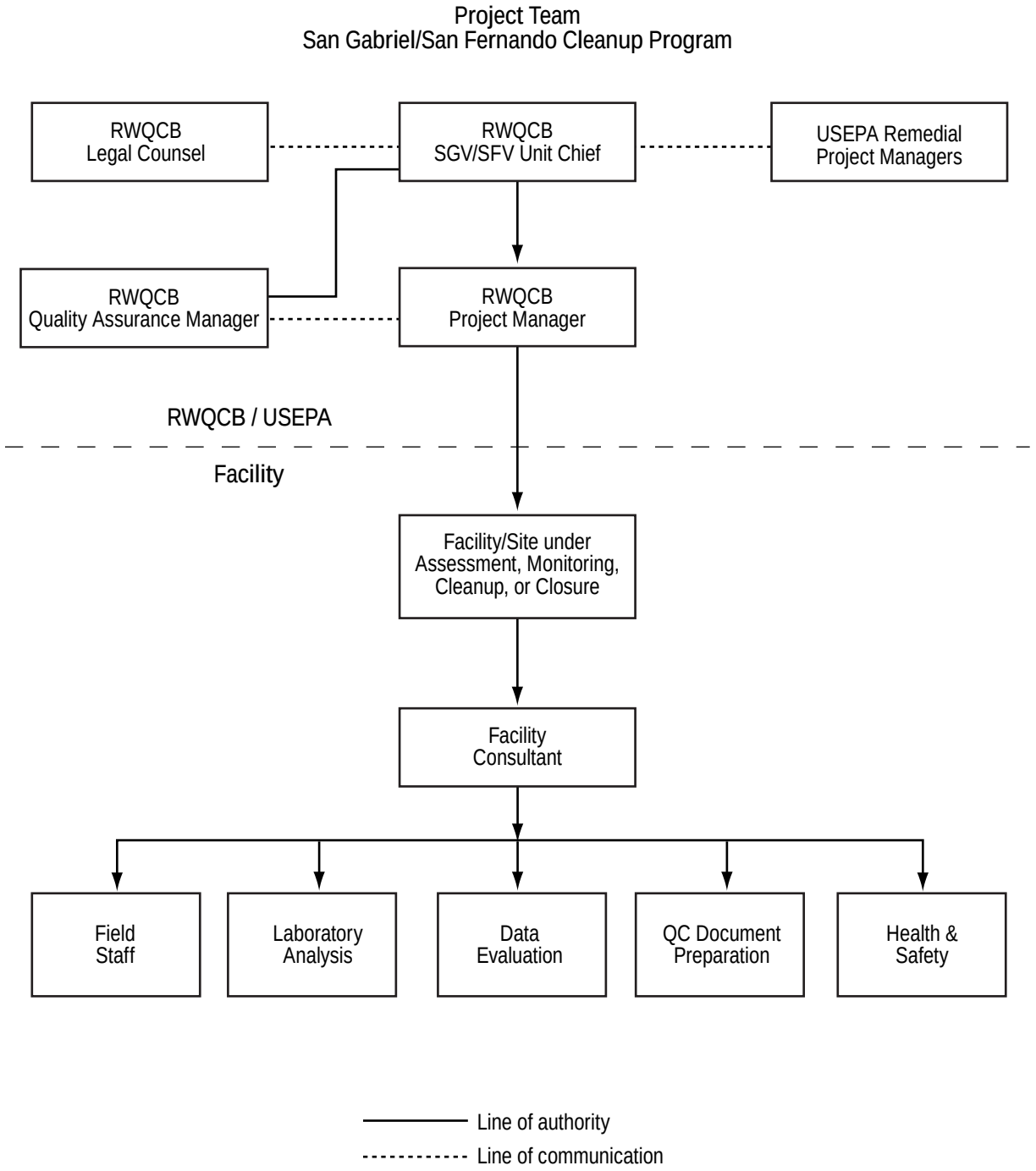


FIGURE 2-2
Project Organization
RWQCB Quality Assurance Project Plan
September 2008

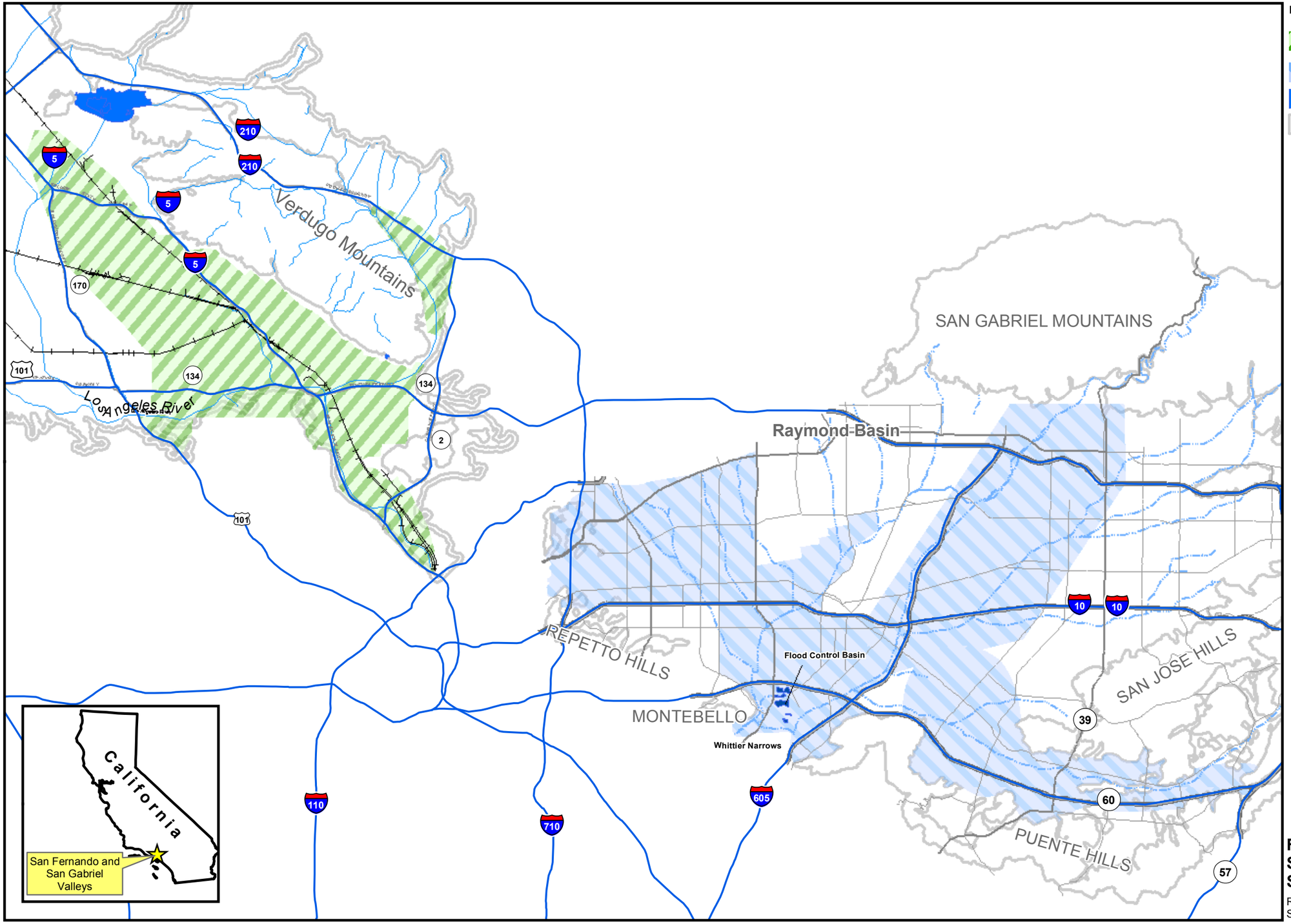


FIGURE 2-3
SAN FERNANDO AND SAN GABRIEL STUDY AREAS
RWQCB QUALITY ASSURANCE PROJECT PLAN, SEPTEMBER 2008

Raymond Basin

Raymond Fault

NPL AREA 3

AREA 3 OU

EL MONTE OU

BALDWIN PARK OU

NPL AREA 2

NPL AREA 1

SOUTH EL MONTE OU

Flood Control Basin
Whittier Narrows

WHITTIER NARROWS OU

NPL AREA 4

PUENTE VALLEY OU

Whittier Narrows

REPETTO HILLS

MONTEBELLO HILLS

SAN JOSE HILLS

PUENTE HILLS

W CHESTNUT AV
HUNTINGTON DR
W HUNTINGTON DR
FOOTHILL BLVD
MISSION ST
S SAN GABRIEL BLVD
ROSEMEAD BLVD
BALDWIN AV
S SANTA ANITA AV
MYRTLE AV
I 605
SAN GABRIEL AV
N GRAND AV
W ALOSTA AV
E ALOSTA AV
S GRAND AV
S SUNFLOWER AV
E LIVE OAK AV
LAS TUNAS DR
E LAS TUNAS DR
ARROW HWY
S CITRUS AV
VINCENT AV
AZUSA AV
W BADILLO ST
E BADILLO ST
N CITRUS AV
GARFIELD AV
E MAIN ST
W MAIN ST
HUNTINGTON DR S
S DEL MAR AV
S ATLANTIC BLVD
E VALLEY BLVD
W VALLEY BLVD
VALLEY BLVD
SANTA ANITA AV
RAMONA BLVD
N DUREE AV
N NEW AV
DEL MAR AV
GARVEY AV
S GARFIELD AV
HILL DR
WALNUT CREEK
S GLENDORA AV
AVACADO CREEK
PUENTE CREEK
SAN JOSE CREEK
N MONTEBELLO BLVD
N HACIENDA BLVD
AMAR RD
E AMAR RD
S NOGALES ST
N AZUSA AV
S AZUSA AV
E TETLEY
E COLIMA RD
S COLIMA RD
HACIENDA
E PATHFINDER
E VALLEY BLVD
HOLT AV
VIA

710 10 605 60 39

LEGEND

- **AREA 3 OU** — Operable Unit Name
- **NPL AREA 3** — National Priorities List (NPL) Area/San Gabriel Valley Superfund Site Name
- Production Well
- Monitoring Well
- Approximate area of San Gabriel Superfund Site
- Lakes
- Bedrock

N

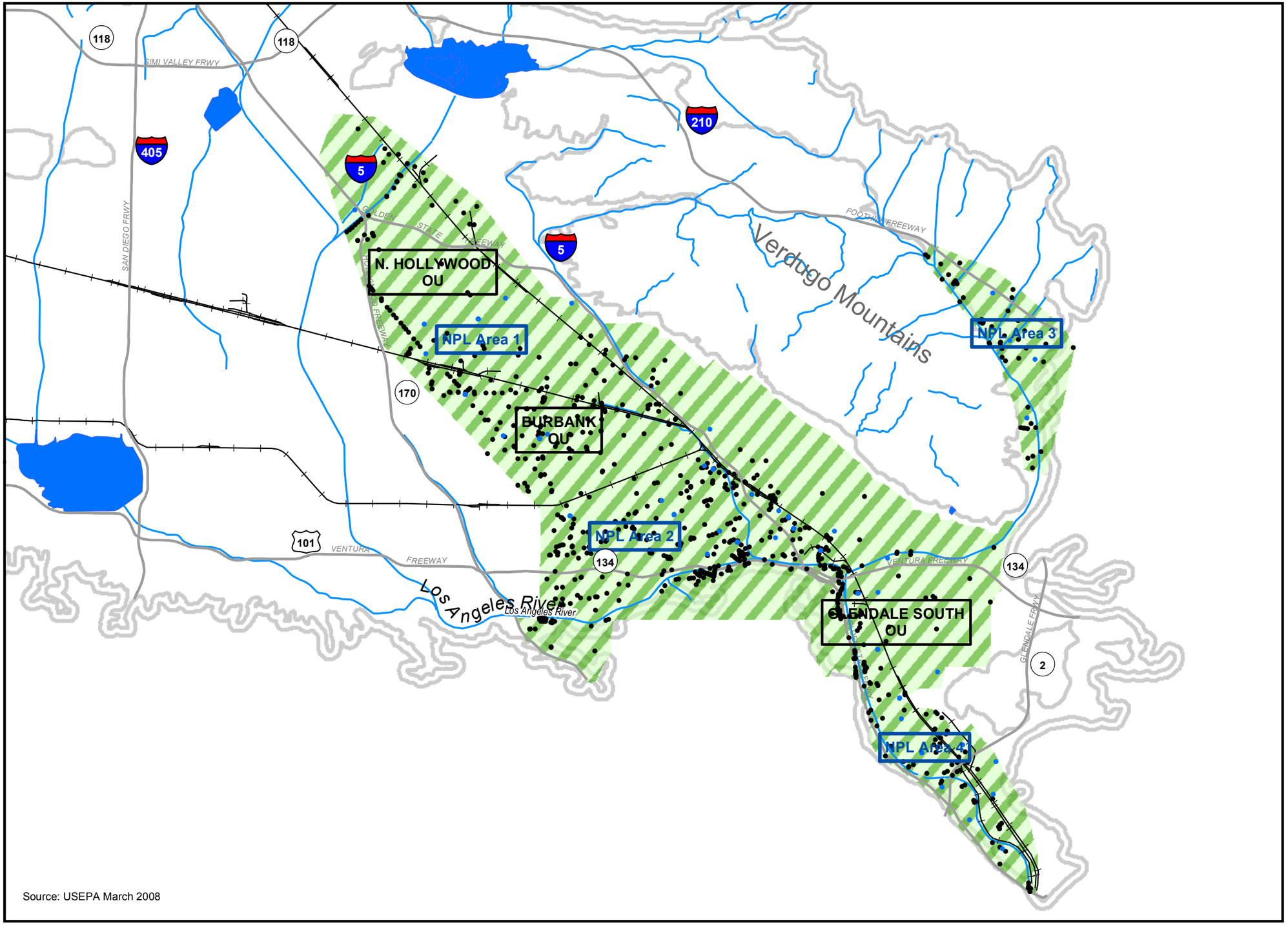
0 0.75 1.5 3

Miles

Source: USEPA March 2008

FIGURE 2-4
SAN GABRIEL VALLEY STUDY AREA
RWQCB QUALITY ASSURANCE PROJECT PLAN, SEPTEMBER 2008

SFO \\CABLECAR\PROJ\USEPA\COMMONFILES\EPASFV\GIS\MAPFILES\2008\OU_LOC_MAP_SGV.MXD OU_LOC_MAP_SGV.PDF 9/8/2008 15:24:12



Source: USEPA March 2008

LEGEND

- Area 1 OU — Operable Unit Name
- NPL Area 1 — National Priorities List (NPL) Area/ San Fernando Valley Superfund Site Name
- Production Well
- Monitoring Well
- Lakes
- Approximate area of San Fernando Superfund Site
- Bedrock

N

0 0.5 1 2 Miles

FIGURE 2-5
SAN FERNANDO VALLEY STUDY AREA
RWQCB QUALITY ASSURANCE PROJECT PLAN, SEPTEMBER 2008

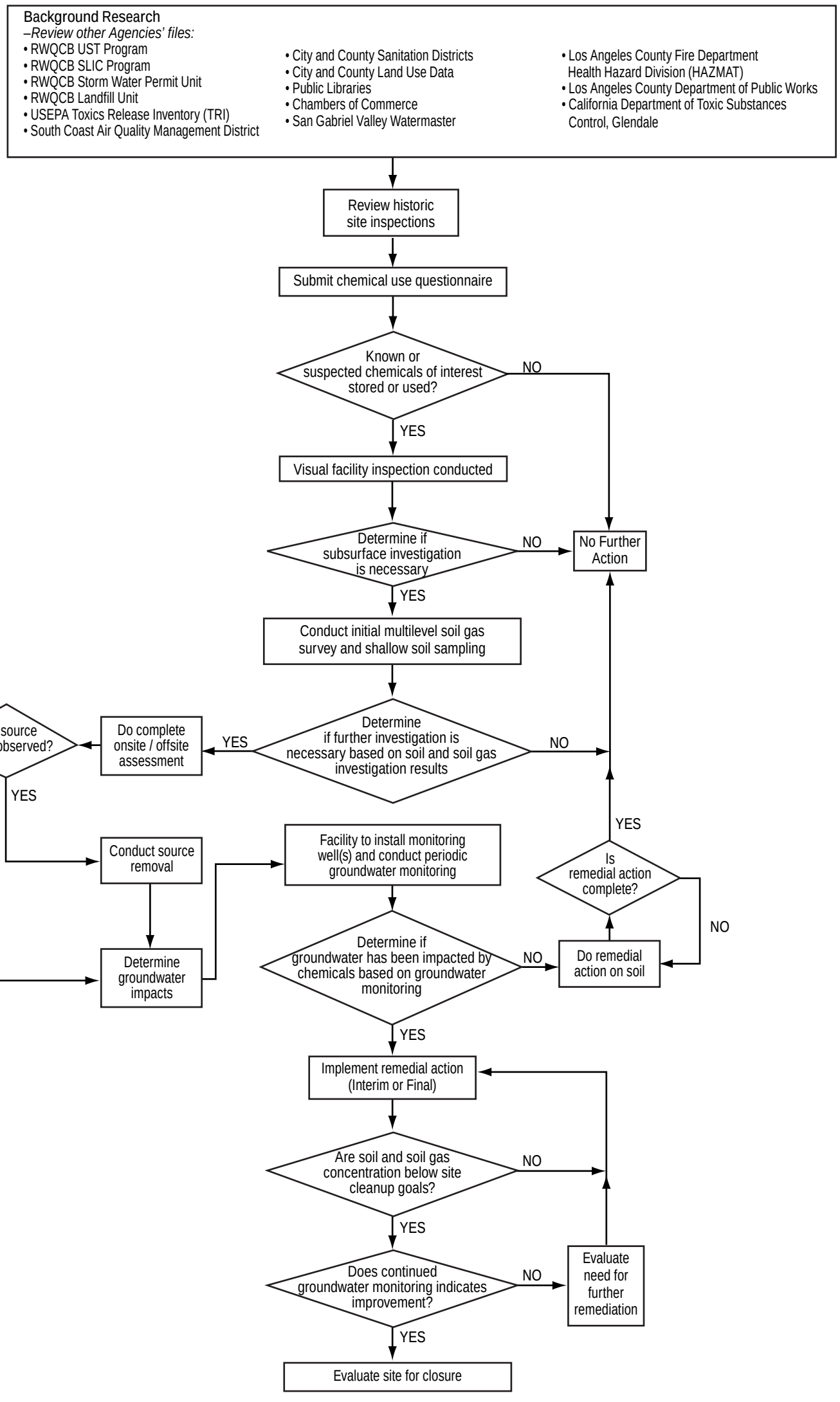


FIGURE 2-6
Decision Tree Flow Diagram for
Site Assessment, Monitoring, Cleanup, and Closure
RWQCB Quality Assurance Project Plan
September 2008

3.0 Data Generation and Acquisition

The following sections conform to the required Group B, Measurement and Data Acquisition, elements as presented in *Guidance for Quality Assurance Project Plans*, EPA QA / G-5 (USEPA, 2002a).

This section includes requirements for developing a sampling process design, as well as field health and safety, field methods, and laboratory methods requirements. This section also presents the minimum requirements for sampling of groundwater, soil, soil-gas vapor, and investigation-derived wastes and the requirements for equipment decontamination and preparation of field quality control samples. RWQCB requires that:

> *All work must be performed in accordance to State Water Resources Control Board Resolution No. 92-49, under CWC Section 13304, which states that all fieldwork related to implementing the required Work Plan (technical report) such as soil borings, soil gas borings, and/or well installation(s) must be conducted by, or under the direct responsible supervision of, a registered geologist or licensed civil engineer. All technical documents submitted to this Regional Board must be reviewed, signed and stamped by a California registered geologist, or a California registered civil engineer with at least five years hydrogeologic experience. Furthermore, the California Business and Professions Code Sections 6735, 7835, and 7835.1 require that engineering and geologic evaluations and judgments be performed by or under the direction of registered professionals. Therefore, all future work must be performed by or under the direction of a registered geologist or registered civil engineer. A statement is required in the report that the registered professional in responsible charge actually supervised or personally conducted all the work associated with the project.*

3.1 Sampling Process Design

The sampling process design is a detailed data collection plan that provides information to satisfy the project DQOs. The sampling process design includes a description of the number, type, location, and frequency of samples to be collected (by matrix), as well as the technical rationale for the collection of the proposed data. The sampling design is specific to each project and is presented in the facility-specific Work Plan.

As applicable to the project scope, the sampling process design will include:

- The technical rationale, consistent with the DQOs, for sampling locations, number of samples, frequency of sampling, sample media, target analytes, and project screening levels.
- A discussion of how data will be used to support critical project decisions.
- A description of sample collection techniques, especially non-standard techniques, and strategies that will be used and how these techniques and strategies meet both project technical and scheduling requirements.

- A summary of the assumptions used in the development and selection of the proposed sampling methodologies by matrix.

Field sampling and other activities and operations should be developed so that these processes provide reliable information that meets the project objectives. The guidance documents presented in Section 2.9.2.1 of this document may be consulted for development of the sampling rationale and specific field sampling protocols. Additional documents include:

- *Soil Sampling Quality Assurance User's Guide – Section Edition* (USEPA, 1989)
- *Preparation of Soil Sampling Protocols: Sampling Techniques and Strategies* (USEPA, 1992)
- *Superfund Program Representative Sampling Guidance - Volume 1: Soil Interim Final* (USEPA, 1995)
- *Guidance for Choosing a Sampling Design for Environmental Data Collection* (QA / 5S) (USEPA, 2002)

The essential information that shall be included in the sampling process design will include:

- The type of design (e.g., systematic or judgmental).
- Sample numbers and proposed locations.
- Media to be sampled.
- Justification for the selected sampling design in terms of the project DQOs.

The sampling process design will be presented in the facility-specific work plan. The requested format of the work plan was presented in Section 2.0. Facility-specific work plans will include a section equivalent to a field sampling plan that will describe the planned field and quality control activities. The use of SOPs for routinely performed tasks is recommended to ensure consistency between events. A deviation from an established procedure during a data collection activity must be described and documented.

As part of project planning, a HASP should be developed prior to engaging in the field activities. The HASP may be a stand-alone document or a section of the facility-specific work plan. The safety plan should include:

- Requirements for health and safety training.
- Requirements for medical monitoring, if required.
- Requirements for personnel protective equipment.
- Detailed chemical and physical hazard analysis.
- Identification of the responsible Health and Safety Officer.
- Designation of personnel with first aid training.
- Level of responsibility for project personnel.

Before starting field work, the RWQCB Project Manager and staff are required to have proper health and safety training. Facilities are required to develop and adhere to their own health and safety guidelines for both facility staff and subcontractors. Each project is required to have a documented and approved HASP and is required to have staff trained in accordance with said plan.

3.2 Sampling Methods

This section describes minimum procedures for sampling groundwater, soil, and soil-vapor for field and offsite laboratory analyses. A detailed description of the sampling methods shall be documented in the facility-specific work plan and shall be approved by the RWQCB Project Manager before sampling. When engaging in field sampling, RWQCB staff will follow the procedures in this section as incorporated into project-specific planning documents.

3.2.1 Groundwater Samples

Procedures to be used for groundwater sampling are presented in:

- *RCRA Groundwater Monitoring: Draft Technical Guidance* (USEPA, 1992).
- *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers* (USEPA, 2002).
- *Representative Sampling of Groundwater for Hazardous Substances – Guidance Manual for Groundwater Investigations* (DTSC and Cal/EPA, 2006).
- *SW846 Sample Collection Guidance* (USEPA, 2007).
- *Requirements for Groundwater Investigation* (RWQCB, 2008).

3.2.1.1 Metals in Groundwater

RWQCB requires that groundwater samples be prepared and analyzed for both total and dissolved metals, with the exception of hexavalent chromium samples. Determination of total metals is made using whole, unfiltered water samples, while determination of dissolved phase metals is made using samples filtered through a 0.45-micron membrane. Samples collected for hexavalent chromium analyses are not filtered. As applicable, samples shall be filtered in the field using a 0.45-micron membrane filter; otherwise, instructions should be provided to the analytical laboratory to filter the samples immediately upon receipt prior to preservation, extraction, and analysis. As applicable, the unfiltered and filtered samples will be preserved with nitric acid to achieve a pH less than or equal to 2 immediately after collection and filtration. Samples for hexavalent chromium determination are not filtered and are not acidified.

3.2.1.2 Groundwater Sample Collection for VOC Analyses

Samples for analysis of VOCs must be collected using a technique/methodology that prevents analyte losses through volatilization. The sample collection procedure presented below includes preparing the test glass container (i.e., 40-mL vial) to verify that sample preservation is adhered to and to prevent volatilization.

The preferred method for collecting groundwater samples is the use of a bladder or submersible stainless-steel pump with capability of flow rates of less than 100 milliliters per minute. RWQCB does not advocate the use of bailers when samples are being collected for VOCs analysis due to the likelihood of analyte losses. Use of bailers should be limited to those situations where use of a pump is not possible. The rationale for use of bailers must be documented in the facility-specific work plan for approval by RWQCB.

When using the pump, groundwater samples are collected using a flow rate of 100 milliliters per minute or less. The groundwater is pumped directly into a vial containing two drops of hydrochloric acid. To reduce volatilization, the sample bottle is held at a 45-degree angle to the discharge to enable the groundwater to flow directly into the vial and down the side of the vial, which should prevent splashing and volatilization. As the vial fills, it is slowly turned to the vertical position. This step is continued until the vial is filled and a reverse meniscus develops at the top of the vial. Once this step is complete a Teflon™ septum is slid onto the top of the vial and cap. To verify that no headspace remains inside the vial, the vial is inverted to observe for bubbles. Note: bubbles smaller than the size of a small green pea are acceptable.

When collecting samples using a bailer, a Teflon™ bailer or other suitable inert material with a bottom-emptying device must be used. The bailer must be lowered into and removed from the well in a manner that causes as little agitation as possible. The bottom-emptying check valve must be used to slowly discharge the sample from the bailer into the sample vial so there is no agitation of the sample. Bailers must be decontaminated between samples, or disposable bailers must be used.

At each groundwater well, a test vial will be prepared to determine whether sufficient preservative is being used. The VOC test sample is prepared in the manner identical to the field samples. Once the test vial is filled and capped, the vial is inverted and then opened and pH or litmus paper is used to verify whether the groundwater has achieved pH <2. If the pH is >2, additional hydrochloric acid is added, and the procedural steps are repeated until the groundwater has reached a pH <2. Based on what steps were used to adjust the pH in the test vial, the same steps should be used for adjusting the amount of hydrochloric acid in the remaining sample vials

3.2.1.3 Non-volatile Organic and Inorganic Parameters other than Metals in Groundwater

For non-volatile organic and inorganic parameters other than metals, groundwater samples must be collected in a manner that preserves the integrity of the specific analyte class. Container, preservation, and holding time requirements vary by analyte, but each specific requirement must be accounted for both in the facility-specific work plan and during the field work implementation. For additional information and guidance, refer to Table 3-1.

3.2.2 Soil Samples

Procedures to be used for soil sampling are presented in:

- *Soil Sampling Quality Assurance User's Guide* (USEPA, 1989).
- *Requirements for Subsurface Soil Investigations* (RWQCB, 2000b).

Soil borings should be logged for soil type according to the Unified Soil Classification System (ASTM, 2006).

Table 3-2 presents representative soil sampling techniques.

3.2.2.1 Samples Collected for VOC Analyses

VOCs in soil should be collected in a manner compatible with USEPA Method 5035A—Closed System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples. This preparation method presents options for collection of low- and

medium-concentration soil samples. Low-concentration soil samples may be collected using an EnCore® or equivalent syringe-type sampling device, and medium-level soil samples may be collected by field preservation using methanol. The facility-specific work plan shall describe the planned type of sample collection method along with the required preservation method and holding times. Guidance regarding soil sampling techniques is presented in *USEPA Region 9 Technical Guidelines For Accurately Determining Volatile Organic Compound (Voc) Concentrations In Soil And Solid Matrices* (USEPA, 2005a) contained in Appendix D. Soil samples collected for VOC determination shall not be mixed or composited. If only VOC determination is required, a 4-ounce jar must be included to provide material for percent solids determination.

3.2.2.2 Non-volatile Organic, Metals, and Other Inorganic Parameters in Soil

Soil samples may be collected as grab samples (surface samples) or as subsurface soil borings. Soil borings may be collected using a variety of drilling equipment such as:

- Hand augers.
- Direct-push technologies.
- Driven tube samplers.

Subsurface soil samples from a soil boring shall be collected using the general procedural steps below:

- Three pre-cleaned brass or stainless steel sleeves are placed inside the decontaminated sampler.
- The sample is collected from the desired depth.
- The sampling device is retrieved and the sleeves are removed.
- The end of each sleeve is covered with Teflon™ swatch and then a plastic cap.

Stainless steel sleeves shall be used if metals analyses are required. In general, the middle sleeve is typically used for the chemical analysis, the bottom sleeve is used for geophysical tests, and the top sleeve is archived as backup.

The sleeves are labeled and packaged according to the default requirements presented in this QAPP or as documented in the approved facility-specific work plan. The sample number, date, time, and description of the sample is recorded on the sample label, chain-of-custody form, boring/sample collection log, and in the field logbook.

3.2.3 Soil-vapor (Gas) Samples

Soil-vapor sampling may be conducted to initially characterize volatile contamination in the subsurface, locate potential contamination source areas, or support evaluation of the vapor intrusion pathway. Soil-vapor sampling will be performed in accordance with RWQCB's *Advisory for Active Soil Gas Investigation* (DTSC and RWQCB, 2012). Modifications to the procedures contained in these guidance documents shall be documented in the facility-specific work plan, which will be approved by RWQCB prior to the soil-gas sample collection field activities described in the project-specific report.

As part of the DQO process, facilities should develop a conceptual site model that includes evaluation of the vapor intrusion pathway. Additional information regarding sampling and

analysis requirements for evaluation of vapor intrusion to indoor air may be found in the following:

- *OSWER Draft Guidance for Evaluation Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)*, EPA530-D-02-004 (USEPA, 2002).
- *User's Guide for Evaluation Subsurface Vapor Intrusion Into Buildings* (USEPA, 2004).
- *Vapor Intrusion Pathway: A Practical Guide* (ITRC, 2007a).
- *Vapor Intrusion Pathway: Investigative Approaches for Typical Scenarios* (ITRC, 2007b).

The site-specific work plan should clearly define the sampling rationale and both the chemicals and concentrations of concern for vapor-phase samples.

Soil gas will be collected from the subsurface in a leak-free manner, thereby preventing the intrusion of ambient air into the sampling train. Leak checks will be performed and documented, and a leak-check compound will be used to evaluate the data. Suggested leak-check compounds include:

- Isobutane
- Butane
- 2-propanol
- 1,1,1,2-tetrafluorethane (Freon 134a)
- Sulfur hexafluoride

Once a probe has been installed, the probe shaft will be withdrawn, leaving the probe point and sampling tube in the subsurface. A small amount of silica sand will be poured into the probe hole to allow soil gas to migrate to the sampling point. The remaining annulus will be backfilled with cement/bentonite grout to grade. Upon completion of soil-gas sampling, the sampling tube will be plugged with a stainless-steel machine screw and pushed below-grade. The remaining depression will be completed at grade using a material consistent with the original site conditions.

The soil-gas collection system will be described in the facility-specific work plan. Soil-gas samples may be analyzed by direct gas injection using a gas-tight syringe into a laboratory-grade, field-operable gas chromatograph or gas chromatograph mass spectrophotometer or may be collected using Summa® canisters for analysis at an offsite laboratory. The type of sample collection technique and analysis option selected must meet the project quality objectives.

While onsite analysis by direct injection may be sufficient for location of hot spots for additional sampling, Summa® canisters and offsite laboratory analyses is required for results that will be used to support risk assessments. The sample collection procedures and the selected analysis options must be documented in the facility-specific work plan.

Site-specific probe purging and sample volume calibrations shall be performed, when practical, to evaluate the appropriate volume of gas to be purged from each probe prior to sample collection. For samples shipped offsite for analysis, a default purge volume may be

used. If the use of a default purge volume is planned, the basis for forgoing the purge volume tests must be presented in the facility-specific work plan.

For projects that will use soil-vapor data for human health risk assessments, additional soil sample analyses are required (DTSC and RWQCB, 2012). Soil samples shall be collected from three depths and shall be analyzed for the following parameters:

- Soil density
- Total organic carbon by the Walkley-Black Method (Walkley and Black, 1934)
- Soil moisture content
- Effective porosity
- Grainsize

Additionally, as described in Section 3.2.2, soil borings shall be logged using the Unified Soil Classification System (ASTM, 2006).

3.2.4 Decontamination

The procedures describing decontamination of field equipment before and during the sample collection process will be specified. Decontamination of reusable sampling equipment will be performed to prevent the introduction of extraneous material into samples and to prevent cross-contamination between samples. Sampling equipment will be decontaminated by steam cleaning or by washing with a non-phosphate detergent. Decontamination water will be collected in 55-gallon drums.

The following steps will be followed for decontamination of non-disposable sample equipment:

1. **Rinse with potable water**: This step will decrease the gross contamination and will reduce the frequency at which the non-phosphate detergent and water solution need to be changed. Using a 5-gallon bucket about 75 percent full of water and a long-handled brush is suggested. Frequent changing of this water will increase its effectiveness.
2. **Wash with non-phosphate detergent (note: some detergents may contain perchlorate) and water solution**: This step will remove the visible contamination from the equipment. Using a 5-gallon bucket, approximately 75 percent full of water and a long-handled brush is suggested. Dilute non-phosphate detergent as directed by the manufacturer.
3. **Rinse with potable water**: This step will rinse the detergent solution away from equipment. Using a 5-gallon bucket about 75 percent full of water and a long-handled brush is suggested. Periodic changing of this water is required.
4. **Rinse with solvent/acid:** This step will remove any organic analytes or residual metals that survive the previous decontamination steps. A solvent such as methanol should be used where organic contaminants are a concern, and a 1 percent nitric acid rinse should be used at sites where metals are a concern. If the possibility exists that both organic and inorganic contaminants are present, a solvent rinse followed by a dilute acid rinse may be used.

5. **Rinse with deionized water**: This step will rinse residual detergent solution and potable water residues. Rinsing is most effective by applying the deionized water from a stainless-steel Hudson-type sprayer or Nalgene™ squeeze bottle while holding equipment over a 5-gallon bucket.
6. **Rinse with the reagent-grade water**: This step will rinse residual analytical contaminants in the deionized water. Rinsing is most effective by applying water from a stainless-steel Hudson-type sprayer or Nalgene™ squeeze bottle while holding equipment over a 5-gallon bucket.

3.2.5 Investigation-derived Waste

Waste materials accumulated during environmental data collection activities must be managed in accordance with all applicable state and federal regulations. The project-specific work plan shall describe the types of investigation-derived waste that will be generated, the required testing, and how waste materials will be classified. A rationale for waste disposal shall be presented for all anticipated types of waste including identification of the classes of disposal facilities that may be required.

3.3 Sample Handling and Custody

This section addresses how samples will be collected, stored, shipped, and disposed of during field investigations. Table 3-1 presents a summary of required sample containers, sample amounts, preservation, and holding times for widely used methods.

3.3.1 Sample Identification

A unique, descriptive sample identification system must be developed and described in the facility-specific work plan. A sample identification scheme should clearly describe both the location and sample identifications. In developing a sample identification strategy, the sample collector should consider the identifications of historical locations and/or samples collected by others at the site to prevent duplication. Individual sample identifications must correspond to one sample from unique x, y, and z coordinates. The identification used for field sample duplicates must be such that the type of sample cannot be inferred by the laboratory. The specifications for sample location survey data must be presented in the work plan and must include the datum used and the required resolution.

The following default sample identification scheme may be used or an alternative described in the facility-specific work plan may be used. The identification of sample 02SW2101-XXX is defined as follows:

02 = the year in which the sample was collected
SW = the type of sample
21 = sample location or well number
01 = the sampling event
XXX = a unique sequential number to ensure unique sample identity

For soil samples, a depth designation may be included. For example, the identification of sample 08-SB-07-05-01-101 is defined as follows:

08 = the year in which the sample was collected

SB = Soil Boring
07-05=Location 7 at 5 feet below ground surface
01 = Sampling Event 1
101 = Sample 101

The sample type may be included in the sample identification. The defined sample types are as follows:

SW = Surface Water
RW = Residential Well
GW = Groundwater
MW = Monitoring Well
SS = Surface Soil
SB = Soil Boring
AA = Ambient Air
SV = Soil-Vapor (only applicable to samples analyzed by an offsite laboratory)
IA = Indoor Air
CS = Clarifier / Sump Sludge
PW = Public Production Well

A figure showing proposed sample locations shall be prepared and included in the facility-specific work plan before field work begins. A cross-reference list equating sample numbers with specific sample information (e.g., location, date sampled, sample media, blank, duplicate, etc.) shall be maintained.

3.3.2 Sample Documentation and Tracking

Sample containers must be pre-labeled with the identification of the preservative. The sample identification and the date and time of sampling are entered on the label immediately after sample collection. The labels must be secured using clear tape (that does not contain VOCs in its adhesive) to maintain the identification of each sample.

Vital information regarding the collection of each sample will be recorded in a field logbook. The field logbook will be bound with consecutively numbered pages. Each entry will be legibly written in black ink and will be signed and dated by the individual making the entries. Factual and objective language will be used. Each entry will be complete and accurate enough to allow reconstruction of each field activity. The following information will be recorded during the collection of each sample:

- Sample location and description (sketch and measured distances from reference points will be recorded if there is no established identification for the sample location)
- Sample identification
- Sampler's name
- Date and time of sampling
- Sample collection method
- Sample matrix
- Type and identification of sampling equipment used

- Field measurement data (pH, temperature, conductivity, etc.)
- Field observations that may be relevant to the analysis or sample integrity (odor, color, weather conditions, etc.)
- Associated QA / QC samples (i.e., duplicates, matrix spikes / matrix spike duplicates (MS / MSDs), blanks, etc.)
- Preservative used
- Lot numbers of sample containers, chain-of-custody number, custody seal number
- Shipping arrangement
- Destination laboratory

3.3.3 Chain of Custody

An unbroken chain-of-custody record must be maintained for each sample from the time of collection through shipment, analysis, and reporting. The procedures for maintenance of both field and laboratory chain-of-custody are described in the following sections.

3.3.3.1 Field Chain of Custody

Collecting data of known quality begins at the point of sample collection. Legally defensible data are generated by using proven evidentiary procedures. These procedures are outlined in the following sections and must be used to preserve and ensure the integrity of each sample from the time of collection through analysis. Sample custody records must be maintained both in the field and in the laboratory. A sample is considered to be in someone's custody if it is either in his or her physical possession or view, locked up, or kept in a secured and restricted area. Until a sample is shipped, its custody will be the responsibility of the sampling team leader.

Chain-of-custody records document sample collection and shipment to the laboratory. A chain-of-custody form is completed for each sampling event. The original copy is provided to the laboratory with the sample-shipping cooler, and a copy retained in the field documentation files. The chain-of-custody form identifies the contents of each shipment and maintains the custodial integrity of the samples. Each chain-of-custody form is signed and dated by each responsible party. The "relinquished by" box will be signed by the responsible sampling team personnel, and the date, time, and air bill number will be noted on the chain-of-custody form. Once the laboratory receives the chain of custody and associated samples, the samples will be inspected, and the chain of custody will be signed. Once the chain of custody is signed, laboratory personnel will return the executed copy of the chain of custody with the hardcopy report.

A self-adhesive custody seal will be placed across the lid of each sample and will be initialed and dated by the person closing and shipping the cooler to maintain integrity until receipt by the laboratory. The shipping coolers containing the samples will be sealed with a custody seal during the time they are not in an individual's possession or view before shipping.

The following will be recorded on the chain-of-custody form:

- Project name
- Project location
- Project number
- Project contact
- Discharger or client representative
- Project Manager (RWQCB or facility)
- Sample numbers
- Date (of sample collection)
- Time (of sample collection, hour:minutes)
- Sample type (composite or grab)
- Sample description (location and matrix)
- Preservation
- Container type
- Number of sample containers
- Analysis required
- Remarks (i.e., filter groundwater samples designated for metals analysis)
- Item numbers (to be relinquished)
- Transfer signature (to relinquish samples)
- Courier / Laboratory representative signature
- Date / time (of custody transfer)
- Additional remarks
  - Transportation method
  - Laboratory name
  - Turnaround time requirement
  - Compositing instruction (if required)
- Sampler signature

3.3.3.2 Laboratory Chain of Custody

A designated sample custodian will accept custody of the shipped samples and will verify that the information on the sample tags / labels matches the information on the chain of custody. Important information regarding the shipment shall be documented, including whether the custody seals are intact, sample bottles are broken, or samples were not chilled properly (the analytical laboratory shall report the temperature of the container when received). Sample tag data shall then be entered into a bound logbook documenting sample receipt.

The sample custodian will use the sample identifier (i.e., tag number) or will assign a unique laboratory number to each tag to track the sample through the laboratory. The sample custodian shall then maintain custody in a secure area until sample analysis.

The custodian will distribute samples to the appropriate laboratory analysts who are then responsible for the care and custody of the samples until they are exhausted or returned to the sample custodian.

When sample analyses and QA / QC checks have been completed, the unused portion of each sample shall be properly discarded. Identifying tags / labels, data sheets, and laboratory

records shall be retained as part of the permanent documentation. The Project Manager will discuss with RWQCB staff whether a data package is complete and whether the laboratory can dispose of remaining sample volumes or containers. Prior to destruction of records, either originals or copies of the records shall be offered to the Project Manager and then to RWQCB.

3.4 Analytical Methods

The following sections present the requirements for laboratories and the types and specifications for field and laboratory analytical methods.

3.4.1 Laboratory Requirements

This section specifies the minimum requirements that must be met to provide data of known and usable quality to RWQCB and USEPA in support of the SGV and SFV investigations. These requirements include a laboratory certification / PE program, QA / QC documentation, and data validation.

Laboratories selected for the project must be capable of providing the appropriate analytical detection limits, reporting limits, required turnaround times, project quality control, and data deliverables required by this QAPP. The laboratory must have the demonstrated ability to analyze samples of similar type, quantity, and concentrations to be subcontracted. Prior to work on a project, the laboratory will provide:

- MDL studies and laboratory-specific quantitation limits at or below the project-specific screening levels; soils sample results will be reported on a dry-weight basis.
- Minimum QA / QC criteria for initial and continuing calibration and interference check samples.
- Minimum QA / QC criteria for surrogate recoveries, laboratory control samples, blanks, MS / MSDs indicating that the methods selected for performing analysis can be met.

The analytical laboratories selected to perform samples analysis shall be certified by the SWRCB through the Environmental Laboratory Accreditation Program (ELAP) for each required method. Data whose quality do not meet the requirements of this document, regardless of laboratory certification, shall be excluded. These requirements apply to onsite mobile laboratories as well as offsite, fixed laboratories.

Mobile laboratories are expected to adhere to all of the specifications of the RWQCB quality program as presented in this QAPP and associated guidance documents. Method modifications or other deviations from QAPP requirements required due to the specialized nature of field laboratory operations must be detailed in the facility-specific work plan. Mobile laboratories must be certified though the Environmental Laboratory Accreditation Program. The use of mobile laboratories shall be documented in the facility-specific work plan. The mobile laboratory quality assurance plan should be provided as part of the facility-specific work plan. The facility-specific work plan should include a plan for collection of split samples for analysis by a fixed laboratory at a frequency of 10 percent of the total number of samples collected when a mobile laboratory is employed.

In addition, facilities that use mobile laboratories, RWQCB will provide oversight in the form of audits as documented in Section 4.1.

3.4.2 Field Analysis Methods

The appropriate equipment, instrumentation, and supplies at the sampling site will be specified in the facility-specific work plan. The field equipment and instrumentation will meet the requirements of the methods and procedures as specified in the facility-specific work plan.

Table 3-3 summarizes potential in-field measurement methods. These methods are considered screening level and may be used to identify hot spots, select locations for further sampling, or collect ancillary environmental measurements. This list of field methods is not intended to be complete. The technical rationale for the use of field screening methods, including real-time water quality measurements, must be provided in the facility-specific work plan. The work plan must also describe the required quality control procedures for proposed field methods and should include, at a minimum:

- Calibration requirements and frequency
- Use of second source standards
- Collection of split samples
- Determination of precision and precision at method specified frequency
- Acceptance criteria for each quality control analysis

The quality control associated with in-field measurements must be documented in bound log books or sampling forms in a legally defensible manner.

3.4.3 Definitive Data Analytical Methods

Analytical laboratories must be certified by the State of California for the project analytical methods and sample matrices prior to accepting project samples. Table 3-4 presents preparation methods, and Table 3-5 presents definitive analytical methods. Definitive analytical methods are approved methods that are designed to produce data within specified precision and accuracy limits and that are presented in a format that permits independent verification of the reported results. The lists of preparation and analysis methods should not be considered exhaustive.

Appendix C presents reporting limit tables for commonly-used methods. The tables in Appendix C are not intended to be used as exhaustive analyte lists. Analytes may be added or deleted to the list, and the list may be altered to meet the project objectives. Required target analytes shall be identified during the planning process, and project-specific target analyte lists and required reporting limits shall be included in each facility-specific work plan.

Analytical methods should follow the requirements and guidelines presented in USEPA test methods. Primary sources for definitive analytical methodologies are:

- *Methods for Chemical Analysis of Water and Wastes* (USEPA, 1983)
- *Methods for the Determination of Organic Compounds in Drinking Water*, Environmental Monitoring Systems Laboratory, Office of Research and Development, EPA-600/4-88/039 (USEPA, 1988)

- *Leaking Underground Fuel Tank Field Manual: Guidelines for Site Assessment, Cleanup, and Underground Storage Tank Closure* (SWRCB, 1989)
- *Methods of Air Sampling and Analysis*, *Third Edition* (Lodge, 1990)
- *Compendium of Method for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, EPA 625/R-96/010b* (USEPA, 1997)
- *General Laboratory Testing Requirements for Petroleum Hydrocarbon Impact Sites* (RWQCB, 2000)
- *Guide to Environmental Analytical Methods, Fifth Edition* (Smith, 2001a)
- *Laboratory Requirements for Soil and Water Sample Analysis* (RWQCB, 2001b)
- *Laboratory QA/QC Requirements for Metal Analyses* (RWQCB, 2001c)
- *Manual for the Certification of Laboratories Analyzing Drinking Water – Criteria and Procedures/Quality Assurance*, EPA 815-R-05-004 (USEPA, 2005)
- *Standard Methods for Examination of Water and Wastewater*, 18th Edition (APHA / AWWA / WPCF, 2006a)
- *Annual Book of ASTM Standards*, Various Volumes (ASTM, 2006b)
- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846, 3rd Edition, Office of Solid Waste and Emergency Response* Revision 6 (USEPA, 2007)
- *NIOSH Manual of Analytical Methods*, *Fifth Edition* (NIOSH, 2014)
- USEPA Method 1625: Revision B—Determination of Semivolatile Toxic Organic Pollutants and Additional Compounds Amenable to Extraction and Capillary Column Gas Chromatography / Mass Spectrometry (GC / MS)

Other methods may be used, such as performance-based methods, but demonstration of method capability and data quality must be presented in the facility-specific work plan.

3.4.4 Analytical Parameters

The following subsections discuss common classes of analytical parameters along with the compounds considered to be emergent chemicals in the State of California.

3.4.4.1 Volatile Organic Compounds

VOCs have been and continue to be detected in the SGV and SFV Basins. The following list presents the analytes that are of particular concern based on concentrations and frequency of detection with in these groundwater basins:

- Carbon tetrachloride
- Chloroethane
- Chloroform
- 1,1-dichloroethane
- 1,2-dichloroethane
- 1,1-dichloroethene
- cis-1,2-dichloroethene

- trans-1,2-dichloroethene
- Dichloromethane (methylene chloride)
- PCE
- 1,1,1,2-tetrachloroethane
- 1,1,2,2-tetrachloroethane
- 1,1,1-trichloroethane
- 1,1,2-trichloroethane
- TCE
- Vinyl chloride
- Benzene
- Toluene
- Ethylbenzene
- Xylenes
- Trichlorofluoromethane (Freon 11)
- Dichlorodifluoromethane (Freon 12)
- 1,1,2-trichloro-trifluoroethane (Freon 113)

The applicable methods are USEPA Method 8260B for soil and groundwater and USEPA Method 524.2 for finished drinking water. Other VOCs such as methyl ethyl ketone (MEK), methyl isobutyl ketone, ethylene dibromide, etc. may also be analyzed by these methods. The target analyte list shall be developed based upon site history and conditions and shall be presented in the facility-specific work plan.

3.4.4.2 Semivolatile Organic Compounds

Semivolatile organic compounds (SVOCs) include base-neutral compounds such as phthalate esters and polynuclear aromatic hydrocarbons, acidic compounds such as phenol and substituted phenols, pesticides, and petroleum hydrocarbons. N-nitrosodimethylamine (NDMA), an emergent compound, is included in the SVOC analyte list and is analyzed using secondary ion monitoring techniques. Another emergent chemical, 1,4-dioxane, can be analyzed by both VOC and SVOC methods. RWQCB recommends that 1,4-dioxane be analyzed as a SVOC. The applicable definitive methods for groundwater and soils are listed in Table 3-5.

3.4.4.3 Inorganic Analytes

Inorganic analytes include metals and other inorganic parameters, including the emergent analytes hexavalent chromium and perchlorate. Metals that may be of concern within the SGV and SFV basins are:

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cadmium
- Calcium
- Chromium (total)

- Chromium (hexavalent)
- Cobalt
- Copper
- Iron
- Lead
- Magnesium
- Manganese
- Mercury
- Molybdenum
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Thallium
- Vanadium
- Zinc

Other inorganics that may also be of concern include nitrate, nitrite, sulfate, and cyanide.

3.4.4.4 Monitored Non-regulated and Regulated Chemicals

RWQCB has identified facilities using the unregulated emergent chemicals 1,2,3-trichloropropane (1,2,3-TCP), NDMA, perchlorate, and 1,4-dioxane and the regulated chemicals methyl tertiary butyl ether (MTBE) and hexavalent chromium (CrVI) within the SGV/SFV investigation areas. To fully characterize the nature and extent of chemical contamination within SGV/SFV, current emergent chemicals are included as target analyte for groundwater investigations. Should new emergent chemicals be identified in the future and should there be evidence of historical use within SGF/SFV, these chemicals will be considered for inclusion on the project-specific target analyte lists. Table 3-6 presents the methods, suggested reporting limits, link to technical information, and applicable regulatory concentration goals for 1,2,3-TCP, NDMA, perchlorate, and 1,4-dioxane.

3.5 Quality Control

The following sections present the requirements for field and laboratory quality control samples.

3.5.1 Field Quality Control

Field quality control includes collection of split samples and field duplicate samples; preparation of field blanks, equipment rinsate blanks, trip blanks; and submission of performance evaluation samples and additional field sample volumes for MS/MSD analyses.

3.5.1.1 Split Sampling

Split samples are collected to determine the comparability of results from two or more laboratories performing the same analysis, comparison of field and offsite laboratory results, or to verify the capability of one laboratory to perform an analysis by using a laboratory

with known competence in the specific test method. A single party using the same sampling equipment, same sampling procedures, and sample bottles obtained from the same source shall perform sample collection for both split and original samples.

Split samples should be collected at a minimum of 10 percent of the samples, with the split samples being analyzed by one or more laboratories. The facility-specific work plan should detail the strategy for comparison, evaluation, and use of split-sample results. When the results of two or more replicate samples do not agree within project specifications, the results should be used with caution. Table 3-7 presents a comparison strategy that may be used when comparing split-sample results. When significant differences are observed between split-sample pairs, data should be reviewed and corrective action should be taken, as appropriate. When the causes of significant differences between the results cannot be resolved, the samples' re-analysis or resampling may be required. Each variance and corrected measure that occurred throughout the project shall be documented and reported.

Soil samples to be analyzed for contaminants other than VOCs shall be homogenized and divided into the two sets of sample containers. Samples to be tested for VOCs shall always be collected as discrete samples following procedures described in the facility-specific work plan.

At the discretion of RWQCB, oversight staff may request facilities to provide split samples. These split-sample data will be used to monitor sampling and analysis procedures throughout the SGV / SFV Basins.

3.5.1.2 Field Duplicates

Field duplicates are collocated samples that are collected to provide information in overall sampling and analysis precision. Field duplicates are collected at the same time and location using identical sampling protocols. Field duplicates will be collected at a frequency of one per 10 samples for the same analysis as the original sample or one per sampling event if there are fewer than 10 total samples being collected. Field duplicates receive unique sample identification numbers to ensure that the identity of the duplicate samples are blind to the analytical laboratory. Exact locations of duplicate samples and their identifications are documented in the field logbook.

3.5.1.3 Source Blanks

Source blanks are portions of the reagent water used for the final rinse following decontamination. A source blank should be prepared and analyzed for each lot of reagent water used to ultimately prepare equipment rinsate blanks and field blanks. For small sampling events, the preparation and analysis of a source blank may not be necessary. The results of source blank analysis may help in evaluating the effectiveness of decontamination by eliminating analytes present at equivalent concentrations in both the equipment rinsate blank and the reagent water. The source water may be analyzed for the same parameters as the field samples or may be analyzed for only the parameters that will be used for critical site decisions. If a subset of parameters is proposed, the rationale for the limited source water analyses shall be presented in the facility-specific work plan. The frequency of source blanks should be at a minimum of one sample per each sampling day.

3.5.1.4 Equipment Rinsate Samples

Equipment rinsate samples are collected from the final rinse of a decontamination procedure to evaluate the potential cross-contamination and effectiveness of the decontamination procedure during sampling events. The final rinse is performed using reagent-grade water. Equipment rinsates will be collected at a frequency of one per day for each piece of reusable sampling equipment that comes in contact with samples. Equipment rinsate blanks are not required for disposable, one-time-use equipment. The equipment rinsate blank may be analyzed for the same parameters as the field samples or may be analyzed for only the parameters that will be used for critical site decisions. If a subset of parameters is proposed, the rationale for the limited equipment rinsate sample analyses shall be presented in the facility-specific work plan. The frequency of equipment rinsate blanks should be at a minimum of one per piece of reusable sampling equipment per each sampling day.

3.5.1.5 Field Blanks

Field blanks or trip blanks are collected for VOC analysis to ensure that no pre-contaminated situation existed. For groundwater samples, the blanks are prepared by the laboratory using reagent-grade water. For soil samples, the blanks are prepared by the laboratory using reagent-grade purified sand. Typically, RWQCB does not recommend the collection and analysis of field blanks for soil samples. For soil-vapor samples, field blanks are collected with the atmospheric air. Field blanks or trip blanks will be collected at a frequency of one per sampling day event or one per every shipping container (such as cooler) that is used to store volatile analysis samples per day.

3.5.1.6 Matrix Spike and Matrix Spike Duplicates

Sufficient amount of duplicate samples are collected for the laboratory to perform MS/MSDs. They are collected at the same time and location using the same sampling protocols. MS/MSDs samples will be collected at a frequency of one per 20 samples for the same analysis as the original samples. At least one set of MS/MSD should be analyzed if less than 20 samples are collected for the project. The MS/MSD samples should be selected by the sampler and should be annotated on the chain-of-custody form. The samples selected for MS/MSD analysis should be representative of the site matrix and an MS/MSD is required for each type of distinct matrix encountered. To the extent possible, parent MS/MSD samples should represent the range of contaminant concentrations expected. Locations that have (through observations or from field measurements) high concentrations of contaminants should be avoided since high native concentrations will mask the analytical spikes and prevent accurate recovery determinations.

3.5.2 Laboratory Quality Control

Laboratory quality control samples (e.g., blanks and laboratory control samples [LCSs]) shall be included in the preparation batch with the field samples. An analytical batch is a group of samples (not exceeding 20 environmental samples plus associated laboratory quality control samples) that are similar in composition (matrix) that are extracted or digested at the same time and with the same lot of reagents and analyzed together as a group. MS/MSDs are treated as environmental samples. The term analytical batch also extends to cover samples that do not need separate extraction or digestion (e.g., volatile analyses by purge and trap). The identity of each analytical batch shall be unambiguously

reported with the analyses so that a reviewer can identify the quality control samples and the associated environmental samples.

The type of quality control samples and the frequency of use of these samples are discussed below.

3.5.2.1 Laboratory Control Sample

The LCS is a sample of known composition prepared using contaminant-free water or an inert solid such as glass beads or Teflon™ chips, which is spiked with target analytes. Each analyte in the LCS shall be spiked at a level less than or equal to the midpoint of the calibration curve. (The midpoint is defined as the median point in the curve, not the middle of the range.) The LCS shall be carried through the complete sample preparation and analysis procedure.

The LCS is used to evaluate each analytical batch and to determine whether the method is in control. Except for VOC analysis, the LCS cannot be used as the continuing calibration verification.

At least one LCS shall be included in every analytical batch. If more than one LCS is analyzed in an analytical batch, results from each LCS shall be reported. A quality control failure of an analyte in one of the LCSs shall require appropriate corrective action, including re-preparation and reanalysis. Each field sample included in the batch of samples associated with the failed LCS shall be reanalyzed with a compliant LCS.

3.5.2.2 Matrix Spike/Matrix Spike Duplicate

An MS/MSD is an aliquot of sample spiked with known concentrations of the target analytes of interest. The spiking occurs prior to sample preparation and analysis. Each analyte in the MS and MSD shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. Only project samples shall be used for spiking. The MS/MSD samples should be selected by the sampler and should be annotated on the chain-of-custody form.

The MS/MSD samples are used to document potential matrix effects in associated samples collected at a site. The prime contractor must select the samples for MS/MSDs. The sample replicates will be generated in the field and will be used by the laboratory to prepare the appropriate MS/MSDs. Only one soil sample container may be necessary for the parent sample, the MS sample, and the MSD sample (except for VOCs). The MS/MSD results and flags must be associated or related to samples that are collected from the same site from which the MS/MSD set were collected.

A site-specific MS/MSD is normally specified for each media (e.g., a different soil, water, or sediment) at each site during each sampling event. Project managers should designate the MS/MSD and determine whether they are site-specific based on the project requirements. The standard collection frequency is one MS and one MSD for each site and included for every 20 field samples (i.e., collect up to 20 field samples followed by two additional samples designated as MS and MSD). The frequency may be modified based on project-specific DQOs or the quantity of historical data available for a site.

The performance of the MS and MSD is evaluated against the quality control acceptance limits shown in the Appendix B tables. If either the MS or the MSD is outside the quality

control acceptance limits, the data shall be evaluated to determine whether there is a matrix effect or analytical error, and the analytes in the related samples shall be qualified according to the data flagging criteria in Section 5.0. The laboratory should communicate potential matrix difficulties to the prime contractor so an evaluation can be made with respect to the DQOs.

3.5.2.3 Surrogates

Surrogates are compounds similar to the target analyte(s) in chemical composition and behavior in the analytical process but are not normally found in environmental samples. Surrogates are used to evaluate accuracy, method performance, and extraction efficiency. Surrogates shall be added to environmental samples, controls, and blanks in accordance with the method requirements.

Whenever a surrogate recovery is outside the acceptance limit, a corrective action must be performed. After the system problems have been resolved and system control has been reestablished, the sample must be re-prepared and re-analyzed. If corrective actions are not performed or are ineffective, the appropriate flag, as described in Section 5.0, shall be applied to the sample results.

3.5.2.4 Internal Standards

Internal standards are known amounts of standards added to a portion of a sample or sample extract and carried through the entire determination procedure. They are used as a reference for calibration and for controlling the precision and bias of the analytical method. Internal standards shall be added to environmental samples, controls, and blanks, in accordance with the method requirements. When the initial standards results are outside of the acceptance limits, corrective actions shall be performed. After the system problems have been resolved and system control has been reestablished, the samples that were analyzed while the system was malfunctioning shall be re-analyzed. If corrective actions are not performed or are ineffective, the appropriate flag, as described in Section 5.0, shall be applied to the sample results.

3.5.2.5 Retention Time Windows

Retention time windows are used in gas chromatography, ion chromatography, and high-performance liquid chromatography analysis for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days. The procedure and calculation method are given in SW846, USEPA Method 8000C. The center of retention time window is established for each analyte and surrogate using the retention of the midpoint standard of the initial calibration. For methods other than mass spectroscopy, these windows are updated daily using the absolute retention times in the initial calibration verification.

When the retention time is outside of the acceptance limits, corrective action shall be performed. This applies to each continuing calibration verification subsequent to the initial calibration verification and to the LCS. After the system problems have been resolved and system control has been re-established, each sample analyzed prior to identifying the system problems shall be re-analyzed since the last acceptable retention time check. If corrective actions are not performed, the appropriate flag, as described in Section 5.0, shall be applied to the sample results.

3.5.2.6 Interference Check Samples

Interference check samples (ICSs) are used in inductively-coupled plasma/atomic emission spectra and inductively-coupled plasma/mass spectrometry analyses only and contain known concentrations of interferences and affected analytes. The ICSs are used to verify background and interelement correction factors.

The ICSs are run at the beginning of each run sequence for SW6010B and SW6020B.

When the interference check sample results are outside of the acceptance limits given in Appendix E, a corrective action shall be performed. After the system problems have been resolved and system control has been re-established, the ICSs must be re-analyzed. If the ICS results are acceptable, each affected sample must be re-analyzed. If corrective action is not performed or the corrective action was ineffective, the appropriate flag, as described in Section 5.0, shall be applied to each affected result.

3.5.2.7 Method Blank

A method blank is an analyte-free matrix to which reagents are added in the same volumes or proportions as used in sample processing. The method blank is carried through the complete sample preparation and analytical procedure and is used to assess possible contamination resulting from the analytical process. A method blank shall be included in every analytical batch. The presence of analytes in a method blank at concentrations greater than the MDL indicates the need for further assessment of the data. The source of contamination should be investigated, and measures should be taken to correct, minimize, or eliminate the problem if the concentration exceeds one-half the reporting limit. For common laboratory contaminants (e.g., methylene chloride, acetone, phthalates), the method blank must not exceed the reporting limit. No analytical data shall be corrected for the presence of analytes in blanks. When an analyte is detected in the method blank and in the associated samples and corrective actions are not performed or are ineffective, the appropriate flag, as described in Section 5.0, shall be applied to the sample results.

3.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

The procedures describing how to ensure that field equipment and instrumentation are in working order are presented in the following sections, which include a description of calibration procedures and schedules, maintenance procedures and schedules, maintenance logs, and service arrangements for equipment. Calibration and maintenance of field equipment and instrumentation shall be in accordance with manufacturers' specifications or applicable test specifications and should be documented.

3.6.1 Maintenance

To minimize downtime and interruption of analytical work, routine preventive maintenance shall be performed on each analytical instrument. Designated laboratory personnel should be trained in major instrumentation. When repairs are necessary they should be performed by either trained laboratory employees or service engineers employed by the instrument manufacturer working, under contract, for the laboratory.

The laboratory will have dedicated SOPs that describe preventive maintenance procedures and will maintain records of the maintenance, preventive or corrective, events for each analytical instrument.

3.6.1.1 Field Instrument Preventive Maintenance

Specific preventive maintenance procedures to be followed for field equipment will be based on those recommended by the manufacturer. Field instruments will be checked and calibrated daily before use. Calibration checks will be documented on the field calibration log sheets. The maintenance schedule and troubleshooting procedures for field instruments will be kept onsite. Critical spare parts, such as tape and batteries, will be kept onsite to reduce potential downtime. Backup instruments and equipment will be available onsite or within 1-day shipment to avoid delays in the field schedule.

3.6.1.2 Laboratory Instrument Preventive Maintenance

As part of the QAPP, a routine preventive maintenance program will be conducted by the contracted laboratory to minimize the occurrence of instrument failure and other system malfunctions. Designated laboratory employees will regularly perform routine scheduled maintenance and repair of each instrument. Maintenance to be performed will be documented in the laboratory's operating record. Each laboratory instrument shall be maintained in accordance with manufacturer's specifications.

3.6.2 Instrument/Equipment Calibration And Frequency

This section describes the calibration procedures and the frequency at which these procedures will be performed for both field and laboratory instruments.

3.6.2.1 Field Instrument Calibration

The field instrument will be calibrated as described in field SOPs or the field investigation plan. Field instruments will be calibrated daily prior to use and will be recalibrated after a certain number of samples, as suggested by the manufacturers.

The linearity of the instruments will be checked by using a three-point calibration, with reference standards bracketing the expected measurement. Each calibration procedure performed will be documented in the field logbook and will include the date/time of calibration, name of person performing the calibration, reference standard used, and temperature at which readings were taken and the readings. Multiple readings on one sample or standard, as well as reading on replicate samples, will likewise be documented.

3.6.2.2 Laboratory Instrument Calibration

Calibration procedures for a specific laboratory instrument will generally consist of initial calibrations, initial calibration verifications, and continuing calibration verifications. All calibrations will conform to the specifications of the analytical method employed. The SOP for each analysis performed in the laboratory describes the calibration procedure, its frequency acceptance criteria, and the conditions that will require recalibration. In each case, the initial calibration will be verified using an independently prepared calibration verification solution.

The laboratory will maintain a sample logbook for each instrument that will contain the instrument identification, serial number, date of calibration, analyst, calibration solutions run, and the samples associated with these calibrations.

3.7 Inspection/Acceptance of Supplies

A comprehensive quality assurance program must include procedures for ensuring that materials used meet minimum criteria for acceptability and for identifying materials that may negatively impact project quality objectives. Facility-specific work plans will identify the critical project supplies that will be used, the acceptability criteria, the procedures for acceptance and maintenance of critical supplies, and consumables.

3.8 Secondary Data

Secondary data include existing information used as basis for future data collection activities. These data may include:

- Data from an organization or facility other than the one currently / planning to collect new data.
- Background information from other data collectors or state, federal, or local agencies.
- Information obtained from the published literature.
- Other types of information such as photographs, topographical maps, or outputs from computer models.

The facility-specific work plan shall include a discussion of the types of non-direct information source used, how the information was used, and the assumptions made that affect the use of the information. The quality acceptance criteria for these data should also be discussed in terms of the current project quality objectives. Figure 3-1 presents a generalized procedure for evaluation of secondary data.

3.9 Data Management and Reporting

Management of both electronic and hardcopy environmental data will be described in the facility-specific work plan. Each project shall have a comprehensive data management system to ensure the integrity of collected data. The data management system shall address:

- Definition of roles and responsibilities of personnel involved in project data management.
- Standardization of documentation procedures for documentation of field sample collection, field analyses, and field observations.
- Implementation of a systematic process for collecting, reviewing, and entering environmental data into an information repository.
- Description of the preferred electronic data deliverable format to be used by the designated analytical laboratories.

- Procedures for verifying electronic information and for documentation of errors and corrections.
- Management and archive procedures for hardcopy and electronic project documentation.

3.9.1 Electronic Deliverables

The facility-specific work plans shall include specification for electronic data deliverables that conforms to the requirements of RWQCB GeoTracker database system. Information regarding GeoTracker may be found at: http://geotracker.waterboards.ca.gov/. As part of the project organization, the facility shall designate a data manager who will have the responsibility for obtaining and tracking GeoTracker deliverables and ensuring that data uploads are completed in a timely manner.

3.9.2 Hard Copy Deliverables

Laboratory reports shall include the wet signature of the laboratory manager or their designee. The format of laboratory reports shall be specified in the facility-specific work plan. Results submitted as preliminary shall be clearly identified. In general, laboratories shall submit, at a minimum, results reports that contain sample results and standard quality control summary forms and flag definitions similar to USEPA Contract Laboratory Program format. Laboratories shall also submit as requested full data documentation packages, including raw data and supporting logs. Table 3-8 presents the elements of both summary and full data packages.

TABLE 3-1
Sample Containers, Preservation, and Holding Times
RWQCB Quality Assurance Project Plan, February 2015

Method	Bottle Type	Temperature Preservative	Chemical Preservative	Number per Sample	Project Holding Time	Notes
Air and Soil Gas - Organics, Volatile Organic Compounds						
EPA Method TO-14	Summa Canister	None	None	1	14 days to analysis	
EPA Method TO-15	Summa Canister	None	None	1	14 days to analysis	
EPA Method TO-17	Adsorbent Tubes	chill to 4°C.	None	1	30 days to analysis	
Air and Soil Gas - Organics, Volatile Organic Compounds						
EPA Method 504.1	40-mL glass VOA vial	chill to 4°C.	sodium thiosulfate	3	14 days to analysis	
EPA Method 524.2	40-mL amber glass VOA vial	chill to 4°C.	HCl to pH ≤ 2 (residual chlorine present add ascorbic acid)	3	14 days to analysis	
EPA Method 8260B	40-mL glass VOA vial	chill to 4°C.	HCl to pH ≤ 2	3	14 days to analysis	
EPA Method CaDPH Method-VOA	40-mL amber glass VOA vial	chill to 4°C.	None; (residual chlorine present add ascorbic acid)	3	14 days to analysis	1,2,3-Trichloropropane
Soil - Organics, Volatile Organic Compounds						
EPA Method 8260B	EnCore Sampling Device or equivalent	chill to 4°C.	None	3	14 days (preserved with methanol or sodium bisulfate); 7 days (frozen); 48 hours (EnCore or equivalent sampling device, unpreserved, not frozen).	
Water - Organics, Semivolatile Organic Compounds						
EPA Method 1625	1-L amber glass bottle	chill to 4°C.	None	2	7 days to extraction; 40 days to extract analysis	
EPA Method 8270C	1-L amber glass bottle	chill to 4°C.	None	2	7 days to extraction; 40 days to extract analysis	
EPA Method 8270C-SIM	1-L amber glass bottle	chill to 4°C.	None	2	7 days to extraction; 40 days to extract analysis	
EPA Method 8310	1-L amber glass bottle	chill to 4°C.	None	2	7 days to extraction; 40 days to extract analysis	
EPA Method CaDPH Method-SVOA	1-L amber glass bottle	chill to 4°C.	None; (residual chlorine present add ascorbic acid)	2	14 days to extraction; 24 hours to extract analysis	1,2,3-Trichloropropane
Soil - Organics, Semivolatile Organic Compounds						
EPA Method 8270C	8-ounce glass jar	chill to 4°C.	None	1	14 days to analysis	
EPA Method 8270C-SIM	8-ounce glass jar	chill to 4°C.	None	1	14 days to analysis	

TABLE 3-1
Sample Containers, Preservation, and Holding Times
RWQCB Quality Assurance Project Plan, February 2015

Method	Bottle Type	Temperature Preservative	Chemical Preservative	Number per Sample	Project Holding Time	Notes
Water - Organics, Petroleum Products						
EPA Method M8015B-Extractables	1-L amber glass bottle	chill to 4°C.	None	2	7 days to extraction; 40 days to extract analysis	Extractable hydrocarbons
EPA Method M8015B-Purgabless	40-mL glass VOA vial	chill to 4°C.	HCl to pH ≤ 2	3	4 days to analysis	Purgable hydrocarbons
Soil - Organics, Petroleum Products						
EPA Method M8015B-Extractables	8-ounce glass jar	chill to 4°C.	None	1	7 days to extraction; 40 days to extract analysis	Extractable hydrocarbons
EPA Method M8015B-Purgabless	8-ounce glass jar	chill to 4°C.	None	1	14 days (preserved with methanol or sodium bisulfate); 7 days (frozen); 48 hours (EnCore or equivalent sampling device, unpreserved, not frozen).	Purgable hydrocarbons
Water - Inorganics, Metals						
EPA Method 200.7	500-mL poly	chill to 4°C.	HNO3 to pH ≤ 2	1	6 months to analysis	
EPA Method 200.8	500-mL poly	chill to 4°C.	HNO3 to pH ≤ 2	1	6 months to analysis	
EPA Method 218.6	125-mL poly	chill to 4°C.	None	1	24 hours to analysis	
EPA Method 245.1	500-mL poly	chill to 4°C.	HNO3 to pH ≤ 2	1	28 days to analysis	
EPA Method 6010B	500-mL poly	chill to 4°C.	HNO3 to pH ≤ 2	1	6 months to analysis	
EPA Method 6010B	500-mL poly	chill to 4°C.	HNO3 to pH ≤ 2	1	6 months to analysis	
EPA Method 7196A	125-mL poly	chill to 4°C.	None	1	24 hours to analysis	
EPA Method 7470A	500-mL poly	chill to 4°C.	HNO3 to pH ≤ 2	1	28 days to analysis	
Soil - Inorganics, Metals						
EPA Method 6010B	8-ounce glass jar	chill to 4°C.	None	1	6 months to analysis	
EPA Method 6020	8-ounce glass jar	chill to 4°C.	None	1	6 months to analysis	
EPA Method 7471A	8-ounce glass jar	chill to 4°C.	None	1	28 days to analysis	
Water - Organics, Pesticides						
EPA Method 8081A	1-L amber glass bottle	chill to 4°C.	None	2	7 days to extraction; 40 days to extract analysis	

TABLE 3-1
Sample Containers, Preservation, and Holding Times
RWQCB Quality Assurance Project Plan, February 2015

Method	Bottle Type	Temperature Preservative	Chemical Preservative	Number per Sample	Project Holding Time	Notes
EPA Method 8141	1-L amber glass bottle	chill to 4°C.	None	2	7 days to extraction; 40 days to extract analysis	
Soil - Organics, Pesticides						
EPA Method 8081A	8-ounce glass jar	chill to 4°C.	None	1	14 days to extraction; 40 days to extract analysis	
EPA Method 8141	8-ounce glass jar	chill to 4°C.	None	1	14 days to extraction; 40 days to extract analysis	
Water - Organics, Polychlorinated Biphenyls as Aroclors						
EPA Method 8082	1-L amber glass bottle	chill to 4°C.	None	2	7 days to extraction; 40 days to extract analysis	No Holding Time Per SW846
Soil - Organics, Polychlorinated Biphenyls as Aroclors						
EPA Method 8082	8-ounce glass jar	chill to 4°C.	None	1	14 days to extraction; 40 days to extract analysis	No Holding Time Per SW846
Water - Organics, Herbicides						
EPA Method 8151A	1-L amber glass bottle	chill to 4°C.	None	2	7 days to extraction; 40 days to extract analysis	
Soil - Organics, Herbicides						
EPA Method 8151A	8-ounce glass jar	chill to 4°C.	None	1	14 days to extraction; 40 days to extract analysis	
Water - Organics, Other Organics						
EPA Method 314.1	250-mL poly	chill to 4°C.	None	1	28 days to analysis	
EPA Method 415.1	100-mL poly	chill to 4°C.	HCl to pH ≤ 2	1	28 days to analysis	
EPA Method 6850	250-mL poly	chill to 4°C.	None	1	28 days to analysis	
EPA Method 9060	1-L glass bottle	chill to 4°C.	H2SO4 or HCl to pH ≤ 2	2	28 days to analysis	
EPA Method RSK 175	40-mL glass VOA vial	chill to 4°C.	HCl to pH ≤ 2	3	14 days to analysis	
Soil - Organics, Other Organics						
EPA Method 9060	8-ounce glass jar	chill to 4°C.	None	1	14 days to extraction; 40 days to extract analysis	
Water - Organics, Other Organics						
EPA Method 130.2	500-mL poly	chill to 4°C.	None	1	14 days to analysis	

TABLE 3-1
Sample Containers, Preservation, and Holding Times

RWQCB Quality Assurance Project Plan, February 2015

Method	Bottle Type	Temperature Preservative	Chemical Preservative	Number per Sample	Project Holding Time	Notes
EPA Method 160.1	500-mL poly	chill to 4°C.	None	1	7 days to analysis	
EPA Method 160.2	500-mL poly	chill to 4°C.	None	1	7 days to analysis	
EPA Method 180.1	100-mL poly	chill to 4°C.	None	1	48 hours to analysis	
EPA Method 300.0	125-mL poly	chill to 4°C.	None	1	28 days to analysis	Nitrate: 48 hours
EPA Method 310.1	500-mL poly	chill to 4°C.	None	1	14 days to analysis	
EPA Method 353.1/353.2	200-mL poly	chill to 4°C.	H2SO4 to pH ≤ 2	1	28 days to analysis	
EPA Method 9010B	500-mL poly	chill to 4°C.	Zinc Acetate/NaOH to pH ≥ 12	1	14 days to analysis	
EPA Method 9012A	500-mL poly	chill to 4°C.	Ascorbic Acid/ NaOH to pH ≥ 12	1	14 days to analysis	
EPA Method 9030	500-mL poly	chill to 4°C.	Zinc Acetate/NaOH to pH ≥ 12	1	7 days to analysis	
EPA Method 9056	500-mL poly	chill to 4°C.	None	1	28 days to analysis	Nitrate: 48 hours

TABLE 3-2
Representative Soil Sampling Techniques
Quality Assurance Project Plan, February 2015

Method	Surface	Subsurface	Target Analytes	Geology	Type
Hollow Stem Auger		✓	All	Unconsolidated	Drilling
Direct Mud Rotary		✓	All		Drilling
Air Rotary		✓	Semivolatiles, metals, inorganics	Consolidated	Drilling
Scoops, Spoons, Shovels	✓	✓ (shallow)	All	NA	Hand
Augers	✓	✓	All	NA	Power-driven
Split Barrel		✓	All	NA	Power-driven

TABLE 3-3
In-field Screening Analytical Methods
Quality Assurance Project Plan, February 2015

Method	Parameter
USEPA Method 9040B	pH (water)
USEPA Method 9050A	Conductance
Hach Method 8146	Ferrous iron
Hach Method 8051	Sulfate
Hach Method 8507	Nitrate-nitrogen
Hach Method 10023	Ammonia-nitrogen
Hach Method 8131	Sulfide
Hach Method 8048	Phosphoros (ortho-phosphate)
Hach Test Kit	Carbon dioxide
Organic vapor-analysis using an instrument equipped with a flame ionization detector or photoionization detector or other selective detector (e.g., for explosives, chlorinated hydrocarbons).	Soil-gas screening—halogenated, aromatic, and petroleum hydrocarbons. Screening of drill cuttings, borings, monitoring wells, and temporary probes.
ASTM D1498	Oxidation-reduction potential
USEPA Method 4020	Polychlorinated biphenyls by immunoassay
USEPA Method 4030	Total petroleum hydrocarbons by immunoassay
USEPA Method 4035	Polycyclic aromatic hydrocarbons by immunoassay

TABLE 3-4
Sample Preparation and Cleanup Methods
Quality Assurance Project Plan, February 2015

USEPA Method	Parameter
Volatile Organics	
5030B	Purge and trap for volatile organic compounds (aqueous samples)
5031	Volatile, nonpurgeable, water-soluble compounds by azeotropic distillation
5032	Volatile organic compounds (aqueous and solid samples) by vacuum distillation
5035Aa	Closed-system purge-and-trap and extraction for volatile organics in soil and waste samples
3585	Waste dilution for volatile organics (solid samples)
Extractable Organics	
3510C	Separatory funnel liquid-liquid extraction (aqueous samples)
3520C	Continuous liquid-liquid extraction (aqueous samples)
3535A b	Solid-phase extraction (aqueous samples)
3540C/3541	Soxhlet extraction (solid samples)
3545	Pressurized fluid extraction (solid samples)
3550B	Ultrasonic extraction (solid samples)
Metals	
3005A	Acid digestion of water samples for metals analysis
3010A	Acid digestion of aqueous samples and extracts for metals analysis
3015	Microwave assisted acid digestion of aqueous samples and extracts for metals analysis
3020A	Acid digestion of aqueous samples and extracts for metals analysis
3050B	Acid digestion of solids, sediments, and sludges for metals analysis
3051	Microwave assisted acid digestion of solids, sediments, and sludges for metals analysis
3060A	Alkaline digestion for hexavalent chromium in sediment, sludge, and soil samples
Leaching Procedures	
CAWET (State of California Method)	California Administrative Code waste extraction test
1311	Toxicity characteristic leaching procedure (aqueous and solid samples)
1312	Synthetic precipitation leaching procedure (aqueous and solid samples)
Cleanup	
3610B	Alumina cleanup adsorption
3620B	Florisil cleanup adsorption
3630C	Silica gel cleanup adsorption
3640A	Gel-permeation cleanup size-separation
3650B	Acid-base partition cleanup acid-base partitioning
3660B	Sulfur cleanup oxidation/reduction
3665A	Sulfuric acid/permanganate oxidation/reduction cleanup

TABLE 3-5
Definitive Analytical Methods
Quality Assurance Project Plan, February 2015

Analytical Technique	USEPA Method	Parameter	Water	Soil	Reference
Gas Chromatography	8015B	TPH-gasoline-range organics	X	X	1
	8015B	TPH-diesel-range organics	X	X	1
	8015B	TPH-kerosene-range organics			
	8081A	Organochlorine pesticides	X	X	1
	8082	Polychlorinated biphenyls	X	X	1
	8141A	Organophosphorus compounds	X	X	1
	8151A	Chlorinated herbicides	X	X	1
	RSK-175	Dissolved gasses in water	X	X	2
Gas Chromatography/Mass Spectrometry	504.1	EDB, DBCP, and 1,2,3-TCP	X		3
	CDPH Method	1,2,3-TCP	X		8
	8260B	Volatile organics	X	X	1
	524.2	Volatile organics	X		3
	8270C, 8270C-SIM	Semi-volatile organics	X	X	1
	8270C, 8270C-SIM	1,4-dioxane	X	X	1
	TO-14A/TO-15/TO-17	Volatile organics in air and soil gas	air	air	4
	1625	NDMA	X		5
High-performance Liquid Chromatography	8310	Polycyclic aromatic hydrocarbons	X	X	1
Inductively-coupled Mass Spectrometry	6010B	Trace metals by ICP-AES	X	X	1
	200.7	Trace metals by ICP-AES	X		6
	6020	Trace metals by ICP-MS	X	X	1
	200.8	Trace metals by ICP-MS	X		6
Cold Vapor Atomic Absorption	7470A	Mercury (water)	X		1
	245.1	Mercury (water)	X		
	7471A	Mercury (soil)		X	1
Ion Chromatography	218.6	Hexavalent chromium	X		6
	300.0	Fluoride, chloride, nitrite-N, bromide, nitrate-N, phosphate-P, and sulfate	X		6
Other Inorganic Methods	130.2	Total hardness	X		6
	160.1	Total dissolved solids	X		6
	160.2	Total suspended solids	X		6
	180.1	Turbidity	X		6
	310.1	Alkalinity	X		6
	314.1	Perchlorate	X		6
	68506860	Perchlorate	X	X	7

TABLE 3-5
Definitive Analytical Methods
Quality Assurance Project Plan, February 2015

Analytical Technique	USEPA Method	Parameter	Water	Soil	Reference
	353.1/2	Nitrate	X		6
	9030	Sulfide	X		1
	7196A/7197	Hexavalent chromium	X		1
	9010B	Total and amenable cyanide (distillation)	X		1
	9012A	Total and amenable cyanide (colorimetric)	X		1
	9056	Common anions	X		1
	415.1	Total organic carbon	X		6
	9045C	pH		X	
	9060	Total organic carbon		X	1

References

1. United States Environmental Protection Agency. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. EPA SW-846, 3rd Edition, Office of Solid Waste and Emergency Response. September (including Final Updates I, II, IIA, and III).
2. Kampbell, Don H. and Vandergrift, Steve A. 1998. Analysis of Dissolved Methane, Ethane, and Ethylene in Ground Water by Standard Gas Chromatographic Technique. *Journal of Chromatographic Science*, Volume 36, May.
3. United States Environmental Protection Agency. 1988. *Methods for the Determination of Organic Compounds in Drinking Water*. Environmental Monitoring Systems Laboratory, Office of Research and Development, EPA-600/4-88/039 December. (Revised July 1991.)
4. United States Environmental Protection Agency. 1997. *Compendium of Method for the Determination of Toxic Organic Compounds in Ambient Air*, Second Edition, EPA 625/R-96/010b. January.
5. United States Environmental Protection Agency. *Method 1625: Revision B -- Determination of Semivolatile Toxic Organic Pollutants and Additional Compounds Amenable to Extraction and Capillary Column Gas Chromatography/Mass Spectrometry*.
6. United States Environmental Protection Agency. 1983. *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, March.
7. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. EPA SW-846. New methods on-line, http://www.epa.gov/SW-846/new-meth.htm.
8. http://www.cdph.ca.gov/CERTLIC/DRINKINGWATER/Pages/123TCPanalysis.aspx

TABLE 3-6
Emergent Chemicals
Quality Assurance Project Plan, January 2015

Emergent Chemical	Method	Reporting Limits	Concentration Goal[a]	Units
Perchlorate	314.0	4	6	µg/L
N-Nitrosodimethylamine	1625	0.002	10	µg/L
1,4-dioxane	8270C (recommended) 8260B	1	3	µg/L
1,2,3-Trichloropropane[b]	CDPH Method	0.0005	0.0005	µg/L
Hexavalent chromium	218.6, 218.7	1	10	µg/L
Methyl-tertiary-butyl ether	8260B, 524.2	3	13	µg/L

Notes:
[a] Concentration goals for perchlorate, methyl-tertiary-butyl ether, and hexavalent chromium are California MCLs. The concentration goals for N-nitrosodimethylamine and 1,2,3-trichloropropane are advisory action limits.

[b] Alternative methods such as USEPA Method 504.1 may be used.

References:

State of California Water Resources Control Board (SWRCB), Division of Clean Water Programs. 2002. *Draft Groundwater Information Sheet, (NDMA)*. (http://www.swrcb.ca.gov/gama/docs/ndma_oct2002_rev3.pdf. October.

_____. Division of Clean Water Programs. 2002. *Draft Groundwater Information Sheet, Chromium VI*. http://www.swrcb.ca.gov/gama/docs/cr6_oct2002_rev3.pdf. October.

_____. Division of Clean Water Programs. 2002. *Draft Groundwater Information Sheet, Methyl Tertiary Butyl Ether (MTBE)*. http://www.swrcb.ca.gov/gama/docs/mtbe_oct2002_rev3.pdf. October.

_____. Division of Clean Water Programs. 2003. *Draft Groundwater Information Sheet, 1,2,3-Trichloropropane (TCP)*. http://www.swrcb.ca.gov/gama/docs/tcp_jun2003.pdf. June.

United States Environmental Protection Agency (USEPA). 1995. 1,4-Dioxane Fact Sheet. EPA 749-F-95-010a. http://www.epa.gov/opptintr/chemfact/dioxa-sd.txt. February.

California Environmental Protection Agency Perchlorate Fact Sheet. http://www.dtsc.ca.gov/HazardousWaste/Perchlorate/upload/CalEPA_FS_Perchlorate.pdf.

TABLE 3-7
Guidelines Used for Comparing Split Sample Data
Quality Assurance Project Plan, February 2015

Analytical Results Obtained	Evaluation Criteria Applied	Conclusion
Both results not detected.	Reporting limits differ by more than ±25%	Disagreement
One positive result, one result not detected.	>5x difference in result and reporting limits	Disagreement
	>10x difference in result and reporting limits	Major disagreement
One positive result above the reporting limit, one positive result between the MDL and reporting limit.	>3x difference in results	Disagreement
	>5x difference in results	Major disagreement
Both results above the reporting limit, calculate relative percent difference.	>30% relative percent difference	Disagreement
	>65% relative percent difference	Major disagreement

Note:

Relative Percent Difference: 100* |(Result1-Result2)| /((Result1+Result2)/2)

TABLE 3-8
Laboratory Deliverable Requirements
Quality Assurance Project Plan, February 2015

Analytical Fractions	
Case Narrative – A detailed case narrative per analytical fraction is required and will include explanation of the non-compliance and/or exceptions and corrective action. Exceptions will be noted for receipt, holding times, methods, preparation, calibration, blanks, spikes, surrogates (if applicable), and sample exceptions.	•
Sample ID Cross Reference Sheet (Lab IDs and Client IDs)	•
Completed Chain of Custody and the sample receipt information	•
Sample preparation (extraction/digestion) logs	•
Copies of non-conformance memos and corrective actions	•

Form[a]	GC/MS Organic Fractions	Preliminary	Summary	Full
1	Sample results	•	•	• + raw
2	Surrogate recovery summary (with applicable control limits)	•	•	•
3	MS/MSD accuracy and precision summary[b]	•	•	• + raw
3	LCS accuracy summary	•	•	• + raw
4	Method blank summary	•	•	• + raw
5	Instrument tuning summary (including tuning summary for applicable initial calibrations)		•	•
6	Initial calibration summary (including concentration levels of standards)		•	• + raw
7	Continuing calibration summary		•	• + raw
8	Internal standard summary (including applicable initial calibrations)		•	•

Form[a]	GC/HPLC Organic Fractions	Preliminary	Summary	Full
1	Sample results	•	•	• + raw
2	Surrogate recovery summary (with applicable control limits)	•	•	•
3	MS/MSD accuracy and precision summary[b]	•	•	• + raw
3	LCS accuracy summary	•	•	• + raw
4	Method blank summary	•	•	• + raw
6	Initial calibration summary (including concentration levels of standards)[c]		•	• + raw
7	Continuing calibration summary[c]		•	• + raw
7	Degradation summary (organochlorine pesticides only)[c]		•	• + raw
8	Analytical sequence (including internal standard area performance where applicable)[c]		•	•
10	Compound identification summary (where confirmation required)[c]		•	•

TABLE 3-8
Laboratory Deliverable Requirements
Quality Assurance Project Plan, February 2015

Form[a]	Metals Inorganic Fractions	Preliminary	Summary	Full
1	Sample results	•	•	• + raw
2A	Initial and continuing calibration summary		•	• + raw
3	Initial and continuing calibration blanks and method blanks summary	•	•	• + raw
4	Interference check standard summary		•	• + raw
5A	Pre-digestion matrix spike recoveries summary	•	•	• + raw
5B	Post-digestion spike recoveries summary		•	• + raw
6	Native Duplicate or MS/MSD precision summary[b]	•	•	• + raw
7	Laboratory control sample recovery summary	•	•	• + raw
8	Method of standard addition (if necessary)		•	• + raw
9	Serial dilution		•	• + raw
10	Instrument or method detection limit summary		•	•
11	ICP interelement correction factors		•	•
12	Linear range summary		•	•
13	Preparation log summary		•	• + raw
14	Analytical run sequence and GFAA post-spike recovery summary		•	• + raw

Form[a]	General Chemistry Fractions: (Includes Potentiometric, Gravimetric, Colorimetric, and Titrimetric Analytical Techniques. Examples, TPH (418.1), Total Organic Carbon, etc.)	Preliminary	Summary	Full
1	Sample results	•	•	• + raw
2A	Initial and continuing calibration summary		•	• + raw
3	Initial and continuing calibration blanks and method blanks summary	•	•	• + raw
5A	Pre-digestion matrix spike recoveries summary	•	•	• + raw
6	Native duplicate or MS/MSD precision summary[b]	•	•	• + raw
7	Laboratory control sample recovery summary	•	•	• + raw
10	Instrument or method detection limit summary		•	•

[a] Contract Laboratory Program Form or summary form with equivalent information.

[b] With relative percent difference calculated according to method specifications (Contract Laboratory Program using percent recovery, SW846 using concentration).

[c] Including deliverables for primary and confirmation analysis (where applicable).

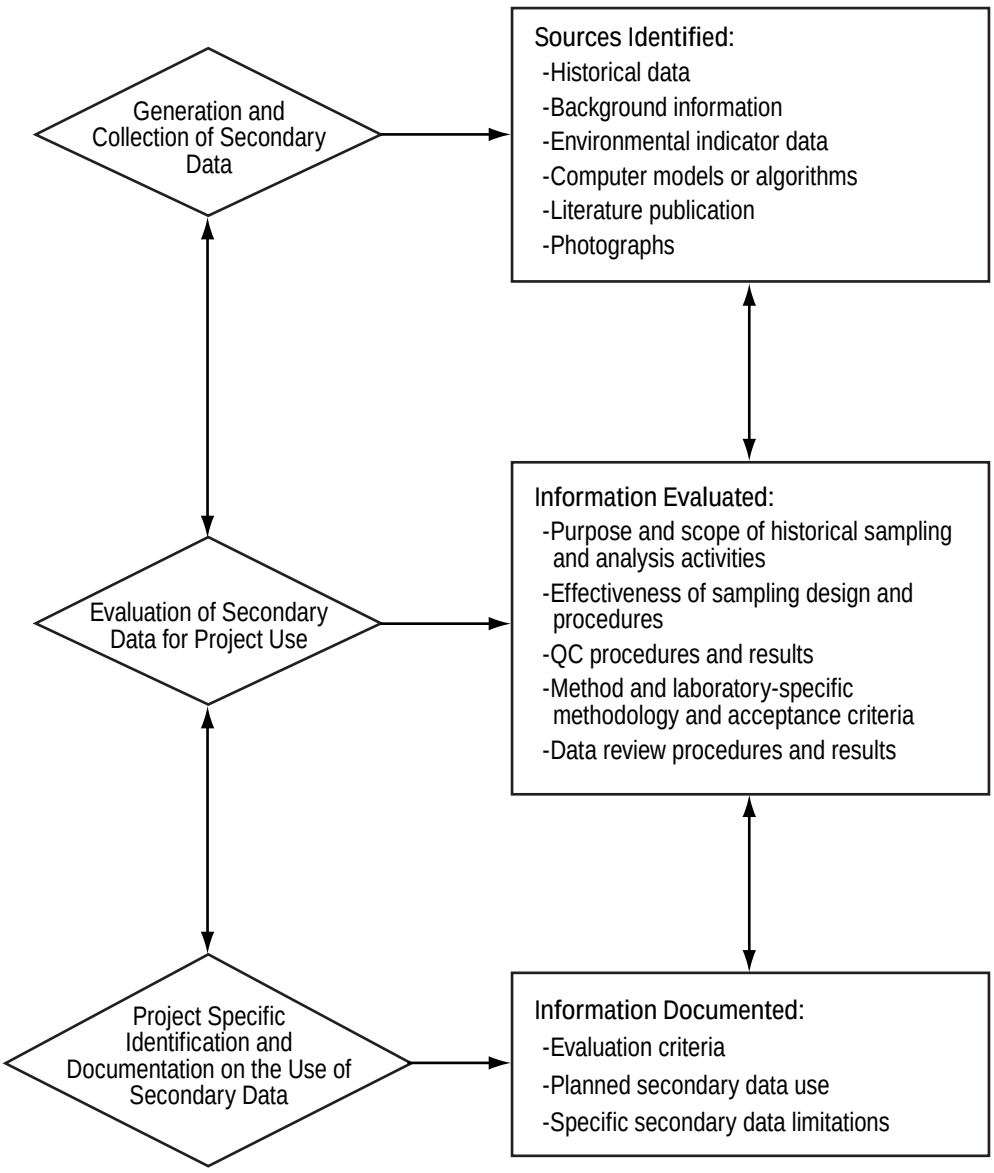


FIGURE 3-1
Secondary Data Evaluation
RWQCB Quality Assurance Project Plan
September 2008

4.0 Assessment and Oversight

This section presents the elements of Group C (USEPA, 2002a) and describes assessments and evaluations that are implemented to determine whether the following QAPP requirements have been met:

- Have they been implemented as approved?
- Have they been established to the required level of confidence in the collected information?
- Have they been determined to indicate whether information is of sufficient quality to meet the project objectives?

4.1 Assessments and Response Actions

Assessment and response actions include, but are not limited to:

- Performance audits of field and laboratory activities.
- System audits of field and laboratory documentation.
- Routine review of field and laboratory documents.
- Identification and resolution of nonconforming conditions.

The following sections describe the procedures for possible assessment and response actions. A thorough description of the procedures that will be applied to site-specific activities must be described in the facility-specific work plan.

4.1.1 Performance Audits

Performance audits of field and laboratory activities are conducted to evaluate compliance with approved planning documents, each organization's SOPs and accepted industry standards.

4.1.1.1 Laboratory Audits

Laboratory audits include both onsite technical and offsite systems evaluations. Laboratory audits may be requested by facilities or by RWQCB or USEPA. The audit requirements shall be documented in the site-specific work plan.

Onsite Technical Laboratory Audit. An onsite laboratory audit shall begin with a pre-audit meeting between the auditor and the laboratory staff in which the auditor will discuss the purpose of the audit, the schedule and areas to be audited, and the procedures that will be followed. The pre-audit meeting may include a brief tour of the laboratory. The audit will then be conducted. The auditor will assemble the findings at the conclusion of the audit and will discuss the findings with laboratory staff in a post-audit meeting. Critical items that will be covered in a technical systems audit of the laboratory include:

- Certification and training records.
- Calibration procedures and documentation.

- Treatment and handling of standards.
- Completeness of data forms, notebooks, and other reporting requirements.
- Data review and verification procedures.
- Data storage, filing, and recordkeeping procedures.
- Sample custody procedures.
- Quality control procedures, tolerances, and documentation.
- Operating conditions of facilities and equipment.
- Documentation of staff training and instrument maintenance activities.
- Systems and operations overview.

A written audit report will then be sent to the laboratory within a specified time. A copy of the audit report will be sent to the project-specific Project Manager. A copy will be retained in the project files.

The need for follow-up action will be determined based on the laboratory's responses. If an audit identifies an unacceptable condition or unacceptable data, the auditor will be responsible for developing and initiating corrective action. The Project Manager will be notified if the non-conformance impacts the project and requires resources not normally available to the project team. In such cases, the Project Manager will decide whether resources to pursue corrective action will be made available. Disposition may include:

- Reanalysis of samples if holding time has not expired.
- Resampling and analysis.
- Amending analytical procedures.
- Acceptance of suspect data acknowledging the limits on usability.

Laboratory Systems Audit. Systems audits include the use of split samples, performance evaluation samples, data review and validation, and review of laboratory SOPs and the Quality Assurance Manual. The following describes these types of audit activities.

Split Samples. In some cases, laboratory evaluation may be performed by sending split samples or PE samples to ascertain the laboratory's ability to generate quality data. Performance evaluation samples are samples of known concentrations of target analytes that are packed and shipped to the laboratory along with field samples. The performance evaluation samples shall be identified in a manner indistinguishable from field samples. Split samples are duplicate field samples sent to a second, referee laboratory. For both split samples and performance evaluation samples, the evaluation process involves comparing the primary laboratory's results to the referee laboratory's results (split samples) or to the known concentration or concentration range (performance evaluation samples). In addition, the evaluation should include review of raw data, analytical reports, and other documentation specific to the samples, as well as reviewing SOPs, laboratory policies, and the laboratory's Quality Assurance Manual. Procedures for evaluation of split-sample or performance evaluation results shall be documented in the facility-specific work plan, with a procedure for determining both minor and major disagreement between split sample results and minor and major analyte recovery failure for performance evaluation samples. The facility-specific work plan shall also describe potential corrective actions appropriate to the observed nonconformance.

Review of Laboratory Documentation. Review of laboratory quality systems documentation, along with representative results report and raw data, shall be conducted to verify that analytical results are being produced in accordance with applicable plans and procedures. These reviews will most likely include but not be limited to:

- Comparison of resulting data to the SOP or method, including coding for deviations.
- Verification of initial and continuing calibrations within control limits.
- Verification of surrogate recoveries and instrument timing results where applicable.
- Review of extended quantitation reports for comparisons of library spectra to instrument spectra, where applicable.
- Recoveries on control standard runs.
- Review of run logs with run times, ensuring proper order of runs.
- Review of spike recoveries / quality control sample data.
- Review of suspected manually integrated gas chromatography data and its cause (where applicable).
- Review of gas chromatography peak resolution for isolated compounds as compared to reference spectra (where applicable).
- Assurance that samples are run within holding times.

The review of laboratory documentation is method and project specific. Technical requirements and acceptability criteria for the systems evaluation shall be provided in the facility-specific work plan.

4.1.1.2 Field Audits

Field audits shall be conducted at least once at the beginning of the site sample collection activities. The audit will include examination of field sampling records, field screening analytical results, field instrument operating records, sample collection, handling, and packaging for compliance with the established quality assurance procedures. Follow-up audits will be conducted to correct deficiencies and to verify that quality assurance procedures are maintained throughout the investigation. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation.

The field audits shall be reported to the management team weekly. The written report shall include, at a minimum, findings from the checklist, deviations (if identified) from the facility-specific work plan or the QAPP, corrective actions taken, and a summary of the findings from any follow-up audits.

4.2 Assessment Findings and Corrective Action Responses

Corrective actions will be required when a performance failure is discovered or when performance or system audits reveal deficiencies. Each corrective action response will be documented, and the documentation will be maintained with project records.

4.2.1 Laboratory Corrective Action

Initial data assessment lies with the laboratory analyst, who must verify that required quality control procedures were followed and that analytical results are within acceptable limits. If quality control acceptance criteria are not met, the analyst must assess the system and, if the problem is not immediately correctable, notify the laboratory Quality Assurance Coordinator that there is an issue. If the problem has affected data that were already generated, the laboratory Quality Assurance Coordinator or the laboratory Signoff Manager must notify the RWQCB Project Manager of the problem, corrective action taken, and the result of the corrective action, and how data have been affected.

If negative findings are reported by the discharger to the laboratory based on either onsite audits or project data review, the laboratory will investigate the root cause and will take corrective action in a manner similar to that described for internal laboratory assessments described above. Where reported data are affected, the laboratory will provide corrections as part of the response if possible. The discharger's Project Manager will document the event and will notify the Quality Assurance Officer to decide the type of action necessary (i.e., resample and rerun samples, performance or systems audit). The laboratory must demonstrate that a system is "in control" before further sample analysis can be conducted, and the acceptability of the laboratory's corrective action must be documented by the discharger prior to close of the Corrective Action Request.

4.2.2 Field Corrective Action

Responsibility for the quality of sample collection, sample handling, and field measurements lies with field personnel. The field supervisor will be responsible for verifying that proper techniques were used and that the quality control steps necessary to meet project objectives were taken. If a problem arises that might jeopardize project integrity, the field supervisor will notify their management, who in turn will inform the RWQCB Project Manager on what type of corrective action is being recommended and/or implemented. The field supervisor will also be responsible for documenting the problem, the corrective action taken, and the results of the action taken.

Both short- and long-term corrective action will be documented and will be entered into a master log for each project. For example, if a short-term problem occurs (i.e., equipment failure and immediate repair corrects the problem), the circumstances will be recorded in the field notebook and will require no further action. Conversely, if unacceptable data are generated without initial detection, then long-term corrective action, such as a periodic performance audit or system audit, may be required. The Project Manager and Quality Assurance Officer will be responsible for deciding what kind of audit is needed and the extent of the auditing process that is needed to resolve the problem.

4.3 Report to Management

Results of project oversight and assessment activities will be reported to project management at a frequency specified in the facility-specific work plan. The type of reports may include but are not limited to:

- Field and laboratory assessment reports.

- Results of the analysis of performance evaluation samples.
- Field documentation including instrument calibration and quality control samples prepared and analyzed.
- Notifications of non-conforming conditions and corrective actions.

The personnel responsible and the type of reports required to document audit findings, evaluations, assessments, corrective actions, and quality control results shall be identified in the facility-specific work plan.

5.0 Data Validation and Usability

This section presents the elements of Group D Data Validation and Usability (USEPA, 2002a) and provides the procedures to be used to verify and evaluate project data.

5.1 Data Review, Verification, and Validation

The procedures presented in this section provide the final documentation, quality, and acceptability checks on the information obtained from environmental projects. With regards to analytical data, RWQCB and USEPA recommend that data review and validation be performed by a third party, and the identity of the third-party data validator shall be presented in the facility-specific work plan.

For the purposes of RWQCB and/or USEPA activities, the terms "Verification," "Review," and "Validation" are defined as follows:

- Data verification is generally the first step in the process and may be performed by the discharger or their designee. The verification process includes checks on completeness of samples collected and analyses performed for correctness.
- Data review is a systematic review of documentation associated with sample collection and includes review of sample and quality control results presented on standardized report forms. Data review is a limited evaluation of the reported results.
- Data validation is a systematic review of sample and quality control results, along with inspection of raw data and laboratory bench sheets, to verify that method implementation, performance, and quality control results meet project specifications. Significant deficiencies identified during data validation may result in implementation of additional quality control procedures such as additional data validation, collection of split samples, analysis of performance evaluation samples, or laboratory audits.

Appendix F contains a sample worksheet that may be used to document data review, verification, and validation activities. The results of data review and validation include, at a minimum, a set of data of known and documented quality. Where associated quality control results are outside project and/or method specifications, data are flagged using the following standard data qualifiers:

J	Analyte was present but reported value may not be accurate or precise.
R	This result has been rejected and is considered unusable.
U	This analyte was analyzed for but not detected at the specified reporting limit.
UJ	The analyte was not detected above the detection limit objective. However, the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample

Data will be reviewed and validated in accordance with the requirements of this QAPP, the facility-specific work plan, the applicable analytical methods, and:

- *Contract Laboratory Program National Functional Guidelines for Organic Data Review*, EPA-540/R-99-008 (PB99-963506) (USEPA, 1999)
- *USEPA Region 9 Laboratory Documentation Required for Data Evaluation,* R9QA/004.2 (USEPA, 2001a)
- *Contract Laboratory Program National Functional Guidelines for Low Concentration Organic Data Review*, EPA-540-R-00-006 (USEPA, 2001b).
- *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, OSWER 9240.1-45, EPA 540-R-04-004 (USEPA, 2004).
- *Contract Laboratory Program National Functional Guidelines for Chlorinated Dioxin/Furan Data Review*. Web site: http://www.epa.gov/superfund/programs/clp/guidance.htm - inorg#inorg, EPA-540-R-05-001 (USEPA, 2005).
- *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review*, OSWER 9240.1-44, EPA-540-R-08-001 (USEPA, 2008).
- *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review,* OSWER 9240.1-51, EPA-540-R-10-011 (USEPA, 2010).

The facility-specific work plan shall state the planned percentage of sample results that will receive full validation and the percentage that will require review. The need for validation versus review is an output of the DQO process and is determined based on the purpose of the data collection and the end use of the data. RWQCB recommends that, at a minimum, 20 percent of the samples be validated by an independent data validation company. At the request of RWQCB, CDPH Laboratory may provide the data validation service, while other independent companies shall be contracted for data validation if the laboratory analyses were conducted by the CDPH Laboratory.

5.2 Data Usability

Data collectors should consider all possible data end uses when developing a plan for data verification, review, and validation. Figure 5-1 presents the steps that should be used during final project data evaluation. For each data collection activity, the data collector must select analytical methods, target analytes, sensitivity requirements, and quality control requirements that meet the needs of the most critical end use objective under consideration.

5.3 Reconciliation with User Requirements

Data will be evaluated quantitatively for compliance with the project Measurement Quality Objectives (MQOs) in terms of precision, accuracy, and completeness and will be evaluated qualitatively through preparation of an assessment that summarizes the overall usability of the collected data to meet the project objectives. The project management team should make a determination as to whether the collected data is sufficient or if additional work is required to remedy insufficient or unusable data. Additional work may entail re-sampling, redesign of the sampling plan, making improvements to sampling quality control, making improvements to analytical quality control, amending the required analyses for the project,

or other types of remedies as deemed appropriate by the project management team and by regulatory guidance.

5.3.1 Precision, Accuracy, and Completeness

5.3.1.1 Precision

If calculated from duplicate measurements:

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

Where:

RPD = relative percent difference.
C_1 = larger of the two observed values.
C_2 = smaller of the two observed values.

If calculated from three or more replicates, use relative standard deviation (RSD) rather than relative percent difference (RPD):

$$RSD = (s / \bar{y})\ x\ 100\% \quad (3)$$

Where:

RSD = relative standard deviation.
s = standard deviation.
$\bar{y}$ = mean of replicate analyses.

Standard deviation, s, is defined as follows:

$$S = \sqrt{\frac{\sum_{i=1}^{n}\left(X_i - \overline{X}\right)^2}{n-1}} \quad (4)$$

Where:

s = standard deviation.
$\underline{X}_i$ = measured value of the i^{th} replicate.
X = mean of replicate analyses.
n = number of replicates.

5.3.1.2 Accuracy

For measurements where matrix spikes are used:

$$\%R = 100\%\ x\ \left[\frac{S-U}{C_{sa}}\right] \quad (5)$$

Where:

%R = percent recovery.
S = measured concentration in spiked aliquot.
U = measured concentration in unspiked aliquot.
C_{sa} = actual concentration of spike added.

For situations where a standard reference material (SRM) is used instead of or in addition to matrix spikes:

$$\%R = 100\% \times \left[\frac{C_m}{C_{sm}}\right] \qquad (6)$$

Where:

%R = percent recovery.
C_m = measured concentration of SRM.
C_{sm} = actual concentration of SRM.

5.3.1.3 Completeness (Statistical)

Defined as follows for each measurement:

$$\%C = 100\% \times \left[\frac{V}{T}\right] \qquad (7)$$

Where:

%C = percent completeness.
V = number of measurements judged valid.
T = total number of measurements.

The default completeness requirement for chemical data is 90 percent. The required holding time completeness is 100 percent. Alternative completeness goals must be stated in the facility-specific work plan.

5.3.2 Data Assessment

The data assessment process is a summary of outcome of the project quality control process, including procedures and the interim steps that were used to obtain project environmental data. The assessment should address overall measurement error associated with the project, significant non-conformances, the output of data review and validation, split-sample comparisons, deviations from approved planning documents, field-implemented changes, and overall suitability of the information to meet the project objectives.

The facility-specific work plan should present applicable approaches to data assessment. If a statistical sample collection plan is employed, the techniques presented in *Data Quality Assessment: A Reviewers Guide*, EPA G-9R (USEPA, 2006) should be used to develop the assessment plan.

If the project uses a non-statistical approach, the assessment will be limited to descriptions of the data and qualitative statements regarding the impact of non-conforming data on the overall project. The assessment appropriate approach should be documented in the facility-specific work plan and the final assessment included in the final report.

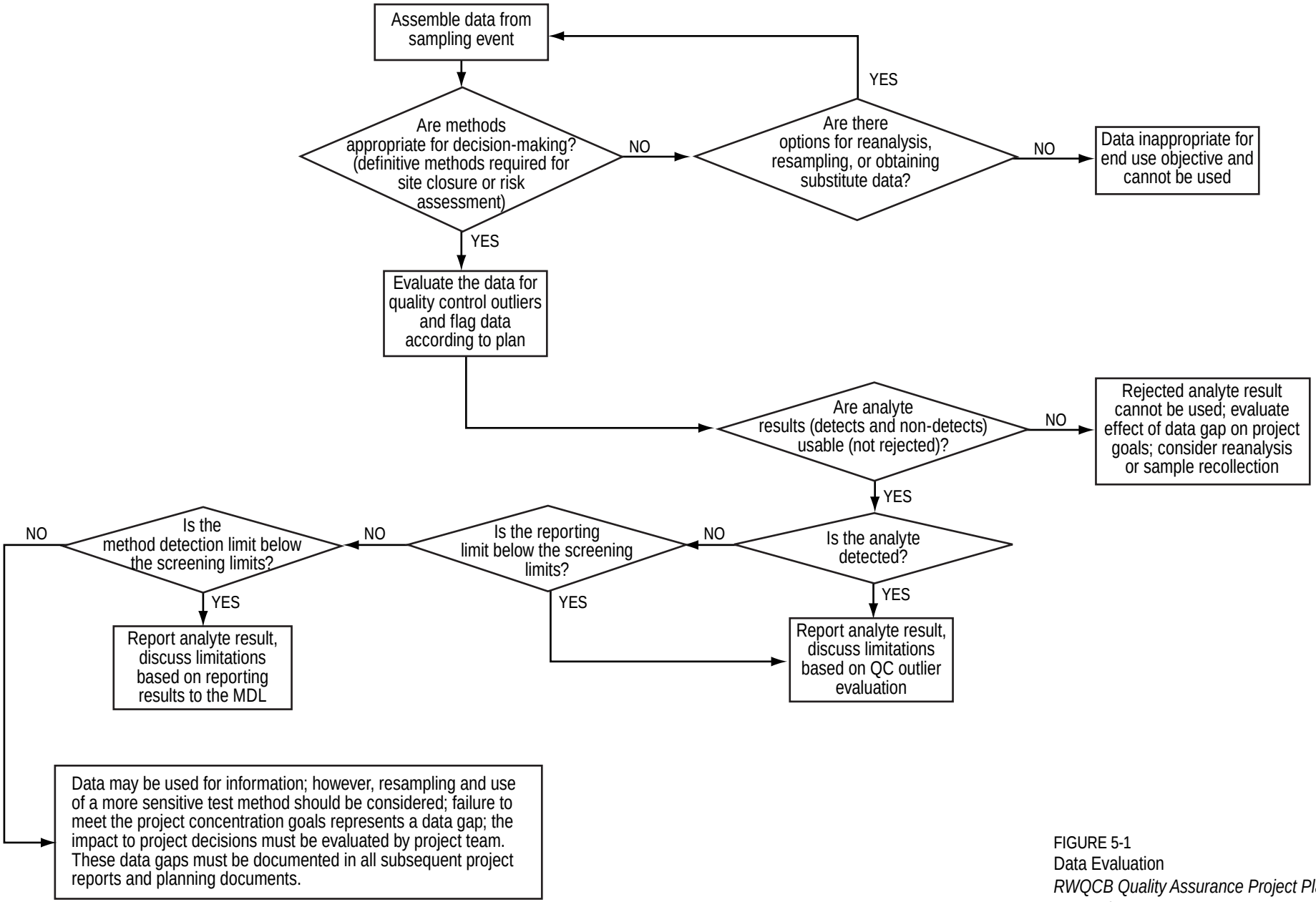


FIGURE 5-1
Data Evaluation
RWQCB Quality Assurance Project Plan
September 2008

6.0 References

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Appendix A
QAPP Planning and Implementation Worksheets

WORKSHEETS FOR QAPP IMPLEMENTATION AND PLANNING

The worksheets in Appendix A present the minimum elements needed to complete a quality plan and are designed as a guide for preparing a project QAPP or the QAPP section of a facility work plan. The worksheets are not intended to be comprehensive and do not include all required QAPP elements. The QAPP worksheets are limited to elements from Groups A, B, and D (USEPA 2002a)(See Table 1-1) and are focused on those QAPP elements that address sample collection, chemical analysis, data management, and data assessment. Additional worksheets and/or adaptation of these worksheets to meet the needs of specific projects may be required to complete an acceptable planning document.

Group A Project Management/Data Quality Objectives	A1 Title and Approval Sheet and A.3 Distribution List	Worksheet #1: Title Page, Approval Sheet, and Distribution List
Group A Project Management/Data Quality Objectives	A4 Project Task Organization	Worksheet #2: Project Organization Worksheet #3: Key Personnel, Responsibilities, Qualifications, contact Information
Group A Project Management/Data Quality Objectives	A5 Problem Definition and Background, A6 Project/Task Description and A.7 Quality Objectives and Criteria	Worksheet #4:Project Description And Rationale For Sample Collection And Analysis
Group B Measurement Data Acquisition	B1 Sampling Process Design (Experimental Design) and B2 Sampling Methods	Worksheet # 5: Sample Collection Matrix Worksheet #6: Detailed Sampling Plan
Group B Measurement Data Acquisition	B4 Analytical Methods	Worksheet #7: Required Reporting Limits
Group B Measurement Data Acquisition	B5 Quality Control	Worksheet #8: Test Methods And Data Quality Indicators Worksheet #9: Field Quality Control
Group B Measurement Data Acquisition	B10 Data Management	Worksheet #10: Data Management
Group D Data Validation and Usability	D1 Data Review, Verification, and Validation, D2 Verification and Validation Methods, D3 Reconciliation with User Requirements	Worksheet #11 Data Usability Assessment Procedure Worksheet #12 Project Completeness Worksheet

WORKSHEET #1
PROJECT MANAGEMENT: TITLE PAGE AND APPROVAL SHEET AND DISTRIBUTION LIST

If a stand-alone QAPP is developed, the QAPP must have a title and approval page with the relevant review and approval signatures. If the QAPP is included as a subsection of the work plan without a separate title page, the title page must include the stamp of a California-registered geologist, or a California registered civil engineer with at least 5 years of hydrogeologic experience.

Document Title

Lead Organization

Preparer's Name and Organizational Affiliation

Preparer's Address, Telephone Number, and E-mail Address

Preparation Date (Day/Month/Year)

APPROVAL SIGNATURES

Facility (Discharger/Property Owner) _____
Signature

_____
Printed Name

Facility Project Manager _____
Signature

_____
Printed Name/Organization/Date

Facility Project QA Officer: _____
Signature

_____
Printed Name/Organization/Date

_____
Signature

Engineer/Geologist [a] _____
Printed Name/Title/Date
☐ Registered Geologist
☐ Professional Engineer

Stamp

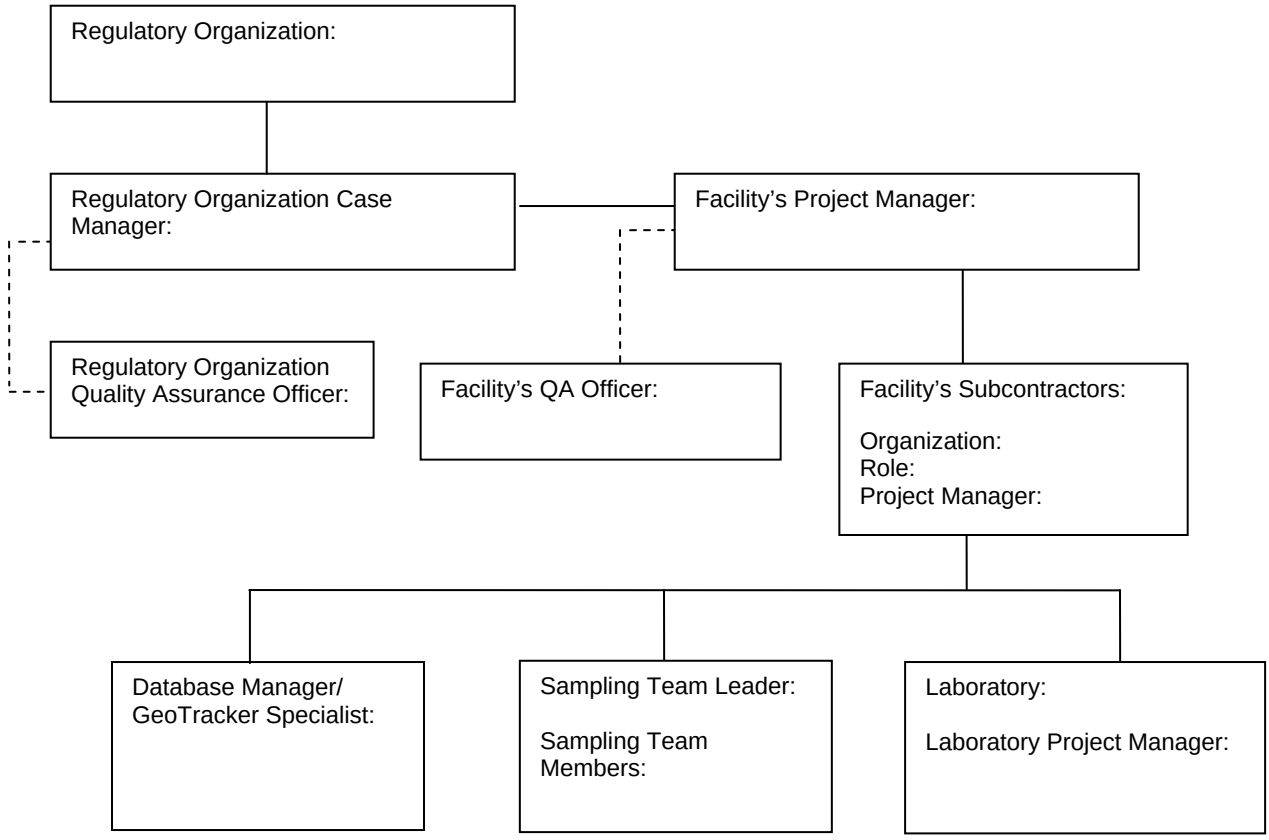
DISTRIBUTION LIST

QAPP Recipients	Title	Organization

[a] Required for work plan.

WORKSHEET #2
PROJECT ORGANIZATION CHART

Quality planning must have as an output a description of the project organization in the form of an organization chart. The organization chart must show lines of authority and communication for the key stakeholders and project personnel.



_____ Line of Authority

- - - - - - - Line of Communication

WORKSHEET #3
KEY PERSONNEL RESPONSIBILITIES, QUALIFICATIONS, and CONTACT INFORMATION

	Name	Organization	Contact Information	Project Title/Responsibilities
Regulators	RWQCB Case Manager			
	RWQCB Quality Assurance Officer			
Facility	Facility (Discharger/Property Owner)			
	Facility Quality Assurance Officer			
	Facility Project Manager			
	Facility Sample Team Leader			
	Database Manager/Geotracker Specialist			
	Laboratory Project Manager			

WORKSHEET #4
PROJECT DESCRIPTION AND RATIONALE FOR SAMPLE COLLECTION AND ANALYSIS

This worksheet provides the minimum documentation requirements for the organization of the site background information and the rationale behind the proposed sampling and analysis activities. This worksheet is intended to provide the outputs from the DQO process as supported by the information in Sections 2.9.1, 3.0, and Table 2-2 of this QAPP.

Required Elements	Narrative Description
Summarize site history and findings of RWQCB site inspection (if conducted)	
What type of sampling and analysis activities are plan: ☐ Initial Investigation ☐ Source Investigation-Soil Vapor Survey ☐ Source Investigation-Soil Sampling ☐ Nature and Extent Investigation-Soil Sampling ☐ Soil Vapor Intrusion Assessment ☐ Indoor air quality Assessment ☐ Source Investigation-Groundwater Monitoring ☐ Nature And Extent Investigation-Groundwater Monitoring ☐ Other	
What are the principle target analytes?	
What matrices will be sampled?	
What are the screening levels that will be used to make environmental decisions?	
What type of data are needed (matrix, target analytes, analytical groups, field screening, onsite analytical or offsite laboratory techniques, sampling techniques) to achieve project goals?	
Who will use the data?	
What decisions will be made based on the collected data?	

WORKSHEET # 5
SAMPLE COLLECTION MATRIX

The sample collection matrix represents a summary of the proposed sampling locations, the general basis for the selection of the proposed locations, and the number and type of samples to be collected.

Sample Location	Sample Identification	Matrix	Depth (units)	Analytical Group	Normal/ Field Duplicate/Equipment Blank/Trip Blank/ Other	Rationale for Sampling Location
					N/FD/EB/TB/Other:_____	SI UGW DGW NE RC MON SC IAQ SGS VIE other
					N/FD/EB/TB/Other:_____	SI UGW DGW NE RC MON SC IAQ SGS VIE other
					N/FD/EB/TB/Other:_____	SI UGW DGW NE RC MON SC IAQ SGS VIE other

SI: Site Investigation
UGW: Up-Gradient Well
DGW: Down-Gradient Well
NE: Nature and Extent Characterization
RC: Remedial Effectiveness Confirmation
MON: Ongoing Monitoring
SC: Site Closure
IAQ: Indoor Air Quality
SGS: Soil Gas Survey
VIE: Vapor Intrusion Evaluation

N: Normal field sample
FD: Field Duplicate
EB: Equipment Blank
TB: Trip Blank

Other, describe:

WORKSHEET #6
DETAILED SAMPLING PLAN

The detailed sampling plan is a listing of each sample to be collected by matrix, analytical method, and sampling method. It serves to summarize the containers, methods, method holding times, field QC samples including blanks and duplicates, and planned laboratory QC samples (MS/MSDs). Supporting information for completing this worksheet may be found in Section 3.0.

				Method					
				Preservative					
				Holding Time					
				Container					
				Number of Containers per Sample [a]					
Sample Identification	**Matrix**	**Type**	**Depth**	**Sample Collection Method**					

[a] Triplicate volumes (triplicate containers) required for the sample selected for matrix spike/matrix spike duplicate at a frequency of 1 per 20 field samples of the same matrix.

Example Sample Codes:

Matrix:
GW: Groundwater
SW: Surface Water
MW: Monitoring Well
SS: Surface Soil
SB: Soil Boring
AA: Ambient Air
SV: Soil Vapor (off site-analysis)
IA: Indoor Air
PW: Public Production well
SO: Surface Soil
SG: Soil Gas (on-site analysis)

Sample Collection Method:
PP: Portable Pump
DP: Dedicated Pump
BL: Bailer
DP: Direct Push
GB: Grab
SU: Summa canister
CT: Charcoal Tube
SP: SimulProbe
HP: Hydropunch
TG: Tedlar Bag
MG: Mylar Bag

Type:
N: Normal
FD: Field Duplicate
EB: Equipment Blank
TB: Trip Blank
FB: Field Blank
PE: Performance Evaluation Sample
SS: Split Sample

WORKSHEET #7
REQUIRED REPORTING LIMITS

For each analytical method, the target analytes, required reporting limits, and screening levels must be listed. Every effort to achieve reporting limits below the applicable screening levels must be made. Soil samples must be reported on a dry-weight basis, and the effect of dry-weight corrections must be considered when setting required reporting limits. An evaluation of the reporting limits compared to the screening levels must be made and documented on this worksheet. For analytes for which there is no method to achieve the screening levels, a discussion of the effect of possible data gaps (non-detect results above the screening level) must be presented in the work plan. Appendix C presents target analyte lists, groundwater screening levels, and suggested reporting limits.

Analyte	Method	Units	Project Screening Limit	Screening Limit Reference	Required Reporting Limits	Reporting Limits Below the Screening Limit (if no, provide explanation)
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N

WORKSHEET #8
TEST METHODS AND DATA QUALITY INDICATORS

This worksheet organizes the essential project required data quality indicators by analytical method. Section 2.9.2 and Appendices B and F present supporting information for the selection of test methods and development of data quality indicators.

Matrix	soil/water/ other_____	Data Quality Indicators						
		Laboratory Blanks	Laboratory Control Sample recovery	Matrix Spike/ Spike Duplicate Recovery	Matrix Spike/Spike Duplicate Precision	Surrogate Recovery	Equipment Blanks	Trip Blanks
Project Requirements								
Sampling Procedure	Analytical Method							

WORKSHEET #9
FIELD QUALITY CONTROL

Worksheet 9 summarizes the field quality control samples to be collected. Section 3.5.1 presents a description of the types of field quality control samples that may be required and the required collection frequency.

Method	Matrix	Number of Normal Samples	Number of Field Duplicate Pairs	Number of Field Blanks	Number of Equip. Blanks	Total Number of Samples

WORKSHEET #10
DATA MANAGEMENT

Worksheet 10 presents the required elements to adequately manage field and laboratory information. Sections 3.3 and 3.9 present supporting information, and Table 3-8 presents the requirements for laboratory data deliverables.

Element	Planned Procedures
Identify the project document and records that will be managed:	**Sample Collection** ☐ Field Notes ☐ COC Records ☐ Boring Logs ☐ Well Completion Diagrams ☐ Telephone Logs **Field Analysis Records** ☐ Equipment Calibration Logs ☐ Field Sampling Results **Laboratory Records** ☐ Sample Receipt and Log-In ☐ Laboratory Reports ☐ Laboratory Data Packages ☐ Laboratory EDDs
Identify the electronic data management system that will be used.	
For each of the type of records that will be maintained, describe the system that will be used to manage collected data and supporting documentation. Include both management of hardcopy and electronic information.	
Describe how data will be incorporated into the data management system and the personnel responsible for validation of the entries.	
Identify the format of final data including electronic deliverables from the laboratory. If Geotracker format not used, provide a justification and description of the alternative format.	☐ Geotracker format ☐ Other
Describe how final project data will be incorporated into the Geotracker system and identify the person responsible.	
Identify the personnel responsible for release of final data to the end users.	

WORKSHEET #11
DATA ASSESSMENT PROCEDURES

This worksheet presents the steps that are required to assess the usability and limitations of the collected data. The planning process should include a specific procedure for identifying and resolving suspect data in terms of the project objectives. The outputs of the data quality assessment shall be documented in all subsequent reports prepared using the acquired data

Step	Responsible Person	Suggested Procedures	Project Procedures
Data Verification		Check that results for all submitted samples are reported.	
		Check that correct methods are used	
		Check that holding time requirements are met	
		Check electronic data and hardcopy data agree	
Data Review/ Validation		Verify blanks are free of contamination	
		Verify that quality control sample analysis results meet project requirements	
		Verify reported results based on recalculation from raw data (data validation only)	
		Flag data according to plan	
Data Usability Assessment		Summary of significant field or laboratory quality problems	
		Summary of data flags from review/validation step	
		Evaluation of blanks and field duplicates	
		State whether project goals were met in terms of completeness (Worksheet #12)	
		State the limitations of the data; suspect data should be discussed in terms of bias, the possibility of false negative or false positive results, and uncertainties with regards to project decisions.	

Step	Responsible Person	Suggested Procedures	Project Procedures
		and discuss failure to meet project sensitivity goals for specific analytes, that is reporting limits which exceed screening limits.	

WORKSHEET #12
PROJECT COMPLETENESS

Worksheet 12 presents quantitative options for calculating project completeness. The work plan must define how project completeness will be calculated and identify the project completeness goal that will ensure that sufficient data are available for decision-making.

Type	Apply to Project	Completeness Goal (percent)	Procedures
Field	yes/no		
Holding Time	yes/no		
Analytical	yes/no		
Usability	yes/no		

Definitions:

Field Completeness: Ratio of the number of samples collected to the number of samples planned.

Holding Time Completeness: ratio of the number of samples analyzed within the method holding time to the total number of samples (recommended goal is 100 percent).

Analytical Completeness: Ratio of the number of qualified results to the total number of results (per analyte).

Usability Completeness: Ratio of the number of qualified results to the total number of samples collected (recommended goal is 90 percent).

Appendix B
Accuracy and Precision Guidelines for Definitive Methods

Table B1

Quality Control Limits for Definitive Methods (Water Only)

RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	LCS %R	MS/MSD %R	MSD RPD
Organics, Volatile Organic Compounds			
EPA Method 504.1			
1,2,3-Trichloropropane	80-120	75-125	25
1,2-Dibromoethane (EDB)	80-120	75-125	25
Dibromochloropropane (DBCP)	80-120	75-125	25
EPA Method 504.1 - Surrogates	**Surrogate %R**		
4-Bromofluorobenzene	70-130	NA	NA
EPA Method CaDPH Method-VOA			
1,2,3-Trichloropropane	80-120	75-125	25
EPA Method 524.2			
1,1,1,2-Tetrachloroethane	80-120	75-125	25
1,1,1-Trichloroethane	80-120	75-125	25
1,1,2,2-Tetrachloroethane	80-120	75-125	25
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	80-120	75-125	25
1,1,2-Trichloroethane	80-120	75-125	25
1,1-Dichloroethane	80-120	75-125	25
1,1-Dichloroethene	80-120	75-125	25
1,1-Dichloropropene	80-120	75-125	25
1,2,3-Trichlorobenzene	80-120	75-125	25
1,2,3-Trichloropropane	80-120	75-125	25
1,2,4-Trichlorobenzene	80-120	75-125	25
1,2,4-Trimethylbenzene	80-120	75-125	25
1,2-Dibromoethane (EDB)	80-120	75-125	25
1,2-Dichlorobenzene	80-120	75-125	25
1,2-Dichloroethane	80-120	75-125	25
1,2-Dichloropropane	80-120	75-125	25
1,3,5-Trimethylbenzene	80-120	75-125	25
1,3-Dichlorobenzene	80-120	75-125	25
1,3-Dichloropropane	80-120	75-125	25
1,4-Dichlorobenzene	80-120	75-125	25
2,2-Dichloropropane	80-120	75-125	25
2-Chlorotoluene	80-120	75-125	25
4-Chlorotoluene	80-120	75-125	25
Acetone	80-120	75-125	25
Benzene	80-120	75-125	25
Bromobenzene	80-120	75-125	25
Bromochloromethane	80-120	75-125	25
Bromodichloromethane	80-120	75-125	25
Bromoform	80-120	75-125	25
Bromomethane	80-120	75-125	25
Carbon disulfide	80-120	75-125	25
Carbon tetrachloride	80-120	75-125	25
Chlorobenzene	80-120	75-125	25
Chloroethane	80-120	75-125	25
Chloroform	80-120	75-125	25
Chloromethane	80-120	75-125	25
cis-1,2-Dichloroethene	80-120	75-125	25

Table B1

Quality Control Limits for Definitive Methods (Water Only)

RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	LCS %R	MS/MSD %R	MSD RPD
Organics, Volatile Organic Compounds			
EPA Method 524.2			
cis-1,3-Dichloropropene	80-120	75-125	25
Dibromochloromethane	80-120	75-125	25
Dibromochloropropane (DBCP)	80-120	75-125	25
Dibromomethane	80-120	75-125	25
Dichlorodifluoromethane (Freon 12)	80-120	75-125	25
Ethylbenzene	80-120	75-125	25
Hexachlorobutadiene	80-120	75-125	25
Isopropyl benzene (cumene)	80-120	75-125	25
Isopropyl ether	80-120	75-125	25
Methyl ethyl ketone (2-butanone)	80-120	75-125	25
Methyl isobutyl ketone (MIBK)	80-120	75-125	25
Methyl tert-butyl ether (MTBE)	80-120	75-125	25
Methylcyclohexane	80-120	75-125	25
Methylene chloride	80-120	75-125	25
Naphthalene	80-120	75-125	25
n-Butylbenzene	80-120	75-125	25
n-Propylbenzene	80-120	75-125	25
p-Cymene (p-isopropyltoluene)	80-120	75-125	25
sec-Butylbenzene	80-120	75-125	25
Styrene	80-120	75-125	25
tert-Butylbenzene	80-120	75-125	25
Tetrachloroethene (PCE)	80-120	75-125	25
Toluene	80-120	75-125	25
trans-1,2-Dichloroethene	80-120	75-125	25
trans-1,3-Dichloropropene	80-120	75-125	25
Trichloroethene (TCE)	80-120	75-125	25
Trichlorofluoromethane (Freon 11)	80-120	75-125	25
Vinyl chloride	80-120	75-125	25
Xylenes, m & p	80-120	75-125	25
Xylenes, o	80-120	75-125	25
EPA Method 524.2 - Surrogates	**Surrogate %R**		
1,2-Dichloroethane-d4	70-130	NA	NA
4-Bromofluorobenzene	70-130	NA	NA
Dibromofluoromethane	70-130	NA	NA
Toluene-d8	70-130	NA	NA
Organics, Semivolatile Organic Compounds			
EPA Method 1625			
N-Nitrosodimethylamine (NDMA)	50-135	30-140	35
EPA Method 1625 - Surrogates	**Surrogate %R**		
N-Nitrosodimethylamine (NDMA) D6	30-150	NA	NA
EPA Method CaDPH Method-SVOA			
1,2,3-Trichloropropane	80-120	75-125	25
EPA Method 8310			
Acenaphthene	65-135	40-135	30

Table B1

Quality Control Limits for Definitive Methods (Water Only)

RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	LCS %R	MS/MSD %R	MSD RPD
Organics, Semivolatile Organic Compounds			
EPA Method 8310			
Acenaphthylene	65-135	40-135	30
Anthracene	65-135	40-135	30
Benzo(a)anthracene	65-135	40-135	30
Benzo(a)pyrene	65-135	40-135	30
Benzo(b)fluoranthene	65-135	40-135	30
Benzo(g,h,i)perylene	65-135	40-135	30
Benzo(k)fluoranthene	65-135	40-135	30
Chrysene	65-135	40-135	30
Dibenz(a,h)anthracene	65-135	40-135	30
Fluoranthene	65-135	40-135	30
Fluorene	65-135	40-135	30
Indeno(1,2,3-cd)pyrene	65-135	40-135	30
Naphthalene	65-135	40-135	30
Phenathrene	65-135	40-135	30
EPA Method 8310 - Surrogates	**Surrogate %R**		
p-terphenyl	65-135	NA	NA

Table B1

Quality Control Limits for Definitive Methods (Water Only)

RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	LCS %R	MS/MSD %R	Duplicate RPD
Inorganics, Metals			
EPA Method 200.7			
Aluminum	75-125	75-125	20
Antimony	75-125	75-125	20
Arsenic	75-125	75-125	20
Barium	75-125	75-125	20
Beryllium	75-125	75-125	20
Cadmium	75-125	75-125	20
Calcium	75-125	75-125	20
Chromium (total)	75-125	75-125	20
Cobalt	75-125	75-125	20
Copper	75-125	75-125	20
Iron	75-125	75-125	20
Lead	75-125	75-125	20
Magnesium	75-125	75-125	20
Manganese	75-125	75-125	20
Nickel	75-125	75-125	20
Potassium	75-125	75-125	20
Selenium	75-125	75-125	20
Silver	75-125	75-125	20
Sodium	75-125	75-125	20
Thallium	75-125	75-125	20
Vanadium	75-125	75-125	20
Zinc	75-125	75-125	20
EPA Method 200.8			
Antimony	75-125	75-125	20
Arsenic	75-125	75-125	20
Barium	75-125	75-125	20
Beryllium	75-125	75-125	20
Cadmium	75-125	75-125	20
Chromium (total)	75-125	75-125	20
Cobalt	75-125	75-125	20
Copper	75-125	75-125	20
Lead	75-125	75-125	20
Manganese	75-125	75-125	20
Nickel	75-125	75-125	20
Selenium	75-125	75-125	20
Silver	75-125	75-125	20
Thallium	75-125	75-125	20
Vanadium	75-125	75-125	20
Zinc	75-125	75-125	20
EPA Method 218.6			
Hexavalent Chromium	80-120	75-125	20
EPA Method 245.1			
Mercury	80-120	75-125	20
EPA Method 7196A			
Hexavalent Chromium	80-120	75-125	20

Table B1

Quality Control Limits for Definitive Methods (Water Only)

RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	LCS %R	MS/MSD %R	Duplicate RPD
Inorganics, Metals			
EPA Method 7470A			
Mercury	80-120	75-125	20
Organics, Water Quality Parameters			
EPA Method RSK 175 *			
Ethane	80-120	NA	20
Ethene	80-120	NA	20
Methane	80-120	NA	20
EPA Method 314.1			
Perchlorate	75-125	65-135	20
EPA Method 415.1 *			
Total Organic Carbon	75-125	NA	20
EPA Method 6850			
Perchlorate	75-125	65-135	20
EPA Method 6860			
Perchlorate	75-125	65-135	20
Inorganics, Water Quality Parameters			
EPA Method 300.0			
Chloride	75-125	75-125	20
Sulfate	75-125	75-125	20
EPA Method 353.1/353.2			
Nitrate as Nitrogen	75-125	65-135	20
Nitrite as Nitrogen	75-125	65-135	20
EPA Method 9030			
Sulfide	75-125	75-125	20

Table B1

Quality Control Limits for Definitive Methods (Water Only)

RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	LCS %R	MS/MSD %R	Duplicate RPD
Inorganics, Water Quality Parameters			
EPA Method 9056			
Chloride	80-120	75-125	20
Sulfate	80-120	75-125	20
EPA Method 9010B			
Cyanide	80-115	75-125	20
EPA Method 9012A			
Cyanide	80-115	75-125	20
EPA Method 130.2 *			
Hardness (as CaCO3)	95-105	NA	50
EPA Method 160.1 *			
Total Dissolved Solids	60-125	NA	20
EPA Method 160.2 *			
Total Suspended Solids	75-125	NA	20
EPA Method 310.1 *			
Alkalinity	80-120	NA	20

Notes:

* An LCS and LCSD will be run in lieu of an MS/MSD. The listed RPD applies to the LCS/LCSD.
LCS: Laboratory Control Sample
LCSD: Laboratory Control Sample Duplicate
%R: Percent Recovery
MS: Matrix Spike
MSD: Matrix Spike Duplicate
RPD: Relative Percent Difference

Table B2

Quality Control Limits for Definitive Methods (Water and Soil)

RWQCB Quality Assurance Project Plan, September 2008

	Water			Soil		
Target Analyte	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**
Organics, Volatile Organic Compounds						
EPA Method 8260B						
1,1,1,2-Tetrachloroethane	80-120	75-125	20	75-125	75-125	40
1,1,1-Trichloroethane	80-120	75-125	20	75-125	75-125	40
1,1,2,2-Tetrachloroethane	80-120	75-125	20	75-125	75-125	40
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	80-120	75-125	20	75-125	75-125	40
1,1,2-Trichloroethane	80-120	75-125	20	75-125	75-125	40
1,1-Dichloroethane	80-120	75-125	20	65-135	60-140	40
1,1-Dichloroethene	80-120	75-125	20	75-125	75-125	40
1,1-Dichloropropene	80-120	75-125	20	75-125	75-125	40
1,2,3-Trichlorobenzene	80-120	75-125	20	75-125	75-125	40
1,2,3-Trichloropropane	80-120	75-125	20	75-125	75-125	40
1,2,4-Trichlorobenzene	80-120	75-125	20	75-125	75-125	40
1,2,4-Trimethylbenzene	80-120	75-125	20	75-125	75-125	40
1,2-Dibromoethane (EDB)	80-120	75-125	20	75-125	75-125	40
1,2-Dichlorobenzene	80-120	75-125	20	75-125	75-125	40
1,2-Dichloroethane	80-120	75-125	20	65-135	60-140	40
1,2-Dichloropropane	80-120	75-125	20	65-135	60-140	40
1,3,5-Trimethylbenzene	80-120	75-125	20	75-125	75-125	40
1,3-Dichlorobenzene	80-120	75-125	20	75-125	75-125	40
1,3-Dichloropropane	80-120	75-125	20	65-135	60-140	40
1,4-Dichlorobenzene	80-120	75-125	20	75-125	75-125	40
2-Hexanone	80-120	75-125	20	60-140	60-140	40
Acetone	80-120	75-125	20	60-140	60-140	40
Benzene	80-120	75-125	20	75-125	70-130	40
Bromobenzene	80-120	75-125	20	75-125	70-130	40
Bromochloromethane	80-120	75-125	20	75-125	75-125	40
Bromodichloromethane	80-120	75-125	20	75-125	75-125	40
Bromoform	80-120	75-125	20	65-135	60-140	40
Bromomethane	80-120	75-125	20	75-125	75-125	40
Carbon disulfide	80-120	75-125	20	65-135	60-140	40
Carbon tetrachloride	80-120	75-125	20	75-125	75-125	40
Chlorobenzene	80-120	75-125	20	75-125	75-125	40
Chloroethane	80-120	75-125	20	65-135	60-140	40
Chloroform	80-120	75-125	20	75-125	75-125	40
Chloromethane	80-120	75-125	20	65-135	60-140	40
cis-1,2-Dichloroethene	80-120	75-125	20	65-135	60-140	40
cis-1,3-Dichloropropene	80-120	75-125	20	75-125	75-125	40
Cyclohexane	80-120	75-125	20	75-125	75-125	40
Dibromochloromethane	80-120	75-125	20	75-125	75-125	40
Dibromochloropropane (DBCP)	80-120	75-125	20	75-125	75-125	40
Dichlorodifluoromethane (Freon 12)	80-120	75-125	20	75-125	75-125	40

Table B2

Quality Control Limits for Definitive Methods (Water and Soil)

RWQCB Quality Assurance Project Plan, September 2008

	Water			Soil		
Target Analyte	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**
Organics, Volatile Organic Compounds						
EPA Method 8260B						
Ethyl tert-butyl ether	80-120	75-125	20	75-125	75-125	40
Ethylbenzene	80-120	75-125	20	75-125	75-125	40
Isopropyl benzene (cumene)	80-120	75-125	20	75-125	75-125	40
Isopropyl ether	80-120	75-125	20	75-125	75-125	40
Methyl acetate	80-120	75-125	20	75-125	75-125	40
Methyl ethyl ketone (2-butanone)	80-120	75-125	20	60-140	60-140	40
Methyl isobutyl ketone (MIBK)	80-120	75-125	20	65-135	60-140	40
Methyl tert-butyl ether (MTBE)	80-120	75-125	20	65-135	60-140	40
Methylcyclohexane	80-120	75-125	20	75-125	75-125	40
Methylene chloride	80-120	75-125	20	65-135	60-140	40
n-Butylbenzene	80-120	75-125	20	75-125	75-125	40
n-Propylbenzene	80-120	75-125	20	75-125	75-125	40
p-Cymene (p-isopropyltoluene)	80-120	75-125	20	75-125	75-125	40
sec-Butylbenzene	80-120	75-125	20	75-125	75-125	40
Styrene	80-120	75-125	20	75-125	75-125	40
Tert-amyl methyl ether	80-120	75-125	20	75-125	75-125	40
tert-butyl alcohol	80-120	75-125	20	75-125	75-125	40
tert-Butylbenzene	80-120	75-125	20	75-125	75-125	40
Tetrachloroethene (PCE)	80-120	75-125	20	75-125	75-125	40
Toluene	80-120	75-125	20	75-125	75-125	40
trans-1,2-Dichloroethene	80-120	75-125	20	65-135	60-140	40
trans-1,3-Dichloropropene	80-120	75-125	20	75-125	75-125	40
Trichloroethene (TCE)	80-120	75-125	20	75-125	75-125	40
Trichlorofluoromethane (Freon 11)	80-120	75-125	20	75-125	75-125	40
Vinyl chloride	80-120	75-125	20	65-135	60-140	40
Xylenes, m & p	80-120	75-125	20	75-125	75-125	40
Xylenes, o	80-120	75-125	20	75-125	75-125	40
Xylenes, total	80-120	75-125	20	75-125	75-125	40
EPA Method 8260B - Surrogates	**Surrogate %R**			**Surrogate %R**		
1,2-Dichloroethane-d4	56-144	NA	NA	50-145	NA	NA
4-Bromofluorobenzene	75-117	NA	NA	74-145	NA	NA
Dibromofluoromethane	70-130	NA	NA	70-130	NA	NA
Toluene-d8	85-115	NA	NA	61-135	NA	NA
Organics, Semivolatile Organic Compounds						
EPA Method 8270C						
1,1'-Biphenyl	65-135	60-140	30	65-135	65-135	40
1,2,4,5-Tetrachlorbenzene	65-135	60-140	30	60-140	60-140	40
1,4-Dioxane (p-dioxane)	65-135	60-140	30	65-135	65-135	40
2,2'-Oxybis(1-Chloropropane)	65-135	60-140	30	65-135	65-135	40

Table B2

Quality Control Limits for Definitive Methods (Water and Soil)

RWQCB Quality Assurance Project Plan, September 2008

	Water			Soil		
Target Analyte	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**
Organics, Semivolatile Organic Compounds						
EPA Method 8270C						
2,4,5-Trichlorophenol	65-135	60-140	30	60-140	60-140	40
2,4,6-Trichlorophenol	65-135	60-140	30	60-140	60-140	40
2,4-Dichlorophenol	65-135	60-140	30	60-140	45-140	40
2,4-Dimethylphenol	65-135	60-140	30	60-140	45-140	40
2,4-Dinitrophenol	65-135	60-140	30	60-140	45-140	40
2,4-Dinitrotoluene	65-135	60-140	30	45-140	45-140	40
2,6-Dinitrotoluene	65-135	60-140	30	45-140	45-140	40
2-Chloronaphthalene	65-135	60-140	30	60-140	60-140	40
2-Chlorophenol	65-135	60-140	30	60-140	45-140	40
2-Methylnaphthalene	65-135	60-140	30	60-140	60-140	40
2-Methylphenol	65-135	60-140	30	60-140	45-140	40
2-Nitroaniline	65-135	60-140	30	45-140	45-140	40
2-Nitrophenol	65-135	60-140	30	60-140	45-140	40
3,3'-Dichlorobenzidine	65-135	60-140	30	45-140	45-140	40
3,4-methylphenol	65-135	60-140	30	65-135	65-135	40
3-Nitroaniline	65-135	60-140	30	45-140	45-140	40
4,6-Dinitro-2-methylphenol	65-135	60-140	30	60-140	45-140	40
4-Bromophenylphenyl ether	65-135	60-140	30	60-140	60-140	40
4-Chloro-3-methylphenol	65-135	60-140	30	60-140	45-140	40
4-Chloroaniline	65-135	60-140	30	45-140	45-140	40
4-Chlorophenylphenyl ether	65-135	60-140	30	60-140	60-140	40
4-Methylphenol	65-135	60-140	30	60-140	45-140	40
4-Nitroaniline	65-135	60-140	30	45-140	45-140	40
4-Nitrophenol	65-135	60-140	30	45-140	45-140	40
Acenaphthene	65-135	60-140	30	60-140	60-140	40
Acenaphthylene	65-135	60-140	30	60-140	60-140	40
Acetophenone	65-135	60-140	30	65-135	45-140	40
Anthracene	65-135	60-140	30	60-140	60-140	40
Atrazine	65-135	60-140	30	65-135	65-135	40
Benzaldehyde	65-135	60-140	30	65-135	65-135	40
Benzo(a)anthracene	65-135	60-140	30	60-140	60-140	40
Benzo(a)pyrene	65-135	60-140	30	60-140	60-140	40
Benzo(b)fluoranthene	65-135	60-140	30	60-140	60-140	40
Benzo(g,h,i)perylene	65-135	60-140	30	60-140	60-140	40
Benzo(k)fluoranthene	65-135	60-140	30	60-140	60-140	40
Benzyl alcohol	65-135	60-140	30	45-140	45-140	40
bis(2-Chloroethoxy)methane	65-135	60-140	30	60-140	60-140	40
Bis(2-Chloroethyl)ether	65-135	60-140	30	60-140	60-140	40
Bis(2-Ethylhexyl)phthalate	65-135	60-140	30	60-140	45-140	40
Butylbenzylphthalate	65-135	60-140	30	60-140	45-140	40

Table B2

Quality Control Limits for Definitive Methods (Water and Soil)

RWQCB Quality Assurance Project Plan, September 2008

	Water			Soil		
Target Analyte	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**
Organics, Semivolatile Organic Compounds						
EPA Method 8270C						
Caprolactam	65-135	60-140	30	65-135	65-135	40
Carbazole	65-135	60-140	30	45-140	45-140	40
Chrysene	65-135	60-140	30	60-140	60-140	40
Dibenz(a,h)anthracene	65-135	60-140	30	60-140	60-140	40
Dibenzofuran	65-135	60-140	30	60-140	60-140	40
Diethylphthalate	65-135	60-140	30	60-140	45-140	40
Dimethylphthalate	65-135	60-140	30	60-140	45-140	40
Di-n-butylphthalate	65-135	60-140	30	60-140	45-140	40
Di-n-octylphthalate	65-135	60-140	30	60-140	45-140	40
Diphenylamine	65-135	60-140	30	65-135	65-135	40
Fluoranthene	65-135	60-140	30	60-140	60-140	40
Fluorene	65-135	60-140	30	60-140	60-140	40
Hexachlorobenzene	65-135	60-140	30	60-140	60-140	40
Hexachlorobutadiene	65-135	60-140	30	45-140	45-140	40
Hexachlorocyclopentadiene	65-135	60-140	30	45-140	45-140	40
Hexachloroethane	65-135	60-140	30	60-140	60-140	40
Indeno(1,2,3-cd)pyrene	65-135	60-140	30	60-140	60-140	40
Isophorone	65-135	60-140	30	60-140	60-140	40
Naphthalene	65-135	60-140	30	60-140	60-140	40
Nitrobenzene	65-135	60-140	30	60-140	60-140	40
N-Nitroso-di-n-propylamine	65-135	60-140	30	45-140	45-140	40
N-Nitrosodiphenylamine	65-135	60-140	30	45-140	45-140	40
Pentachlorophenol	65-135	60-140	30	45-140	45-140	40
Phenathrene	65-135	60-140	30	60-140	60-140	40
Phenol	65-135	60-140	30	60-140	60-140	40
Pyrene	65-135	60-140	30	60-140	60-140	40
EPA Method 8270C - Surrogates	**Surrogate %R**			**Surrogate %R**		
2,4,6-Tribromophenol	26-123	NA	NA	19-122	NA	NA
2-Fluorobiphenyl	40-116	NA	NA	40-115	NA	NA
2-Fluorophenol	30-124	NA	NA	30-121	NA	NA
Nitrobenzene-d5	40-116	NA	NA	40-115	NA	NA
Phenol-d6	28-122	NA	NA	50-122	NA	NA
Terphenyl-d14	50-141	NA	NA	50-137	NA	NA
EPA Method 8270C-SIM						
Acenaphthene	60-135	50-140	35	65-135	45-140	40
Acenaphthylene	60-135	50-140	35	65-135	45-140	40
Anthracene	60-135	50-140	35	65-135	45-140	40
Benzo(a)anthracene	60-135	50-140	35	65-135	45-140	40
Benzo(a)pyrene	60-135	50-140	35	65-135	45-140	40
Benzo(b)fluoranthene	60-135	50-140	35	65-135	45-140	40

Table B2

Quality Control Limits for Definitive Methods (Water and Soil)

RWQCB Quality Assurance Project Plan, September 2008

	Water			Soil		
Target Analyte	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**
Organics, Semivolatile Organic Compounds						
EPA Method 8270C-SIM						
Benzo(g,h,i)perylene	60-135	50-140	35	65-135	45-140	40
Benzo(k)fluoranthene	60-135	50-140	35	65-135	45-140	40
Chrysene	60-135	50-140	35	65-135	45-140	40
Dibenz(a,h)anthracene	60-135	50-140	35	65-135	45-140	40
Fluoranthene	60-135	50-140	35	65-135	45-140	40
Fluorene	60-135	50-140	35	65-135	45-140	40
Indeno(1,2,3-cd)pyrene	60-135	50-140	35	65-135	45-140	40
Naphthalene	60-135	50-140	35	65-135	45-140	40
Phenathrene	60-135	50-140	35	65-135	45-140	40
Pyrene	60-135	50-140	35	65-135	45-140	40
EPA Method 8270C-SIM - Surrogates	**Surrogate %R**			**Surrogate %R**		
Terphenyl-d14	65-165	NA	NA	60-122	NA	NA
Triphenylene	65-135	NA	NA	60-140	NA	NA
Organics, Petroleum Products						
EPA Method M8015B-Extractables						
TPH as Diesel	65-135	60-140	30	65-135	50-150	30
TPH as Kerosene	65-135	60-140	30	65-135	50-150	30
TPH as Motor Oil	65-135	60-140	30	65-135	50-150	30
EPA Method M8015B-Extractables - Surrogates	**Surrogate %R**			**Surrogate %R**		
n-Octacosane	50-150	NA	NA	50-150	NA	NA
EPA Method M8015B-Purgables						
TPH as Gasoline	65-135	60-140	30	65-135	50-150	30
EPA Method M8015B-Purgables - Surrogates	**Surrogate %R**			**Surrogate %R**		
4-Bromofluorobenzene	65-135	NA	NA	65-135	NA	NA

Table B2

Quality Control Limits for Definitive Methods (Water and Soil)

RWQCB Quality Assurance Project Plan, September 2008

	Water			Soil		
Target Analyte	**LCS %R**	**MS/MSD %R**	**Duplicate RPD**	**LCS %R**	**MS/MSD %R**	**Duplicate RPD**
Inorganics, Metals						
EPA Method 6010B						
Aluminum	80-120	75-125	20	80-120	75-125	40
Antimony	75-125	60-140	20	75-125	60-140	40
Arsenic	75-125	60-140	20	75-125	60-140	40
Barium	80-120	75-125	20	80-120	75-125	40
Beryllium	80-120	75-125	20	80-120	75-125	40
Cadmium	80-120	75-125	20	80-120	75-125	40
Calcium	80-120	75-125	20	80-120	75-125	40
Chromium (total)	80-120	75-125	20	80-120	75-125	40
Cobalt	80-120	75-125	20	80-120	75-125	40
Copper	80-120	75-125	20	80-120	75-125	40
Iron	80-120	75-125	20	80-120	75-125	40
Lead	75-125	60-140	20	75-125	60-140	40
Magnesium	80-120	75-125	20	80-120	75-125	40
Manganese	80-120	75-125	20	80-120	75-125	40
Nickel	80-120	75-125	20	80-120	75-125	40
Potassium	80-120	75-125	20	80-120	75-125	40
Selenium	75-125	60-140	20	75-125	60-140	40
Silver	75-125	60-140	20	75-125	60-140	40
Sodium	80-120	75-125	20	80-120	75-125	40
Thallium	75-125	60-140	20	75-125	60-140	40
Vanadium	80-120	75-125	20	80-120	75-125	40
Zinc	80-120	75-125	20	80-120	75-125	40
EPA Method 6020						
Antimony	80-120	75-125	20	75-125	60-140	40
Arsenic	80-120	75-125	20	75-125	60-140	40
Barium	80-120	75-125	20	75-125	60-140	40
Beryllium	80-120	75-125	20	80-120	75-125	40
Cadmium	80-120	75-125	20	80-120	75-125	40
Chromium (total)	80-120	75-125	20	80-120	75-125	40
Cobalt	80-120	75-125	20	80-120	75-125	40
Copper	80-120	75-125	20	80-120	75-125	40
Lead	80-120	75-125	20	75-125	60-140	40
Manganese	80-120	75-125	20	80-120	75-125	40
Nickel	80-120	75-125	20	80-120	75-125	40
Selenium	80-120	75-125	20	75-125	60-140	40
Silver	80-120	75-125	20	75-125	60-140	40
Thallium	80-120	75-125	20	75-125	60-140	40
Vanadium	80-120	75-125	20	80-120	75-125	40
Zinc	80-120	75-125	20	80-120	75-125	40
EPA Method 7471A						
Mercury	NA	NA	NA	80-120	75-125	40

Table B2

Quality Control Limits for Definitive Methods (Water and Soil)

RWQCB Quality Assurance Project Plan, September 2008

	Water			Soil		
Target Analyte	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**
Organics, Pesticides						
EPA Method 8081A						
4,4'-DDE	65-135	60-140	20	65-135	65-135	40
4-4'-DDD	65-135	60-140	20	65-135	65-135	40
4-4'-DDT	65-135	60-140	20	65-135	65-135	40
Aldrin	65-135	60-140	20	65-135	65-135	40
Alpha-BHC	65-135	60-140	20	65-135	65-135	40
Alpha-Chlordane	65-135	60-140	20	65-135	65-135	40
Beta-BHC	65-135	60-140	20	65-135	65-135	40
delta-BHC	65-135	60-140	20	65-135	65-135	40
Dieldrin	65-135	60-140	20	65-135	65-135	40
Endosulfan I	65-135	60-140	20	65-135	65-135	40
Endosulfan II	65-135	60-140	20	65-135	65-135	40
Endosulfan sulfate	65-135	60-140	20	65-135	65-135	40
Endrin	65-135	60-140	20	65-135	65-135	40
Endrin aldehyde	45-140	60-140	20	45-140	45-140	40
Endrin ketone	65-135	60-140	20	65-135	65-135	40
Gamma-BHC	65-135	60-140	20	65-135	65-135	40
Gamma-Chlordane	65-135	60-140	20	65-135	65-135	40
Heptachlor	65-135	60-140	20	65-135	65-135	40
Heptachlor epoxide	65-135	60-140	20	65-135	65-135	40
Methoxychlor	65-135	60-140	20	65-135	65-135	40
Toxaphene	45-140	60-140	20	45-140	45-140	40
EPA Method 8081A - Surrogates	**Surrogate %R**			**Surrogate %R**		
Decachlorobiphenyl	50-150	NA	NA	50-150	NA	NA
Tetrachloro-m-xylene	50-150	NA	NA	50-150	NA	NA
EPA Method 8141						
Coumaphos	65-135	60-140	30	65-135	65-135	40
Demeton, Total	65-135	60-140	30	65-135	65-135	40
Diazinon	65-135	60-140	30	65-135	65-135	40
Dichlorvos	65-135	60-140	30	65-135	65-135	40
Dimethoate	65-135	60-140	30	65-135	65-135	40
Disulfoton	65-135	60-140	30	65-135	65-135	40
Ethoprop	65-135	60-140	30	65-135	65-135	40
Fensulfothion	65-135	60-140	30	65-135	65-135	40
Fenthion	65-135	60-140	30	65-135	65-135	40
Malathion	65-135	60-140	30	65-135	65-135	40
Merphos	65-135	60-140	30	65-135	65-135	40
Mevinphos	65-135	60-140	30	65-135	65-135	40
Naled	65-135	60-140	30	65-135	65-135	40
Parathion, ethyl	65-135	60-140	30	65-135	65-135	40
Parathion, methyl	65-135	60-140	30	65-135	65-135	40
Phorate	65-135	60-140	30	65-135	65-135	40
Ronnel	65-135	60-140	30	65-135	65-135	40
Stirophos (Tetrachlorvinphos)	65-135	60-140	30	65-135	65-135	40
Tokuthion (Protothiofos)	65-135	60-140	30	65-135	65-135	40
Trichloronate	65-135	60-140	30	65-135	65-135	40

Table B2

Quality Control Limits for Definitive Methods (Water and Soil)

RWQCB Quality Assurance Project Plan, September 2008

	Water			Soil		
Target Analyte	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**	**LCS %R**	**MS/MSD %R**	**MS/MSD RPD**
Organics, Pesticides						
EPA Method 8141 - Surrogates	**Surrogate %R**			**Surrogate %R**		
Tributyl phosphate	50-140	NA	NA	50-150	NA	NA
Triphenyl phosphate	50-140	NA	NA	50-150	NA	NA
Organics, Polychlorinated Biphenyls as Aroclors						
EPA Method 8082						
Aroclor-1016	65-135	60-140	30	65-135	65-135	40
Aroclor-1221	65-135	60-140	30	65-135	65-135	40
Aroclor-1232	65-135	60-140	30	65-135	65-135	40
Aroclor-1242	65-135	60-140	30	65-135	65-135	40
Aroclor-1248	65-135	60-140	30	65-135	65-135	40
Aroclor-1254	65-135	60-140	30	65-135	65-135	40
Aroclor-1260	65-135	60-140	30	65-135	65-135	40
EPA Method 8082 - Surrogates	**Surrogate %R**			**Surrogate %R**		
Decachlorobiphenyl	50-150	NA	NA	50-150	NA	NA
Tetrachloro-m-xylene	50-150	NA	NA	50-150	NA	NA
Organics, Herbicides						
EPA Method 8151A						
2,4,5-T	65-135	45-140	20	65-135	45-140	40
2,4,5-TP	65-135	45-140	20	65-135	45-140	40
2,4-D	65-135	45-140	20	65-135	45-140	40
2,4-DB	65-135	45-140	20	65-135	45-140	40
Dalapon	65-135	45-140	20	65-135	45-140	40
Dicamba	65-135	45-140	20	65-135	45-140	40
Dichlorprop	65-135	45-140	20	65-135	45-140	40
Dinoseb	30-150	30-150	20	30-150	30-150	40
MCPA	30-150	30-150	20	30-150	30-150	40
MCPP	30-150	30-150	20	30-150	30-150	40
EPA Method 8151A - Surrogates	**Surrogate %R**			**Surrogate %R**		
2,4-Dichlorophenylacetic acid	50-150	NA	NA	50-150	NA	NA
Organics, Other Organics						
EPA Method 9060						
Total Organic Carbon	80-120	NA	NA	40-135	NA	40

Notes:

LCS: Laboratory Control Sample
%R: Percent Recovery
MS: Matrix Spike
MSD: Matrix Spike Duplicate
RPD: Relative Percent Difference
NA: Not applicable

Table B3
Quality Control Limits for Definitive Methods (Air and Soil Gas)
RWQCB Quality Assurance Project Plan, September 2008

	Air		Soil Gas	
Target Analyte	**LCS %R**	**Duplicate RPD**	**LCS %R**	**Duplicate RPD**
Organics, Volatile Organic Compounds				
EPA Method TO-14				
1,1,1-Trichloroethane	75-125	30	75-125	30
1,1,2,2-Tetrachloroethane	75-125	30	75-125	30
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	75-125	30	75-125	30
1,1,2-Trichloroethane	75-125	30	75-125	30
1,1-Dichloroethane	75-125	30	75-125	30
1,1-Dichloroethene	75-125	30	75-125	30
1,2,4-Trichlorobenzene	75-125	30	75-125	30
1,2,4-Trimethylbenzene	75-125	30	75-125	30
1,2-Dibromoethane (EDB)	75-125	30	75-125	30
1,2-Dichlorobenzene	75-125	30	75-125	30
1,2-Dichloroethane	75-125	30	75-125	30
1,2-Dichloropropane	75-125	30	75-125	30
1,3,5-Trimethylbenzene	75-125	30	75-125	30
1,3-Butadiene	75-125	30	75-125	30
1,3-Dichlorobenzene	75-125	30	75-125	30
1,4-Dichlorobenzene	75-125	30	75-125	30
1,4-Dioxane (p-dioxane)	75-125	30	75-125	30
2,2,4-Trimethylpentane	75-125	30	75-125	30
2-Hexanone	75-125	30	75-125	30
3-Chloropropene	75-125	30	75-125	30
4-Ethyltoluene	75-125	30	75-125	30
Acetone	75-125	30	75-125	30
Benzene	75-125	30	75-125	30
Benzyl chloride	75-125	30	75-125	30
Bromodichloromethane	75-125	30	75-125	30
Bromoform	75-125	30	75-125	30
Bromomethane	75-125	30	75-125	30
Carbon disulfide	75-125	30	75-125	30
Carbon tetrachloride	75-125	30	75-125	30
Chlorobenzene	75-125	30	75-125	30
Chloroethane	75-125	30	75-125	30
Chloroform	75-125	30	75-125	30
Chloromethane	75-125	30	75-125	30
cis-1,2-Dichloroethene	75-125	30	75-125	30
cis-1,3-Dichloropropene	75-125	30	75-125	30
Cyclohexane	75-125	30	75-125	30
Dibromochloromethane	75-125	30	75-125	30
Dichlorodifluoromethane (Freon 12)	75-125	30	75-125	30
Ethanol	75-125	30	75-125	30
Ethylbenzene	75-125	30	75-125	30

Table B3
Quality Control Limits for Definitive Methods (Air and Soil Gas)
RWQCB Quality Assurance Project Plan, September 2008

	Air		Soil Gas	
Target Analyte	**LCS %R**	**Duplicate RPD**	**LCS %R**	**Duplicate RPD**
Organics, Volatile Organic Compounds				
EPA Method TO-14				
Hexachlorobutadiene	75-125	30	75-125	30
Isopropanol	75-125	30	75-125	30
Isopropyl benzene (cumene)	75-125	30	75-125	30
Methyl ethyl ketone (2-butanone)	75-125	30	75-125	30
Methyl isobutyl ketone (MIBK)	75-125	30	75-125	30
Methyl tert-butyl ether (MTBE)	75-125	30	75-125	30
Methylene chloride	75-125	30	75-125	30
Naphthalene	75-125	30	75-125	30
N-Heptane	75-125	30	75-125	30
n-Propylbenzene	75-125	30	75-125	30
Styrene	75-125	30	75-125	30
Tetrachloroethene (PCE)	75-125	30	75-125	30
Tetrahydrofuran	75-125	30	75-125	30
Toluene	75-125	30	75-125	30
Total hexanes	75-125	30	75-125	30
trans-1,2-Dichloroethene	75-125	30	75-125	30
trans-1,3-Dichloropropene	75-125	30	75-125	30
Trichloroethene (TCE)	75-125	30	75-125	30
Trichlorofluoromethane (Freon 11)	75-125	30	75-125	30
Vinyl acetate	75-125	30	75-125	30
Vinyl chloride	75-125	30	75-125	30
Xylenes, m & p	75-125	30	75-125	30
Xylenes, o	75-125	30	75-125	30
EPA Method TO-14 - Surrogates	**Surrogate %R**		**Surrogate %R**	
1,2-Dichloroethane-d4	70-130	NA	70-130	NA
4-Bromofluorobenzene	70-130	NA	70-130	NA
Dibromofluoromethane	70-130	NA	70-130	NA
Toluene-d8	70-130	NA	70-130	NA
EPA Method TO-15				
1,1,1-Trichloroethane	75-125	30	75-125	30
1,1,2,2-Tetrachloroethane	75-125	30	75-125	30
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	75-125	30	75-125	30
1,1,2-Trichloroethane	75-125	30	75-125	30
1,1-Dichloroethane	75-125	30	75-125	30
1,1-Dichloroethene	75-125	30	75-125	30
1,2,4-Trichlorobenzene	75-125	30	75-125	30
1,2,4-Trimethylbenzene	75-125	30	75-125	30
1,2-Dibromoethane (EDB)	75-125	30	75-125	30
1,2-Dichlorobenzene	75-125	30	75-125	30
1,2-Dichloroethane	75-125	30	75-125	30

Table B3
Quality Control Limits for Definitive Methods (Air and Soil Gas)
RWQCB Quality Assurance Project Plan, September 2008

	Air		Soil Gas	
Target Analyte	**LCS %R**	**Duplicate RPD**	**LCS %R**	**Duplicate RPD**
Organics, Volatile Organic Compounds				
EPA Method TO-15				
1,2-Dichloropropane	75-125	30	75-125	30
1,3,5-Trimethylbenzene	75-125	30	75-125	30
1,3-Butadiene	75-125	30	75-125	30
1,3-Dichlorobenzene	75-125	30	75-125	30
1,4-Dichlorobenzene	75-125	30	75-125	30
1,4-Dioxane (p-dioxane)	75-125	30	75-125	30
2,2,4-Trimethylpentane	75-125	30	75-125	30
2-Hexanone	75-125	30	75-125	30
3-Chloropropene	75-125	30	75-125	30
4-Ethyltoluene	75-125	30	75-125	30
Acetone	75-125	30	75-125	30
Benzene	75-125	30	75-125	30
Benzyl chloride	75-125	30	75-125	30
Bromodichloromethane	75-125	30	75-125	30
Bromoform	75-125	30	75-125	30
Bromomethane	75-125	30	75-125	30
Carbon disulfide	75-125	30	75-125	30
Carbon tetrachloride	75-125	30	75-125	30
Chlorobenzene	75-125	30	75-125	30
Chloroethane	75-125	30	75-125	30
Chloroform	75-125	30	75-125	30
Chloromethane	75-125	30	75-125	30
cis-1,2-Dichloroethene	75-125	30	75-125	30
cis-1,3-Dichloropropene	75-125	30	75-125	30
Cyclohexane	75-125	30	75-125	30
Dibromochloromethane	75-125	30	75-125	30
Dichlorodifluoromethane (Freon 12)	75-125	30	75-125	30
Ethanol	75-125	30	75-125	30
Ethylbenzene	75-125	30	75-125	30
Hexachlorobutadiene	75-125	30	75-125	30
Isopropanol	75-125	30	75-125	30
Isopropyl benzene (cumene)	75-125	30	75-125	30
Methyl ethyl ketone (2-butanone)	75-125	30	75-125	30
Methyl isobutyl ketone (MIBK)	75-125	30	75-125	30
Methyl tert-butyl ether (MTBE)	75-125	30	75-125	30
Methylene chloride	75-125	30	75-125	30
Naphthalene	75-125	30	75-125	30
N-Heptane	75-125	30	75-125	30
n-Propylbenzene	75-125	30	75-125	30
Styrene	75-125	30	75-125	30

Table B3
Quality Control Limits for Definitive Methods (Air and Soil Gas)
RWQCB Quality Assurance Project Plan, September 2008

	Air		Soil Gas	
Target Analyte	**LCS %R**	**Duplicate RPD**	**LCS %R**	**Duplicate RPD**
Organics, Volatile Organic Compounds				
EPA Method TO-15				
Tetrachloroethene (PCE)	75-125	30	75-125	30
Tetrahydrofuran	75-125	30	75-125	30
Toluene	75-125	30	75-125	30
Total hexanes	75-125	30	75-125	30
trans-1,2-Dichloroethene	75-125	30	75-125	30
trans-1,3-Dichloropropene	75-125	30	75-125	30
Trichloroethene (TCE)	75-125	30	75-125	30
Trichlorofluoromethane (Freon 11)	75-125	30	75-125	30
Vinyl acetate	75-125	30	75-125	30
Vinyl chloride	75-125	30	75-125	30
Xylenes, m & p	75-125	30	75-125	30
Xylenes, o	75-125	30	75-125	30
EPA Method TO-15 - Surrogates	**Surrogate %R**		**Surrogate %R**	
1,2-Dichloroethane-d4	70-130	NA	70-130	NA
4-Bromofluorobenzene	70-130	NA	70-130	NA
Dibromofluoromethane	70-130	NA	70-130	NA
Toluene-d8	70-130	NA	70-130	NA
EPA Method TO-17				
1,1,1-Trichloroethane	65-135	30	65-135	30
1,1,2,2-Tetrachloroethane	65-135	30	65-135	30
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	65-135	30	65-135	30
1,1,2-Trichloroethane	65-135	30	65-135	30
1,1-Dichloroethane	65-135	30	65-135	30
1,1-Dichloroethene	65-135	30	65-135	30
1,2,4-Trichlorobenzene	65-135	30	65-135	30
1,2,4-Trimethylbenzene	65-135	30	65-135	30
1,2-Dibromoethane (EDB)	65-135	30	65-135	30
1,2-Dichlorobenzene	65-135	30	65-135	30
1,2-Dichloroethane	65-135	30	65-135	30
1,2-Dichloropropane	65-135	30	65-135	30
1,3,5-Trimethylbenzene	65-135	30	65-135	30
1,3-Butadiene	65-135	30	65-135	30
1,3-Dichlorobenzene	65-135	30	65-135	30
1,4-Dichlorobenzene	65-135	30	65-135	30
1,4-Dioxane (p-dioxane)	65-135	30	65-135	30
2,2,4-Trimethylpentane	65-135	30	65-135	30
2-Hexanone	65-135	30	65-135	30
3-Chloropropene	65-135	30	65-135	30
4-Ethyltoluene	65-135	30	65-135	30
Acetone	65-135	30	65-135	30

Table B3
Quality Control Limits for Definitive Methods (Air and Soil Gas)
RWQCB Quality Assurance Project Plan, September 2008

	Air		Soil Gas	
Target Analyte	**LCS %R**	**Duplicate RPD**	**LCS %R**	**Duplicate RPD**
Organics, Volatile Organic Compounds				
EPA Method TO-17				
Benzene	65-135	30	65-135	30
Benzyl chloride	65-135	30	65-135	30
Bromodichloromethane	65-135	30	65-135	30
Bromoform	65-135	30	65-135	30
Bromomethane	65-135	30	65-135	30
Carbon disulfide	65-135	30	65-135	30
Carbon tetrachloride	65-135	30	65-135	30
Chlorobenzene	65-135	30	65-135	30
Chloroethane	65-135	30	65-135	30
Chloroform	65-135	30	65-135	30
Chloromethane	65-135	30	65-135	30
cis-1,2-Dichloroethene	65-135	30	65-135	30
cis-1,3-Dichloropropene	65-135	30	65-135	30
Cyclohexane	65-135	30	65-135	30
Dibromochloromethane	65-135	30	65-135	30
Dichlorodifluoromethane (Freon 12)	65-135	30	65-135	30
Ethanol	65-135	30	65-135	30
Ethylbenzene	65-135	30	65-135	30
Hexachlorobutadiene	65-135	30	65-135	30
Isopropanol	65-135	30	65-135	30
Isopropyl benzene (cumene)	65-135	30	65-135	30
Methyl ethyl ketone (2-butanone)	65-135	30	65-135	30
Methyl isobutyl ketone (MIBK)	65-135	30	65-135	30
Methyl tert-butyl ether (MTBE)	65-135	30	65-135	30
Methylene chloride	65-135	30	65-135	30
Naphthalene	65-135	30	65-135	30
N-Heptane	65-135	30	65-135	30
n-Propylbenzene	65-135	30	65-135	30
Styrene	65-135	30	65-135	30
Tetrachloroethene (PCE)	65-135	30	65-135	30
Tetrahydrofuran	65-135	30	65-135	30
Toluene	65-135	30	65-135	30
Total hexanes	65-135	30	65-135	30
trans-1,2-Dichloroethene	65-135	30	65-135	30
trans-1,3-Dichloropropene	65-135	30	65-135	30
Trichloroethene (TCE)	65-135	30	65-135	30
Trichlorofluoromethane (Freon 11)	65-135	30	65-135	30
Vinyl acetate	65-135	30	65-135	30
Vinyl chloride	65-135	30	65-135	30
Xylenes, m & p	65-135	30	65-135	30

Table B3

Quality Control Limits for Definitive Methods (Air and Soil Gas)

RWQCB Quality Assurance Project Plan, September 2008

	Air		Soil Gas	
Target Analyte	**LCS %R**	**Duplicate RPD**	**LCS %R**	**Duplicate RPD**
Organics, Volatile Organic Compounds				
EPA Method TO-17				
Xylenes, o	65-135	30	65-135	30

Notes:

LCS: Laboratory Control Sample
%R: Percent Recovery
RPD: Relative Percent Difference
NA: Not applicable

Appendix C
Reporting Limits for Definitive Methods

Table C1

Reporting Limits for Definitive Methods (Water Only)

RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Reporting Limits	Maxiumum Contaminant Levels	Units
Organics, Volatile Organic Compounds			
EPA Method 504.1			
1,2,3-Trichloropropane	0.005	---	µg/L
1,2-Dibromoethane (EDB)	0.02	0.05	µg/L
Dibromochloropropane (DBCP)	0.02	0.2	µg/L
EPA Method CaDPH Method-VOA			
1,2,3-Trichloropropane	0.005	---	µg/L
EPA Method 524.2			
1,1,1,2-Tetrachloroethane	0.5	---	µg/L
1,1,1-Trichloroethane	0.5	200	µg/L
1,1,2,2-Tetrachloroethane	0.5	1	µg/L
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	0.5	1200	µg/L
1,1,2-Trichloroethane	0.5	5	µg/L
1,1-Dichloroethane	0.5	5	µg/L
1,1-Dichloroethene	0.5	6	µg/L
1,1-Dichloropropene	0.5	---	µg/L
1,2,3-Trichlorobenzene	0.5	---	µg/L
1,2,3-Trichloropropane	0.5	---	µg/L
1,2,4-Trichlorobenzene	0.5	5	µg/L
1,2,4-Trimethylbenzene	0.5	---	µg/L
1,2-Dibromoethane (EDB)	0.5	0.05	µg/L
1,2-Dichlorobenzene	0.5	600	µg/L
1,2-Dichloroethane	0.5	0.5	µg/L
1,2-Dichloropropane	0.5	5	µg/L
1,3,5-Trimethylbenzene	0.5	---	µg/L
1,3-Dichlorobenzene	0.5	---	µg/L
1,3-Dichloropropane	0.5	---	µg/L
1,4-Dichlorobenzene	0.5	5	µg/L
2,2-Dichloropropane	0.5	---	µg/L
2-Chlorotoluene	0.5	---	µg/L
4-Chlorotoluene	0.5	---	µg/L
Acetone	5	---	µg/L
Benzene	0.5	1	µg/L
Bromobenzene	0.5	---	µg/L
Bromochloromethane	0.5	---	µg/L
Bromodichloromethane	0.5	100	µg/L
Bromoform	0.5	100	µg/L
Bromomethane	0.5	---	µg/L
Carbon disulfide	0.5	---	µg/L
Carbon tetrachloride	0.5	0.5	µg/L
Chlorobenzene	0.5	70	µg/L

Table C1

Reporting Limits for Definitive Methods (Water Only)

RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Reporting Limits	Maxiumum Contaminant Levels	Units
Organics, Volatile Organic Compounds			
EPA Method 524.2			
Chloroethane	0.5	---	µg/L
Chloroform	0.5	100	µg/L
Chloromethane	0.5	---	µg/L
cis-1,2-Dichloroethene	0.5	6	µg/L
cis-1,3-Dichloropropene	0.5	0.5	µg/L
Dibromochloromethane	0.05	100	µg/L
Dibromochloropropane (DBCP)	0.05	0.2	µg/L
Dibromomethane	0.5	---	µg/L
Dichlorodifluoromethane (Freon 12)	0.5	---	µg/L
Ethylbenzene	0.5	700	µg/L
Hexachlorobutadiene	0.5	---	µg/L
Isopropyl benzene (cumene)	0.5	---	µg/L
Isopropyl ether	0.5	---	µg/L
Methyl ethyl ketone (2-butanone)	5	---	µg/L
Methyl isobutyl ketone (MIBK)	5	---	µg/L
Methyl tert-butyl ether (MTBE)	0.5	13	µg/L
Methylcyclohexane	0.5	---	µg/L
Methylene chloride	0.5	5	µg/L
Naphthalene	0.5	---	µg/L
n-Butylbenzene	0.5	---	µg/L
n-Propylbenzene	0.5	---	µg/L
p-Cymene (p-isopropyltoluene)	0.5	---	µg/L
sec-Butylbenzene	0.5	---	µg/L
Styrene	0.5	---	µg/L
tert-Butylbenzene	0.5	---	µg/L
Tetrachloroethene (PCE)	0.5	5	µg/L
Toluene	0.5	150	µg/L
trans-1,2-Dichloroethene	0.5	10	µg/L
trans-1,3-Dichloropropene	0.5	0.5	µg/L
Trichloroethene (TCE)	0.5	5	µg/L
Trichlorofluoromethane (Freon 11)	0.5	150	µg/L
Vinyl chloride	0.5	0.5	µg/L
Xylenes, m & p	0.5	1750	µg/L
Xylenes, o	0.5	1750	µg/L
Organics, Semivolatile Organic Compounds			
EPA Method 1625			
N-Nitrosodimethylamine (NDMA)	0.002	---	µg/L

Table C1

Reporting Limits for Definitive Methods (Water Only)

RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Reporting Limits	Maxiumum Contaminant Levels	Units
Organics, Semivolatile Organic Compounds			
EPA Method CaDPH Method-SVOA			
1,2,3-Trichloropropane	0.005	---	µg/L
EPA Method 8310			
Acenaphthene	5	---	µg/L
Acenaphthylene	2.3	---	µg/L
Anthracene	0.66	---	µg/L
Benzo(a)anthracene	0.1	---	µg/L
Benzo(a)pyrene	0.1	0.2	µg/L
Benzo(b)fluoranthene	0.2	---	µg/L
Benzo(g,h,i)perylene	1	---	µg/L
Benzo(k)fluoranthene	0.5	---	µg/L
Chrysene	1	---	µg/L
Dibenz(a,h)anthracene	1	---	µg/L
Fluoranthene	1	---	µg/L
Fluorene	1	---	µg/L
Indeno(1,2,3-cd)pyrene	0.75	---	µg/L
Naphthalene	5	---	µg/L
Phenathrene	0.64	---	µg/L
Inorganics, Metals			
EPA Method 200.7			
Aluminum	200	1000	µg/L
Antimony	60	6	µg/L
Arsenic	10	10	µg/L
Barium	200	1000	µg/L
Beryllium	5	4	µg/L
Cadmium	5	5	µg/L
Calcium	5000	---	µg/L
Chromium (total)	10	50	µg/L
Cobalt	50	---	µg/L
Copper	25	1300	µg/L
Iron	100	---	µg/L
Lead	10	15	µg/L
Magnesium	5000	---	µg/L
Manganese	15	---	µg/L
Nickel	40	100	µg/L
Potassium	5000	---	µg/L
Selenium	35	50	µg/L
Silver	10	---	µg/L
Sodium	5000	---	µg/L

Table C1
Reporting Limits for Definitive Methods (Water Only)
RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Reporting Limits	Maxiumum Contaminant Levels	Units
Inorganics, Metals			
EPA Method 200.7			
Thallium	25	2	µg/L
Vanadium	50	---	µg/L
Zinc	60	---	µg/L
EPA Method 200.8			
Antimony	2	6	µg/L
Arsenic	1	10	µg/L
Barium	10	1000	µg/L
Beryllium	1	4	µg/L
Cadmium	1	5	µg/L
Chromium (total)	2	50	µg/L
Cobalt	1	---	µg/L
Copper	2	1300	µg/L
Lead	1	15	µg/L
Manganese	1	---	µg/L
Nickel	1	100	µg/L
Selenium	5	50	µg/L
Silver	1	---	µg/L
Thallium	1	2	µg/L
Vanadium	1	---	µg/L
Zinc	2	---	µg/L
EPA Method 218.6			
Hexavalent Chromium	0.01	50	µg/L
EPA Method 245.1			
Mercury	0.02	2	µg/L
EPA Method 7196A			
Hexavalent Chromium	0.01	50	µg/L
EPA Method 7470A			
Mercury	0.2	2	µg/L
Organics, Water Quality Parameters			
EPA Method RSK 175			
Ethane	0.3	---	µg/L
Ethene	0.3	100	µg/L
Methane	0.3	---	µg/L
EPA Method 314.1			
Perchlorate	4	---	µg/L
EPA Method 415.1			
Total Organic Carbon	1	---	mg/L

Table C1

Reporting Limits for Definitive Methods (Water Only)

RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Reporting Limits	Maxiumum Contaminant Levels	Units
Organics, Water Quality Parameters			
EPA Method 6850			
Perchlorate	4	---	µg/L
EPA Method 6860			
Perchlorate	4	---	µg/L
Inorganics, Water Quality Parameters			
EPA Method 300.0			
Chloride	1	---	mg/L
Sulfate	5	0.25	mg/L
EPA Method 353.1/353.2			
Nitrate as Nitrogen	0.1	0.01	mg/L
Nitrite as Nitrogen	0.1	0.01	mg/L
EPA Method 9030			
Sulfide	0.25	---	mg/L
EPA Method 9056			
Chloride	1	---	mg/L
Sulfate	5	0.25	mg/L
EPA Method 9010B			
Cyanide	10	200	µg/L
EPA Method 9012A			
Cyanide	10	200	µg/L
EPA Method 130.2			
Hardness (as CaCO3)	10	---	mg/L
EPA Method 160.1			
Total Dissolved Solids	5	---	mg/L
EPA Method 160.2			
Total Suspended Solids	4	---	mg/L
EPA Method 180.1			
Turbidity	NA	---	mg/L
EPA Method 310.1			
Alkalinity	5	---	mg/L

Notes:

--- Not available

Table C2
Reporting Limits for Definitive Methods (Water and Soil)
RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Water Reporting Limits	Maxiumum Contaminant Levels	Water Units	Soil Reporting Limits	Soil Units
Organics, Volatile Organic Compounds					
EPA Method 8260B					
1,1,1,2-Tetrachloroethane	0.5	---	µg/L	5	µg/kg
1,1,1-Trichloroethane	0.5	200	µg/L	5	µg/kg
1,1,2,2-Tetrachloroethane	0.5	1	µg/L	5	µg/kg
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	0.5	1200	µg/L	5	µg/kg
1,1,2-Trichloroethane	0.5	5	µg/L	5	µg/kg
1,1-Dichloroethane	0.5	5	µg/L	5	µg/kg
1,1-Dichloroethene	0.5	6	µg/L	5	µg/kg
1,1-Dichloropropene	0.5	---	µg/L	5	µg/kg
1,2,3-Trichlorobenzene	0.5	---	µg/L	5	µg/kg
1,2,3-Trichloropropane	0.5	---	µg/L	5	µg/kg
1,2,4-Trichlorobenzene	0.5	5	µg/L	5	µg/kg
1,2,4-Trimethylbenzene	0.5	---	µg/L	5	µg/kg
1,2-Dibromoethane (EDB)	0.5	0.05	µg/L	5	µg/kg
1,2-Dichlorobenzene	0.5	600	µg/L	5	µg/kg
1,2-Dichloroethane	0.5	0.5	µg/L	5	µg/kg
1,2-Dichloropropane	0.5	5	µg/L	5	µg/kg
1,3,5-Trimethylbenzene	0.5	---	µg/L	5	µg/kg
1,3-Dichlorobenzene	0.5	---	µg/L	5	µg/kg
1,3-Dichloropropane	0.5	---	µg/L	5	µg/kg
1,4-Dichlorobenzene	0.5	5	µg/L	5	µg/kg
2-Hexanone	5	---	µg/L	10	µg/kg
Acetone	5	---	µg/L	5	µg/kg
Benzene	0.5	1	µg/L	5	µg/kg
Bromobenzene	0.5	---	µg/L	5	µg/kg
Bromochloromethane	0.5	---	µg/L	5	µg/kg
Bromodichloromethane	0.5	100	µg/L	5	µg/kg
Bromoform	0.5	100	µg/L	5	µg/kg
Bromomethane	0.5	---	µg/L	5	µg/kg
Carbon disulfide	0.5	---	µg/L	5	µg/kg
Carbon tetrachloride	0.5	0.5	µg/L	5	µg/kg
Chlorobenzene	0.5	70	µg/L	5	µg/kg
Chloroethane	0.5	---	µg/L	5	µg/kg
Chloroform	0.5	100	µg/L	5	µg/kg
Chloromethane	0.5	---	µg/L	5	µg/kg
cis-1,2-Dichloroethene	0.5	6	µg/L	5	µg/kg
cis-1,3-Dichloropropene	0.5	0.5	µg/L	5	µg/kg
Cyclohexane	0.5	---	µg/L	5	µg/kg
Dibromochloromethane	0.5	100	µg/L	5	µg/kg
Dibromochloropropane (DBCP)	0.5	0.2	µg/L	5	µg/kg
Dichlorodifluoromethane (Freon 12)	0.5	---	µg/L	5	µg/kg

Table C2
Reporting Limits for Definitive Methods (Water and Soil)
RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Water Reporting Limits	Maxiumum Contaminant Levels	Water Units	Soil Reporting Limits	Soil Units
Organics, Volatile Organic Compounds					
EPA Method 8260B					
Ethyl tert-butyl ether	1	---	µg/L	5	µg/kg
Ethylbenzene	0.5	700	µg/L	5	µg/kg
Isopropyl benzene (cumene)	0.5	---	µg/L	5	µg/kg
Isopropyl ether	0.5	---	µg/L	5	µg/kg
Methyl acetate	0.5	---	µg/L	5	µg/kg
Methyl ethyl ketone (2-butanone)	5	---	µg/L	5	µg/kg
Methyl isobutyl ketone (MIBK)	5	---	µg/L	5	µg/kg
Methyl tert-butyl ether (MTBE)	0.5	13	µg/L	5	µg/kg
Methylcyclohexane	0.5	---	µg/L	5	µg/kg
Methylene chloride	0.5	5	µg/L	5	µg/kg
n-Butylbenzene	0.5	---	µg/L	5	µg/kg
n-Propylbenzene	0.5	---	µg/L	5	µg/kg
p-Cymene (p-isopropyltoluene)	0.5	---	µg/L	5	µg/kg
sec-Butylbenzene	0.5	---	µg/L	5	µg/kg
Styrene	0.5	---	µg/L	5	µg/kg
Tert-amyl methyl ether	5	---	µg/L	5	µg/kg
tert-butyl alcohol	5	---	µg/L	5	µg/kg
tert-Butylbenzene	0.5	---	µg/L	5	µg/kg
Tetrachloroethene (PCE)	0.5	5	µg/L	5	µg/kg
Toluene	0.5	150	µg/L	5	µg/kg
trans-1,2-Dichloroethene	0.5	10	µg/L	5	µg/kg
trans-1,3-Dichloropropene	0.5	0.5	µg/L	5	µg/kg
Trichloroethene (TCE)	0.5	5	µg/L	5	µg/kg
Trichlorofluoromethane (Freon 11)	0.5	150	µg/L	5	µg/kg
Vinyl chloride	0.5	0.5	µg/L	5	µg/kg
Xylenes, m & p	0.5	1750	µg/L	5	µg/kg
Xylenes, o	0.5	1750	µg/L	5	µg/kg
Xylenes, total	1	---	µg/L	10	µg/kg
Organics, Semivolatile Organic Compounds					
EPA Method 8270C					
1,1'-Biphenyl	10	---	µg/L	330	µg/kg
1,2,4,5-Tetrachlorbenzene	10	---	µg/L	330	µg/kg
1,4-Dioxane (p-dioxane)	1	6.1	µg/L	330	µg/kg
2,2'-Oxybis(1-Chloropropane)	10	---	µg/L	330	µg/kg
2,4,5-Trichlorophenol	10	---	µg/L	330	µg/kg
2,4,6-Trichlorophenol	10	---	µg/L	330	µg/kg
2,4-Dichlorophenol	10	---	µg/L	330	µg/kg
2,4-Dimethylphenol	10	---	µg/L	330	µg/kg
2,4-Dinitrophenol	10	---	µg/L	330	µg/kg
2,4-Dinitrotoluene	10	---	µg/L	330	µg/kg

Table C2
Reporting Limits for Definitive Methods (Water and Soil)
RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Water Reporting Limits	Maxiumum Contaminant Levels	Water Units	Soil Reporting Limits	Soil Units
Organics, Semivolatile Organic Compounds					
EPA Method 8270C					
2,6-Dinitrotoluene	10	---	µg/L	330	µg/kg
2-Chloronaphthalene	10	---	µg/L	330	µg/kg
2-Chlorophenol	10	---	µg/L	330	µg/kg
2-Methylnaphthalene	10	---	µg/L	330	µg/kg
2-Methylphenol	10	---	µg/L	330	µg/kg
2-Nitroaniline	10	---	µg/L	330	µg/kg
2-Nitrophenol	10	---	µg/L	330	µg/kg
3,3'-Dichlorobenzidine	10	---	µg/L	660	µg/kg
3,4-methylphenol	10	---	µg/L	330	µg/kg
3-Nitroaniline	10	---	µg/L	330	µg/kg
4,6-Dinitro-2-methylphenol	10	---	µg/L	330	µg/kg
4-Bromophenylphenyl ether	10	---	µg/L	330	µg/kg
4-Chloro-3-methylphenol	10	---	µg/L	330	µg/kg
4-Chloroaniline	10	---	µg/L	330	µg/kg
4-Chlorophenylphenyl ether	10	---	µg/L	330	µg/kg
4-Methylphenol	10	---	µg/L	330	µg/kg
4-Nitroaniline	10	---	µg/L	330	µg/kg
4-Nitrophenol	10	---	µg/L	330	µg/kg
Acenaphthene	10	---	µg/L	330	µg/kg
Acenaphthylene	10	---	µg/L	330	µg/kg
Acetophenone	10	---	µg/L	330	µg/kg
Anthracene	10	---	µg/L	330	µg/kg
Atrazine	10	---	µg/L	330	µg/kg
Benzaldehyde	10	---	µg/L	330	µg/kg
Benzo(a)anthracene	10	---	µg/L	330	µg/kg
Benzo(a)pyrene	10	0.2	µg/L	330	µg/kg
Benzo(b)fluoranthene	10	---	µg/L	330	µg/kg
Benzo(g,h,i)perylene	10	---	µg/L	330	µg/kg
Benzo(k)fluoranthene	10	---	µg/L	330	µg/kg
Benzyl alcohol	10	---	µg/L	330	µg/kg
bis(2-Chloroethoxy)methane	10	---	µg/L	330	µg/kg
Bis(2-Chloroethyl)ether	10	---	µg/L	330	µg/kg
Bis(2-Ethylhexyl)phthalate	10	4.8	µg/L	330	µg/kg
Butylbenzylphthalate	10	---	µg/L	330	µg/kg
Caprolactam	10	---	µg/L	330	µg/kg
Carbazole	10	---	µg/L	330	µg/kg
Chrysene	10	---	µg/L	330	µg/kg
Dibenz(a,h)anthracene	10	---	µg/L	330	µg/kg
Dibenzofuran	10	---	µg/L	330	µg/kg
Diethylphthalate	10	---	µg/L	330	µg/kg

Table C2
Reporting Limits for Definitive Methods (Water and Soil)
RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Water Reporting Limits	Maxiumum Contaminant Levels	Water Units	Soil Reporting Limits	Soil Units
Organics, Semivolatile Organic Compounds					
EPA Method 8270C					
Dimethylphthalate	10	---	µg/L	330	µg/kg
Di-n-butylphthalate	10	---	µg/L	330	µg/kg
Di-n-octylphthalate	10	---	µg/L	330	µg/kg
Diphenylamine	10	---	µg/L	330	µg/kg
Fluoranthene	10	---	µg/L	330	µg/kg
Fluorene	10	---	µg/L	330	µg/kg
Hexachlorobenzene	10	1	µg/L	330	µg/kg
Hexachlorobutadiene	10	---	µg/L	330	µg/kg
Hexachlorocyclopentadiene	10	50	µg/L	330	µg/kg
Hexachloroethane	10	---	µg/L	330	µg/kg
Indeno(1,2,3-cd)pyrene	10	---	µg/L	330	µg/kg
Isophorone	10	---	µg/L	330	µg/kg
Naphthalene	10	---	µg/L	330	µg/kg
Nitrobenzene	10	---	µg/L	330	µg/kg
N-Nitroso-di-n-propylamine	10	---	µg/L	330	µg/kg
N-Nitrosodiphenylamine	10	---	µg/L	330	µg/kg
Pentachlorophenol	10	---	µg/L	330	µg/kg
Phenathrene	10	---	µg/L	330	µg/kg
Phenol	10	---	µg/L	330	µg/kg
Pyrene	10	---	µg/L	330	µg/kg
EPA Method 8270C-SIM					
Acenaphthene	1	---	µg/L	25	µg/kg
Acenaphthylene	1	---	µg/L	25	µg/kg
Anthracene	1	---	µg/L	25	µg/kg
Benzo(a)anthracene	1	---	µg/L	25	µg/kg
Benzo(a)pyrene	0.1	0.2	µg/L	25	µg/kg
Benzo(b)fluoranthene	1	---	µg/L	25	µg/kg
Benzo(g,h,i)perylene	1	---	µg/L	25	µg/kg
Benzo(k)fluoranthene	1	---	µg/L	25	µg/kg
Chrysene	1	---	µg/L	25	µg/kg
Dibenz(a,h)anthracene	1	---	µg/L	25	µg/kg
Fluoranthene	1	---	µg/L	25	µg/kg
Fluorene	1	---	µg/L	25	µg/kg
Indeno(1,2,3-cd)pyrene	1	---	µg/L	25	µg/kg
Naphthalene	1	---	µg/L	25	µg/kg
Phenathrene	1	---	µg/L	25	µg/kg
Pyrene	1	---	µg/L	25	µg/kg
Organics, Petroleum Products					
EPA Method M8015B-Extractables					
TPH as Diesel	50	---	µg/L	4	mg/kg

Table C2
Reporting Limits for Definitive Methods (Water and Soil)
RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Water Reporting Limits	Maxiumum Contaminant Levels	Water Units	Soil Reporting Limits	Soil Units
Organics, Petroleum Products					
EPA Method M8015B-Extractables					
TPH as Kerosene	50	---	µg/L	4	mg/kg
TPH as Motor Oil	50	---	µg/L	4	mg/kg
EPA Method M8015B-Purgables					
TPH as Gasoline	50	---	µg/L	1	mg/kg
Inorganics, Metals					
EPA Method 6010B					
Aluminum	200	1000	µg/L	20	mg/kg
Antimony	60	6	µg/L	6	mg/kg
Arsenic	10	10	µg/L	1	mg/kg
Barium	200	1	mg/L	20	mg/kg
Beryllium	5	4	µg/L	0.5	mg/kg
Cadmium	5	5	µg/L	0.5	mg/kg
Calcium	5000	---	µg/L	500	mg/kg
Chromium (total)	10	50	µg/L	1	mg/kg
Cobalt	50	---	µg/L	5	mg/kg
Copper	25	1300	µg/L	2.5	mg/kg
Iron	100	---	µg/L	10	mg/kg
Lead	10	15	µg/L	1	mg/kg
Magnesium	5000	---	µg/L	500	mg/kg
Manganese	15	---	µg/L	1.5	mg/kg
Nickel	40	100	µg/L	4	mg/kg
Potassium	5000	---	µg/L	500	mg/kg
Selenium	35	50	µg/L	3.5	mg/kg
Silver	10	---	µg/L	1	mg/kg
Sodium	5000	---	µg/L	500	mg/kg
Thallium	25	2	µg/L	2.5	mg/kg
Vanadium	50	---	µg/L	5	mg/kg
Zinc	60	---	µg/L	6	mg/kg
EPA Method 6020					
Antimony	2	6	µg/L	0.5	mg/kg
Arsenic	1	10	µg/L	0.4	mg/kg
Barium	10	1000	µg/L	20	mg/kg
Beryllium	1	4	µg/L	0.2	mg/kg
Cadmium	1	5	µg/L	0.1	mg/kg
Chromium (total)	2	50	µg/L	0.1	mg/kg
Cobalt	1	---	µg/L	1	mg/kg
Copper	2	1300	µg/L	0.1	mg/kg
Lead	1	15	µg/L	0.1	mg/kg
Manganese	1	---	µg/L	0.1	mg/kg
Nickel	1	100	µg/L	0.1	mg/kg

Table C2
Reporting Limits for Definitive Methods (Water and Soil)
RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Water Reporting Limits	Maxiumum Contaminant Levels	Water Units	Soil Reporting Limits	Soil Units
Inorganics, Metals					
EPA Method 6020					
Selenium	5	50	µg/L	0.1	mg/kg
Silver	1	---	µg/L	0.5	mg/kg
Thallium	1	2	µg/L	0.1	mg/kg
Vanadium	1	---	µg/L	0.5	mg/kg
Zinc	2	---	µg/L	2	mg/kg
EPA Method 7471A					
Mercury	NA	---	NA	0.02	mg/kg
Organics, Pesticides					
EPA Method 8081A					
4,4'-DDE	0.1	---	µg/L	3.4	µg/kg
4-4'-DDD	0.1	---	µg/L	3.4	µg/kg
4-4'-DDT	0.1	---	µg/L	3.4	µg/kg
Aldrin	0.05	---	µg/L	1.7	µg/kg
Alpha-BHC	0.05	---	µg/L	1.7	µg/kg
Alpha-Chlordane	0.05	0.05	µg/L	1.7	µg/kg
Beta-BHC	0.05	---	µg/L	1.7	µg/kg
delta-BHC	0.05	---	µg/L	1.7	µg/kg
Dieldrin	0.1	---	µg/L	3.4	µg/kg
Endosulfan I	0.05	---	µg/L	3.4	µg/kg
Endosulfan II	0.1	---	µg/L	3.4	µg/kg
Endosulfan sulfate	0.1	---	µg/L	3.4	µg/kg
Endrin	0.1	0.1	µg/L	3.4	µg/kg
Endrin aldehyde	0.1	---	µg/L	3.4	µg/kg
Endrin ketone	0.1	---	µg/L	3.4	µg/kg
Gamma-BHC	0.05	---	µg/L	1.7	µg/kg
Gamma-Chlordane	0.05	0.05	µg/L	1.7	µg/kg
Heptachlor	0.05	0.05	µg/L	1.7	µg/kg
Heptachlor epoxide	0.05	---	µg/L	1.7	µg/kg
Methoxychlor	2	0.5	µg/L	50	µg/kg
Toxaphene	2	---	µg/L	50	µg/kg
EPA Method 8141					
Coumaphos	1	---	µg/L	5	µg/kg
Demeton, Total	1	---	µg/L	5	µg/kg
Diazinon	1	---	µg/L	5	µg/kg
Dichlorvos	1	---	µg/L	5	µg/kg
Dimethoate	1	---	µg/L	5	µg/kg
Disulfoton	1	---	µg/L	5	µg/kg
Ethoprop	1	---	µg/L	5	µg/kg
Fensulfothion	1	---	µg/L	5	µg/kg
Fenthion	1	---	µg/L	5	µg/kg

Table C2
Reporting Limits for Definitive Methods (Water and Soil)
RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Water Reporting Limits	Maxiumum Contaminant Levels	Water Units	Soil Reporting Limits	Soil Units
Organics, Pesticides					
EPA Method 8141					
Malathion	1	---	µg/L	5	µg/kg
Merphos	1	---	µg/L	5	µg/kg
Mevinphos	1	---	µg/L	5	µg/kg
Naled	1	---	µg/L	5	µg/kg
Parathion, ethyl	1	---	µg/L	5	µg/kg
Parathion, methyl	1	---	µg/L	5	µg/kg
Phorate	1	---	µg/L	5	µg/kg
Ronnel	1	---	µg/L	5	µg/kg
Stirophos (Tetrachlorvinphos)	1	---	µg/L	5	µg/kg
Tokuthion (Protothiofos)	1	---	µg/L	5	µg/kg
Trichloronate	1	---	µg/L	5	µg/kg
Organics, Polychlorinated Biphenyls as Aroclors					
EPA Method 8082					
Aroclor-1016	1	0.5	µg/L	50	µg/kg
Aroclor-1221	1	0.5	µg/L	50	µg/kg
Aroclor-1232	1	0.5	µg/L	50	µg/kg
Aroclor-1242	1	0.5	µg/L	50	µg/kg
Aroclor-1248	1	0.5	µg/L	50	µg/kg
Aroclor-1254	1	0.5	µg/L	50	µg/kg
Aroclor-1260	1	0.5	µg/L	50	µg/kg
Organics, Herbicides					
EPA Method 8151A					
2,4,5-T	10	---	µg/L	25	µg/kg
2,4,5-TP	10	50	µg/L	25	µg/kg
2,4-D	10	70	µg/L	25	µg/kg
2,4-DB	10	---	µg/L	25	µg/kg
Dalapon	10	---	µg/L	25	µg/kg
Dicamba	10	---	µg/L	25	µg/kg
Dichlorprop	10	---	µg/L	25	µg/kg
Dinoseb	5	---	µg/L	25	µg/kg
MCPA	400	---	µg/L	25000	µg/kg
MCPP	400	---	µg/L	25000	µg/kg
Organics, Other Organics					
EPA Method 9060					
Total Organic Carbon	1	---	mg/L	200	mg/kg

Notes:

The achievable reporting limit depends on the sample size.

--- Not Available
NA Not Applicable

Table C3
Reporting Limits for Definitive Methods (Air and Soil Gas)
RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Air Reporting Limits	Soil Gas Reporting Limits	Units
Organics, Volatile Organic Compounds			
EPA Method TO-14			
1,1,1-Trichloroethane	0.11	2.8	µg/m³
1,1,2,2-Tetrachloroethane	0.14	3.5	µg/m³
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	10	10	µg/m³
1,1,2-Trichloroethane	0.11	2.8	µg/m³
1,1-Dichloroethane	0.082	2	µg/m³
1,1-Dichloroethene	0.4	2	µg/m³
1,2,4-Trichlorobenzene	0.75	15	µg/m³
1,2,4-Trimethylbenzene	0.01	2.5	µg/m³
1,2-Dibromoethane (EDB)	0.16	3.9	µg/m³
1,2-Dichlorobenzene	0.12	2	µg/m³
1,2-Dichloroethane	0.082	2	µg/m³
1,2-Dichloropropane	0.08	0.8	µg/m³
1,3,5-Trimethylbenzene	1	5	µg/m³
1,3-Butadiene	0.005	0.05	µg/m³
1,3-Dichlorobenzene	0.12	3	µg/m³
1,4-Dichlorobenzene	0.12	3	µg/m³
1,4-Dioxane (p-dioxane)	0.1	3	µg/m³
2,2,4-Trimethylpentane	0.3	3	µg/m³
2-Hexanone	1	10	µg/m³
3-Chloropropene	0.1	1	µg/m³
4-Ethyltoluene	0.1	1	µg/m³
Acetone	1	10	µg/m³
Benzene	0.16	1.6	µg/m³
Benzyl chloride	0.01	0.1	µg/m³
Bromodichloromethane	0.05	0.5	µg/m³
Bromoform	0.1	1	µg/m³
Bromomethane	0.2	2	µg/m³
Carbon disulfide	1	10	µg/m³
Carbon tetrachloride	0.13	3.2	µg/m³
Chlorobenzene	0.094	62	µg/m³
Chloroethane	0.13	1.3	µg/m³
Chloroform	0.099	2.5	µg/m³
Chloromethane	0.1	4.2	µg/m³
cis-1,2-Dichloroethene	0.8	2	µg/m³
cis-1,3-Dichloropropene	0.092	2.3	µg/m³
Cyclohexane	1	10	µg/m³
Dibromochloromethane	0.05	0.5	µg/m³
Dichlorodifluoromethane (Freon 12)	10	10	µg/m³
Ethanol	1	10	µg/m³
Ethylbenzene	0.088	2.2	µg/m³

Table C3
Reporting Limits for Definitive Methods (Air and Soil Gas)
RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Air Reporting Limits	Soil Gas Reporting Limits	Units
Organics, Volatile Organic Compounds			
EPA Method TO-14			
Hexachlorobutadiene	1.1	22	µg/m³
Isopropanol	1	10	µg/m³
Isopropyl benzene (cumene)	1	10	µg/m³
Methyl ethyl ketone (2-butanone)	1	10	µg/m³
Methyl isobutyl ketone (MIBK)	1	10	µg/m³
Methyl tert-butyl ether (MTBE)	1	5	µg/m³
Methylene chloride	0.71	1.8	µg/m³
Naphthalene	10	2	µg/m³
N-Heptane	1	10	µg/m³
n-Propylbenzene	1	10	µg/m³
Styrene	0.86	2.2	µg/m³
Tetrachloroethene (PCE)	0.14	3.4	µg/m³
Tetrahydrofuran	0.05	0.5	µg/m³
Toluene	0.76	1.9	µg/m³
Total hexanes	0.1	1	µg/m³
trans-1,2-Dichloroethene	0.4	2	µg/m³
trans-1,3-Dichloropropene	0.092	2.3	µg/m³
Trichloroethene (TCE)	0.016	2.7	µg/m³
Trichlorofluoromethane (Freon 11)	10	10	µg/m³
Vinyl acetate	1	10	µg/m³
Vinyl chloride	0.026	1.3	µg/m³
Xylenes, m & p	0.18	2.2	µg/m³
Xylenes, o	0.088	2.2	µg/m³
EPA Method TO-15			
1,1,1-Trichloroethane	0.11	2.8	µg/m³
1,1,2,2-Tetrachloroethane	0.14	3.5	µg/m³
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	10	10	µg/m³
1,1,2-Trichloroethane	0.11	2.8	µg/m³
1,1-Dichloroethane	0.082	2	µg/m³
1,1-Dichloroethene	0.4	2	µg/m³
1,2,4-Trichlorobenzene	0.75	15	µg/m³
1,2,4-Trimethylbenzene	0.01	2.5	µg/m³
1,2-Dibromoethane (EDB)	0.16	3.9	µg/m³
1,2-Dichlorobenzene	0.12	2	µg/m³
1,2-Dichloroethane	0.082	2	µg/m³
1,2-Dichloropropane	0.08	0.8	µg/m³
1,3,5-Trimethylbenzene	1	5	µg/m³
1,3-Butadiene	0.005	0.05	µg/m³
1,3-Dichlorobenzene	0.12	3	µg/m³
1,4-Dichlorobenzene	0.12	3	µg/m³

Table C3
Reporting Limits for Definitive Methods (Air and Soil Gas)
RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Air Reporting Limits	Soil Gas Reporting Limits	Units
Organics, Volatile Organic Compounds			
EPA Method TO-15			
1,4-Dioxane (p-dioxane)	0.1	3	µg/m³
2,2,4-Trimethylpentane	0.3	3	µg/m³
2-Hexanone	1	10	µg/m³
3-Chloropropene	0.1	1	µg/m³
4-Ethyltoluene	0.1	1	µg/m³
Acetone	1	10	µg/m³
Benzene	0.16	1.6	µg/m³
Benzyl chloride	0.01	0.1	µg/m³
Bromodichloromethane	0.05	0.5	µg/m³
Bromoform	0.1	1	µg/m³
Bromomethane	0.2	2	µg/m³
Carbon disulfide	1	10	µg/m³
Carbon tetrachloride	0.13	3.2	µg/m³
Chlorobenzene	0.094	62	µg/m³
Chloroethane	0.13	1.3	µg/m³
Chloroform	0.099	2.5	µg/m³
Chloromethane	0.1	4.2	µg/m³
cis-1,2-Dichloroethene	0.8	2	µg/m³
cis-1,3-Dichloropropene	0.092	2.3	µg/m³
Cyclohexane	1	10	µg/m³
Dibromochloromethane	0.05	0.5	µg/m³
Dichlorodifluoromethane (Freon 12)	10	10	µg/m³
Ethanol	1	10	µg/m³
Ethylbenzene	0.088	2.2	µg/m³
Hexachlorobutadiene	1.1	22	µg/m³
Isopropanol	1	10	µg/m³
Isopropyl benzene (cumene)	1	10	µg/m³
Methyl ethyl ketone (2-butanone)	1	10	µg/m³
Methyl isobutyl ketone (MIBK)	1	10	µg/m³
Methyl tert-butyl ether (MTBE)	1	5	µg/m³
Methylene chloride	0.71	1.8	µg/m³
Naphthalene	10	2	µg/m³
N-Heptane	1	10	µg/m³
n-Propylbenzene	1	10	µg/m³
Styrene	0.86	2.2	µg/m³
Tetrachloroethene (PCE)	0.14	3.4	µg/m³
Tetrahydrofuran	0.05	0.5	µg/m³
Toluene	0.76	1.9	µg/m³
Total hexanes	0.1	1	µg/m³
trans-1,2-Dichloroethene	0.4	2	µg/m³

Table C3
Reporting Limits for Definitive Methods (Air and Soil Gas)
RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Air Reporting Limits	Soil Gas Reporting Limits	Units
Organics, Volatile Organic Compounds			
EPA Method TO-15			
trans-1,3-Dichloropropene	0.092	2.3	µg/m³
Trichloroethene (TCE)	0.016	2.7	µg/m³
Trichlorofluoromethane (Freon 11)	10	10	µg/m³
Vinyl acetate	1	10	µg/m³
Vinyl chloride	0.026	1.3	µg/m³
Xylenes, m & p	0.18	2.2	µg/m³
Xylenes, o	0.088	2.2	µg/m³
EPA Method TO-17 *			
1,1,1-Trichloroethane	2	20	µg/m³
1,1,2,2-Tetrachloroethane	2	20	µg/m³
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	2	20	µg/m³
1,1,2-Trichloroethane	2	20	µg/m³
1,1-Dichloroethane	2	20	µg/m³
1,1-Dichloroethene	2	20	µg/m³
1,2,4-Trichlorobenzene	2	20	µg/m³
1,2,4-Trimethylbenzene	2	20	µg/m³
1,2-Dibromoethane (EDB)	2	20	µg/m³
1,2-Dichlorobenzene	2	20	µg/m³
1,2-Dichloroethane	2	20	µg/m³
1,2-Dichloropropane	2	20	µg/m³
1,3,5-Trimethylbenzene	2	20	µg/m³
1,3-Butadiene	2	20	µg/m³
1,3-Dichlorobenzene	2	20	µg/m³
1,4-Dichlorobenzene	2	20	µg/m³
1,4-Dioxane (p-dioxane)	2	20	µg/m³
2,2,4-Trimethylpentane	2	20	µg/m³
2-Hexanone	2	20	µg/m³
3-Chloropropene	2	20	µg/m³
4-Ethyltoluene	2	20	µg/m³
Acetone	2	20	µg/m³
Benzene	2	20	µg/m³
Benzyl chloride	2	20	µg/m³
Bromodichloromethane	2	20	µg/m³
Bromoform	2	20	µg/m³
Bromomethane	2	20	µg/m³
Carbon disulfide	2	20	µg/m³
Carbon tetrachloride	2	20	µg/m³
Chlorobenzene	2	20	µg/m³
Chloroethane	2	20	µg/m³
Chloroform	2	20	µg/m³

Table C3
Reporting Limits for Definitive Methods (Air and Soil Gas)
RWQCB Quality Assurance Project Plan, September 2008

Target Analyte	Air Reporting Limits	Soil Gas Reporting Limits	Units
Organics, Volatile Organic Compounds			
EPA Method TO-17 *			
Chloromethane	2	20	µg/m³
cis-1,2-Dichloroethene	2	20	µg/m³
cis-1,3-Dichloropropene	2	20	µg/m³
Cyclohexane	2	20	µg/m³
Dibromochloromethane	2	20	µg/m³
Dichlorodifluoromethane (Freon 12)	2	20	µg/m³
Ethanol	2	20	µg/m³
Ethylbenzene	2	20	µg/m³
Hexachlorobutadiene	2	20	µg/m³
Isopropanol	2	20	µg/m³
Isopropyl benzene (cumene)	2	20	µg/m³
Methyl ethyl ketone (2-butanone)	2	20	µg/m³
Methyl isobutyl ketone (MIBK)	2	20	µg/m³
Methyl tert-butyl ether (MTBE)	2	20	µg/m³
Methylene chloride	2	20	µg/m³
Naphthalene	2	20	µg/m³
N-Heptane	2	20	µg/m³
n-Propylbenzene	2	20	µg/m³
Styrene	2	20	µg/m³
Tetrachloroethene (PCE)	2	20	µg/m³
Tetrahydrofuran	2	20	µg/m³
Toluene	2	20	µg/m³
Total hexanes	2	20	µg/m³
trans-1,2-Dichloroethene	2	20	µg/m³
trans-1,3-Dichloropropene	2	20	µg/m³
Trichloroethene (TCE)	2	20	µg/m³
Trichlorofluoromethane (Freon 11)	2	20	µg/m³
Vinyl acetate	2	20	µg/m³
Vinyl chloride	2	20	µg/m³
Xylenes, m & p	2	20	µg/m³
Xylenes, o	2	20	µg/m³

Notes:

* The achievable reporting limit depends on the sample size.

Appendix D
USEPA Region 9 Technical Guidelines for Accurately Determining Volatile Organic Compound (VOC) Concentrations in Soil and Solid Matrices

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION 9
Quality Assurance Office
75 Hawthorne Street
San Francisco, CA 94105-3901

USEPA REGION 9 TECHNICAL GUIDELINES FOR ACCURATELY DETERMINING VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATIONS IN SOIL AND SOLID MATRICES

R9QA/05.2

FINAL

December 2005

FOREWORD

The U.S. Environmental Protection Agency (EPA) is authorized to make decisions affecting public health and the environment. With the knowledge that there is an inviolable trust in the Agency, EPA mandated that environmental data collected by and for the Agency be of known quality, and, as appropriate, legally defensible in relation to the decisions to be made based on them. The Agency-Wide Quality System, EPA Order 5360.1 A1, EPA Quality Manual for Environmental Programs, May 2000, and EPA Order 5360.1 A2, Policy and Program Requirements for the Mandatory Agency-Wide Quality System, May 2000 (supersedes EPA Order 5360.1, 1984) defines this mandate. The Agency-Wide Quality System is intended to ensure that decision makers are provided the necessary knowledge and confidence on which to base their decisions.

The responsibility for planning, developing and implementing the EPA Region 9's Quality System resides with the Regional Quality Assurance Manager (RQAM) and the Quality Assurance Office (QA Office).

These guidelines have been developed by the RQAM/QA Office to support the mission of EPA Region 9.

These guidelines update and replace the EPA Region 9 "Regional Interim Policy for Determination of Volatile Organic Compound (VOC) Concentrations in Soil and Solid Matrices," June 23, 1999.

If you have any questions, please contact the Region 9 QA Office.

ACKNOWLEDGEMENTS

EPA Region 9 would like to thank all the technical reviewers, from the environmental testing and sampling industries and from State and Federal agencies, who provided input to this document and its predecessor.

TABLE OF CONTENTS

1.0 SUMMARY

These guidelines address methods for: (1) handling of samples as intact soil cores; (2) preserving samples; (3) storing samples in hermetically sealed containers; and (4) minimizing analyte losses due to direct volatilization (both in the field and the laboratory) and biodegradation. Region 9 believes that following these guidelines is an important part of ensuring that accurate concentrations of VOCs are measured. Therefore, the procedures by which data are generated for or by Region 9 should follow project and/or program specific methods for field sample collection and laboratory sample handling which adhere to these guidelines. Specific procedures should be included in a quality assurance project plan (QAPP) or sampling and analysis plan (SAP).

2.0 PURPOSE

EPA Region 9 has developed technical guidelines to help ensure that sampling and analyzing for Volatile Organic Compounds (VOCs) in soil and solid matrices are conducted in a manner that achieves accurate, technically defensible data. Region 9's guidelines, which are intended to apply whenever VOC sampling in and analysis of soil and solid matrices are conducted, are consistent with United States Environmental Protection Agency (USEPA) Office of Solid Waste test methods. These are included as part of a compendium of over 200 documents in "Test Methods for Evaluating Solid Wastes and Physical/Chemical Methods, SW-846" (hereafter "SW-846"), which are applicable when such sampling is conducted under the Resource Conservation and Recovery Act program. Region 9's guidelines provide greater flexibility than SW-846. These guidelines also have general applicability to other EPA programs where VOC data are collected for quantitative uses.

Region 9 recognizes that there may be methodologies other than those referenced in these guidelines that may also measure VOC concentrations in solid matrices. The use of alternative methods is acceptable, but only after credible method validation studies have been performed and documented.

These guidelines are based on the best scientific information available at this time, and therefore, are subject to further clarifications and additions as further peer reviewed and validated research or improved techniques become available.

3.0 BACKGROUND

In the 1990's, a number of studies were conducted to evaluate traditional VOC sampling and analysis techniques to determine whether they provided data that accurately reflected environmental conditions. At the time, the accepted, traditional sampling methodologies included methods such as the use of glass jars with minimal head space and/or sealed sampling sleeves. These studies determined that these techniques often resulted in inaccurately low measurements of VOCs due to volatilization and biodegradation losses from the sample media. These in turn may have lead to an underestimate of the risk posed by VOC contaminants to public health

and the environment. To address these technical deficiencies, USEPA's Office of Solid Waste, developed (as part of SW-846) Method 5035, "Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples," and Method 5021, "Volatile Organic Compounds in Soils and Other Solid Matrices Using Equilibrium Headspace Analysis," to describe procedures and protocols for the collection and analysis of solid samples. (Method 5035 was updated to Method 5035A in July 2002. The update includes an Appendix, "The Collection and Preservation of Aqueous and Solid Samples for Volatile Organic Compound (VOC) Analysis," a useful reference for VOC sampling and analysis.). Soil was deleted as an option for Method 5030, "Purge-and-Trap for Aqueous Samples," (soil sample extracts and certain sample types still reference method 5030 for analysis).

4.0 SCOPE

Region 9 intends to follow the procedures set forth in these guidelines when it is determining VOC concentrations in soil and solid matrices. In order to help ensure that data generated are of known and appropriate quality and accurately reflect environmental conditions, Region 9 recommends that USEPA contractors and grantees, Federal Facilities, and other entities producing data for Region 9 decision-making follow the procedures set forth herein.

If methodologies that differ from those noted in these guidelines are followed, copies of documents which support the alternative methodology, including method validation studies, should be submitted with the data.

5.0 GUIDELINES

To help ensure accurate measurements, Region 9 recommends that these guidelines be followed whenever VOCs in soil or other solid matrices are sampled and analyzed. These guidelines address methods for: (1) handling of samples as intact soil cores; (2) preserving samples; (3) storing samples in hermetically sealed containers; and (4) minimizing analyte losses due to direct volatilization (both in the field and the laboratory) and biodegradation. Region 9 believes that following these guidelines is a scientifically important part of ensuring that accurate concentrations of VOCs are measured. Therefore, the procedures by which data are generated for or by Region 9 should follow project and/or program specific methods for field sample collection and laboratory sample handling referred to in these guidelines. These procedures should be documented in a quality assurance project plan (QAPP) or sampling and analysis plan (SAP).

Region 9's guidelines for measuring VOC concentrations in soil and other solid matrices include the following:

1. **Samples should be handled as intact soil cores until being transferred into methanol or into the container that will be used for analysis.**

Volatilization of VOCs can occur quickly from many matrix types. By preserving a cohesive matrix and minimizing surface area exposed to the atmosphere, VOC losses

can be minimized over a short duration of time. Therefore, Region 9 recommends that coring techniques be used which preserve soil integrity and cohesion.

However, these guidelines do not address the impact of drilling techniques on the collection of a representative VOC sample. Therefore, site/program QAPPs and SAPs should address the impact of all collection techniques on sample integrity and select those appropriate for the project data quality objectives (DQOs). Potential VOC losses due to drilling techniques include, but are not limited to: sample compression and loss of pore space; introduction of air into the sample matrix; mechanical heat introduced in the drilling process; and volatilization from prolonged periods in a non-hermetically sealed sampling apparatus.

Further, solid matrices that are not amenable to the use of a coring technique should be collected in such a way as to preserve their integrity. Transferring of these solids with spatulas or similar devices into sampling containers is discouraged as this disrupts the sample pore spaces and greatly increases the sample surface area available for volatilization. For soil piles, fresh (unexposed), soil at an adequate depth (representative of concentrations from the interior of the pile) should be sampled. Gravel or concrete samples may need to be manually transferred into VOC sampling containers quickly and in a condition and manner that minimizes VOC losses.

2. **Samples should be stored in containers which can be reliably sealed to prevent volatilization losses over the project specified analytical holding time.**

Significant volatilization has been shown to occur when samples are stored in jars, capped sleeves and other containers that do not provide reliable seals. Therefore, Region 9 recommends, consistent with the results of recent studies, that samples be stored in vials with sufficiently thick Teflon™/silicon septa as are commonly used for storage of water samples, to prevent VOC losses over the sample holding time.

3. **Samples should be analyzed or chemically preserved with acid or methanol, within 48 hours of collection.**

Soil samples stored in sealed vials have been shown to undergo significant biodegradation over time periods greater than 48 hours. Holding time guidelines for VOCs are given in SW846, Method 5035A, Appendix A, Table A.1 “Recommended VOC Sample Preservation Techniques and Holding Times.” The holding time for preserved soil samples should be interpreted as 14 days from the time of sample collection (stored at 4 ± 2^{o}C). Due to potential biodegradation, samples stored in sealed containers, but not chemically preserved, should not be stored for more than 48 hours prior to analysis or chemical preservation. On a project/program specific basis, Region 9 will consider other alternatives to extend the holding time of soils that have

not been chemically preserved. Holding time will be considered as cumulative. Exceptions should be documented in a QAPP or a SAP submitted to and approved by the Region 9 QA Office.

It should be noted that some soil types have been shown to exhibit significant degradation of aromatic VOCs in less than 48 hours (Hewitt, et. al., 1999, *Environmental Testing and Analysis*). Also, Sorini, et. al., (2002, *Soil Sediment & Water*) observed significant differences between samples that were extruded directly into methanol and samples where methanol was added at a later time to soil extruded into empty VOA vials (where methanol was added through the septum). Based on these findings, where project or program DQOs require a higher degree of accuracy soil samples may need to be chemically preserved in the field.

Care should be taken in choosing preservatives. For example, Method 5035 notes that, "Soil samples that contain carbonate minerals (either from natural sources or applied as an amendment) may effervesce upon contact with the acidic preservative solution in the low concentration sample vial." Therefore, calcareous soils that effervesce on contact with the preservative solution, which is intended for low-level samples, should be preserved using an alternative technique.

As an alternative to chemical preservatives, several studies have shown that freezing of unpreserved soils, at -7 ^{o}C or less, is an effective means of slowing the biodegradation process. If freezing is determined to meet project or program DQOs, samples should be frozen in containers that have an air tight seal that can be maintained while frozen. Because water expands when frozen, samples extruded into water or samples with extremely high moisture content may rupture or compromise the seal of the storage container.

4. **Steps should be taken to minimize exposure of each sample core to the atmosphere in the field and laboratory.**

As noted by Hewitt and Lukash, "Uncontrollable volatilization losses occur within seconds of exposure for samples with a large surface / mass ratio. Thus, soils obtained in small diameter coring devices should be extruded directly into appropriately prepared analysis vials." (CRREL Special Report 96-5).

6.0 ADDITIONAL CONSIDERATIONS

Field Laboratories: The use of field laboratories to analyze samples within several hours of collection is an alternative to prevent loss of volatiles in transit and storage. The sample collection and analysis procedures should follow the guidelines above. Note that, for extremely short holding times, chemical preservation is not needed and sample storage containers may differ than those used for "fixed" laboratory analysis as long as these containers "prevent volatilization losses over the project specified analytical holding time." Additionally, the quality control criteria and quality

assurance system used by a field laboratory must be adequate for generation of data which will meet project DQOs.

Addition of Surrogates and Matrix Spiking Compounds in the Field: It is best to add analytical surrogate and matrix spiking compounds into soils prior to sample extraction, using water or a solvent. Method 5035A does not incorporate the addition of these compounds prior to extraction in the field. Because this is an important control check on the analytical process, it may be appropriate to incorporate a procedure which adds surrogate and/or matrix spiking compounds prior to extraction for some project/program DQOs. This procedure should be implemented in consultation with the analytical laboratory.

Soil Gas: These guidelines are not intended to address data quality issues associated with collection of soil gas samples for VOCs in conjunction with, or as a substitute for, soil samples. Soil gas is the preferred data type to meet the quality objectives of some subsurface characterization activities. There are also scenarios where soil gas data are unacceptable for decision making (e.g., in excavated soils and when determining disposal or treatment options, or for determining concentrations of VOCs that have a high affinity for the soil matrix).

7.0 ADDITIONAL BACKGROUND

Traditional practices for the sampling and analysis of volatile organic compounds (VOCs) in soil have been shown to have a significantly low bias of inconsistent magnitude (Grant, 1996) resulting from volatilization (Hewitt, 1996) and biodegradation (Hewitt, 1994). Hewitt and Lukash (Hewitt, 1996) demonstrated that capped sleeves can show substantial losses in less than one day. Hewitt and Lukash also demonstrated volatile losses in uncapped core liners of up to 90% in less than 40 minutes for trichloroethene (TCE). Because other analytes, in various matrix types, can have higher mobility than those tested, substantial losses may occur in a shorter period of time. Grant, Jenkins and Mudambi (Grant, 1996) examined split sampling results from a cross section of laboratories. For VOCs in soil they noted that, "The magnitude of this scatter [for a typical data comparison] is so large that it is impossible to recommend effective limits of acceptability. Instead, we believe that steps are urgently needed to improve data quality." Hewitt (1994) noted that biodegradation of benzene and toluene in soil samples stored in sealed glass ampules at $4^{o}C$ for 14 days could be substantial, demonstrating a need for the use of chemical preservatives. Turriff and Reitmeyer (1998) observed that a variety of soil matrices could be held for 48 hours at $4^{o}C$, in sealed zero headspace containers, without substantial VOC losses. Additionally, Turriff and Reitmeyer demonstrated that freezing was an option to extend holding times of En Core™ sampling devices. Because volatile losses have been linked to disturbance of the soil matrix and exposure to the atmosphere, samples should be handled in intact soil cores and stored in hermetically sealed vessels in both the field and the laboratory.

8.0 REFERENCES

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Appendix E
Quality Control and Calibration Requirements for Definitive Methods

Acronyms and Abbreviations

%D	percent difference
BFB	bromofluorobenzene
CCC	calibration check compound
CCV	continuing calibration verification
COD	coefficient of determination
DDT	dichlorodiphenyl-trichloroethane
DQO	data quality objective
DRO	diesel range organics
DFTPP	decafluorotriphenylphosphine
EDL	estimated detection limit
EICP	extracted ion current profile
EMPC	estimated maximum concentration
GC	gas chromatograph
GRO	gasoline range organics
HRCC	high resolution concentration calibration
ICAL	initial calibration
ICS	interference check solution
IS	internal standard
LCS	laboratory control sample
MDL	method detection limit
MS	matrix spike
MS/MSD	matrix spike/matrix spike duplicate
PCB	polychlorinated biphenyl
PCDF	polychlorinated dibenzo furan
PCDPE	polychlorinated diphenyl ether
PFK	perfluorokerosene
PPM	part per million

QC	quality control
RF	response factor
RL	reporting limit
RPD	relative percent difference
RSD	relative standard deviation
RT	retention time
SPCC	system performance check compound
TCDD	tetrachlorinated dibenzo dioxin

TABLE E-1
Summary of Minimum Calibration and Quality Control Procedures for Gas Chromatography Methods

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
EPA Method 8081A Specific: Breakdown check (Endrin and DDT, Method SW8081A only)	Daily prior to analysis of sample	Degradation ≤ 15% for each analyte	Correct problem then repeat breakdown check.
ICAL for all target analytes; minimum five standards; low concentration standard at or below the required reporting limit.	Initial calibration prior to sample analysis	One of the options below (except for Method 8082 which may only use Option 1 or 2): *Option 1*: linear – RSD for each analyte ≤ 20% *Option 2*: linear – least squares regression r ≥ 0.995 for each analyte. *Option 3*: non-linear – COD ≥ 0.99 (six points shall be used for second order, seven points shall be used for third order) not applicable for SW8082	Correct problem then repeat initial calibration.
Second-source initial calibration verification	Once after each ICAL	All analytes within ± 25% of expected value	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration.
Retention time window position established for each analyte and surrogate	Each ICAL and after the initial daily CCV	Position shall be set using the midpoint standard of the initial calibration curve.	N/A
Retention time window width established for each analyte and surrogate	At method set-up and after major maintenance (e.g., column change)	3 times standard deviation for each analyte (each quantitation peak SW8082) retention time from 72-hour study **GRO:** calculate retention time based on EPA Method 8000B, Section 7.6 **DRO:** calculate retention time based on C10 and C28 alkanes per EPA Method 8000B, Section 7.6	N/A
Retention time window verification for each analyte and surrogate	Each calibration verification	Analyte within established window	Correct problem then reanalyze all samples analyzed since the last acceptable retention time check.
CCV	Daily, before sample analysis, unless ICAL performed on same day and after every 10 samples and at the end of the analysis sequence	All analytes within ± 15% of expected value *EPA Method 8015 Specific All analytes within ± 20% of expected value*	Correct problem then repeat CCV. Reanalyze all samples since last successful calibration verification.

TABLE E-1
Summary of Minimum Calibration and Quality Control Procedures for Gas Chromatography Methods

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a.b]
Method blank	One per analytical batch	No analytes detected > ½ RL. For common lab contaminants no analytes detected > RL.	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes *EPA Method 8082 Specific PCB 1016/1260 mix*	One LCS per analytical batch	Acceptance criteria: See Appendix B.	Correct problem then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.
Surrogate spike	Every sample, spiked sample, standard, and method blank	Acceptance criteria: See Appendix B.	Correct problem then re-extract and reanalyze the affected samples. If matrix effect is verified, discuss in case narrative.
MS/MSD	One MS/MSD per every 20 project samples per matrix	Acceptance criteria: See Appendix B.	Assess data to determine whether there is a matrix effect or analytical error. Review LCS for failed target analytes. Potential matrix effects should be communicated to the prime contractor so an evaluation can be made with respect to the DQOs.
Second-column confirmation (not required for multicomponent analytes:, toxaphene, technical chlordane, DRO, GRO, aroclors or dissolved gases by RSK-175)	100% for all positive results	RPD ≤ 25%	Reanalyze if not performed Report higher result if no anomalies found
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample...
Equipment Rinsate Blank	One per day per piece of reusable sampling equipment (or per sampling plan)	No analytes greater than ½ RL.	Equipment rinsate blanks that contain analytes above ½ RL require inspection of sampling and decontamination techniques to ascertain source of residual contamination. Project action required when excessive contamination is observed in equipment rinsate blanks.

TABLE E-1
Summary of Minimum Calibration and Quality Control Procedures for Gas Chromatography Methods

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a.b]

[a] All corrective actions associated shall be documented, and all records shall be maintained by the laboratory.
[b] Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

TABLE E-2
Summary of Minimum Calibration and Quality Control Procedures for Gas Chromatography/Mass Spectrometry Methods (full scan and secondary ion monitoring)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
MS tuning check Use BFB (EPA Method 8260B) or DFTPP (EPA Method 8270C)	Prior to initial calibration and calibration verification	Refer to criteria listed in the method description. (Section 7.2.2.1 for SW8260B, Section 7.2.2.2 for SW8270C)	Retune instrument and verify.
GC Performance Check (EPA Method 8270C only)	Daily prior to analysis of sample or calibration standards	Degradation ≤ 20% for DDT. No visible peak tailing for benzidine or pentachlorophenol (As a default, tailing factors should be less than 3.0 and 5.0, respectively.)	Correct problem, then repeat performance check.
ICAL	Initial calibration prior to sample analysis for all target analytes; minimum five standards; low concentration standard at or below the required reporting limit.	**SPCCs**: Average RF ≥ 0.030 [c] (SW8260B), ≥ 0.050 (SW8270C) **CCCs:** % RSD for RFs ≤ 30% **and** one of the options below: *Option 1*: linear – RSD for each analyte < 15% *Option 2 linear* – linear least squares regression r ≥ 0.995 for each analyte *Option 3 non-linear* – COD ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat initial calibration.
Second-source initial calibration verification	Once after each ICAL	All analytes within ± 25% of expected value	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration.
Retention time window position establishment for each analyte and surrogate	Once per ICAL	Position shall be set using the midpoint standard of the initial calibration curve.	N/A
CCV	Daily, before sample analysis unless ICAL performed on same day and after every 12 hours of analysis time	**SPCCs:** average RF ≥ 0.30[c] (SW8260B), average RF ≥ 0.050 (SW8270C); **CCCs:** ≤ 20% D All analytes within ± 20% D of expected value from ICAL	Correct problem then rerun CCV. If that fails, repeat initial calibration.

TABLE E-2
Summary of Minimum Calibration and Quality Control Procedures for Gas Chromatography/Mass Spectrometry Methods (full scan and secondary ion monitoring)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
Internal Standards (IS)	Each sample	Retention time ± 30 seconds from retention time of the IS in the ICAL mid-point std. EICP area within -50% to +100% of area from IS in ICAL mid-point standard	Inspect mass spectrometer and GC for malfunctions and corrections made as appropriate. Reanalysis of samples analyzed while the system was malfunctioning is mandatory.
Method blank	One per analytical batch	No analytes detected > ½ RL	Assess data. Correct problem. If necessary,-reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: See Appendix B.	Correct problem then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.
MS/MSD	One MS/MSD per every 20 project samples per matrix	Acceptance criteria: See Appendix B.	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to the prime contractor so an evaluation can be made with respect to the PQOs.
Surrogate spike	Every sample, spiked sample, standard, and method blank	Acceptance criteria: See Appendix B.	Correct problem then reprep and reanalyze the affected samples. If matrix effect is verified, discuss in case narrative.
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample...
Equipment Rinsate Blank	One per day per piece of reusable sampling equipment (or per sampling plan)	No analytes greater than ½ RL.	Equipment rinsate blanks that contain analytes above ½ RL require inspection of sampling and decontamination techniques to ascertain source of residual contamination. Project action required when excessive contamination is observed in equipment rinsate blanks.

TABLE E-2
Summary of Minimum Calibration and Quality Control Procedures for Gas Chromatography/Mass Spectrometry Methods (full scan and secondary ion monitoring)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]

[a] All corrective actions shall be documented, and all records shall be maintained by the laboratory.

[b] Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

[c] SW8260B:RF, ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane.

TABLE E-3
Summary of Minimum Calibration and Quality Control Procedures for Methods Air and Soil Gas Methods (TO-14/TO-15/TO-17)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
MS tuning check (Use BFB)	Prior to initial calibration and calibration verification	Refer to criteria listed in method.	Retune instrument and verify.
Initial multipoint calibration for all analytes (minimum five standards) (ICAL)	Initial calibration prior to sample analysis	One of the options below: *Option 1*: linear – RSD for each analyte ≤ 30%. *Option 2*: linear – least squares regression r ≥ 0.995 for each analyte.	Correct problem then repeat initial calibration.
Second-source initial calibration verification	Once per ICAL	All analytes within ± 30% of expected value	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration.
CCV	Daily, before sample analysis unless ICAL performed on same day and every 24 hours of analysis time	All analytes within ± 30% of expected value	Correct problem, rerun CCV. If that fails, repeat initial calibration.
ISs	Each sample	Retention time ± 0.33 minutes from retention time of the IS in the most recent valid calibration. (ICAL mid-point standard or CCV) EICP area within ± 40% of area of the IS in most recent valid calibration	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while the system was malfunctioning is mandatory.
Method blank (humid zero air)	Immediately after ICAL or daily CCV	No analytes detected > ½ RL	Assess data. Correct problem. If necessary,-reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: See Appendix B.	Correct problem then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected analytical batch.
Sample duplicate	One sample duplicate per analytical batch	Acceptance criteria: See Appendix B.	Correct problem and reanalyze sample and duplicate.
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample..

[a] All corrective actions shall be documented, and all records shall be maintained by the laboratory.

[b] Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

TABLE E-4
Summary of Minimum Calibration and Quality Control Procedures for Polynuclear Aromatic Hydrocarbons by High Performance Liquid Chromatography

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
ICAL	Initial calibration prior to sample analysis; minimum five levels.	One of the options below: *Option 1*: linear – RSD for each analyte ≤ 20% *Option 2*: linear – least squares regression r ≥ 0.995 for each analyte.	Correct problem then repeat initial calibration.
Second-source calibration verification	Once per ICAL	All analytes within ±15% of expected value	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration.
Retention time window verification for each analyte and surrogate	Each calibration verification	RT windows ≤3% of the standard deviation of the absolute RT or ±1.5% of the absolute RT	Correct problem then reanalyze all samples analyzed since the last acceptable retention time check.
ICV and CCV	**ICV:** Daily, before sample analysis, unless ICAL performed on same day **CCV**: After every 10 samples and at the end of the analysis sequence	All analytes within ±15% of expected value (% D)	**ICV:** Correct problem, rerun ICV. If that fails, repeat initial calibration. **CCV:** Correct problem then repeat CCV. Reanalyze all samples since last successful calibration verification.
Method blank	One per analytical batch	No analytes detected > RL	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: See Appendix B	Correct problem then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.
Surrogate spike	Every sample, spiked sample, standard, and method blank	Acceptance criteria: See Appendix B	Correct problem then re-extract and reanalyze the affected samples. If matrix effect is verified, discuss in case narrative.

TABLE E-4
Summary of Minimum Calibration and Quality Control Procedures for Polynuclear Aromatic Hydrocarbons by High Performance Liquid Chromatography

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
MS/MSD	One MS/MSD per every 20 project samples per matrix	Acceptance criteria: See Appendix B	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to the prime contractor so an evaluation can be made with respect to the PQOs.
Confirmation[c]	100% for all positive results	Confirmation RPD ≤40 %	Same as for initial or primary analysis
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample..
Equipment Rinsate Blank	One per day per piece of reusable sampling equipment (or per sampling plan)	No analytes greater than ½ RL.	Equipment rinsate blanks that contain analytes above ½ RL require inspection of sampling and decontamination techniques to ascertain source of residual contamination. Project action required when excessive contamination is observed in equipment rinsate blanks.

[a] All corrective actions shall be documented, and all records shall be maintained by the laboratory.

[b] Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

[c] Use a second column or different detector

TABLE E-5
Summary of Minimum Calibration and Quality Control Procedures for Metals by Inductively Coupled Plasma/Atomic Emission Spectrometry

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
ICAL	Daily initial calibration prior to sample analysis	If more than one standard is used, correlation coefficient must be ≥ 0.995	If applicable, correct problem and repeat initial calibration.
ICV (second source)	Daily after ICAL	All analytes within ± 10% of expected value	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat initial calibration.
CCV	After every 10 samples At the end of the analysis sequence	All analyte(s) within ± 10% of expected value and RSD of replicate integrations < 5%	Correct problem then repeat CCV and reanalyze all samples since last successful calibration verification.
Calibration blank	Before beginning a sample run After every calibration verification	No analytes detected ≥ ½ RL	Correct problem then analyze calibration blank and previous 10 samples.
Low-level calibration check standard (at or below RL)	Daily, after initial calibration. Not required if multi-point calibration (3 or more points) with low std at or below RL is performed	All analyte(s) with ± 20% of expected value	Correct problem then reanalyze.
Linear range calibration (high) check standard	Every three months	Analyte within ± 10% of expected value	Correct problem then reanalyze or re-set linear range.
Method blank	One per analytical batch	No analytes detected > ½ RL	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.
Interference check solution (ICS)	At the beginning of an analytical run	Within ± 20% of expected value	Terminate analysis; locate and correct problem; reanalyze ICS.
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: See Appendix B	Correct problem then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.
Dilution test	Each new sample matrix, at least once per analytical batch (only applicable for analytes with concentrations ≥ 50X MDL)	Fivefold (1+4) dilution must agree within ± 10% of the original determination	Perform post digestion spike addition.

TABLE E-5
Summary of Minimum Calibration and Quality Control Procedures for Metals by Inductively Coupled Plasma/Atomic Emission Spectrometry

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
Post digestion spike addition	When dilution test fails or if an analyte's concentration for all samples in a batch is less than 50X MDL	Recovery within 75–125% of expected results	Check for instrumental problem then reanalyze post digestion spike addition if appropriate. If both dilution test and post digestion spike fail, narrate matrix interference.
MS/MSD	One MS/MSD per every 20 project samples per matrix	Acceptance criteria: See Appendix B	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS or failed target analytes. Potential matrix effects should be communicated to the prime contractor so an evaluation can be made with respect to the PQOs.
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample..
Equipment Rinsate Blank	One per day per piece of reusable sampling equipment (or per sampling plan)	No analytes greater than ½ RL.	Equipment rinsate blanks that contain analytes above ½ RL require inspection of sampling and decontamination techniques to ascertain source of residual contamination. Project action required when excessive contamination is observed in equipment rinsate blanks.

[a] All corrective actions shall be documented, and all records shall be maintained by the laboratory.

[b] Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

TABLE E-6
Summary of Minimum Calibration and Quality Control Procedures for Metals by Inductively Coupled Plasma/Mass Spectrometry

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
MS tuning sample	Prior to initial calibration	Mass calibration ≤ 0.1 amu from the true value Resolution <0.9 amu full width at 10% peak height Stability: RSD ≤ 5% for at least four replicate analyses.	Retune instrument then reanalyze tuning solution.
ICAL	Daily initial calibration prior to sample analysis	If more than one standard is used, correlation coefficient must be ≥ 0.995	If applicable, correct problem and repeat initial calibration.
ICV	After ICAL, before beginning a sample run – at a concentration other than used for calibration	All analytes within ± 10% of expected value	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat initial calibration.
CCV	After every 10 samples. At the end of the analysis sequence – at a concentration near the middle of the calibration range.	All analytes within ± 10% of expected value	Correct problem then repeat CCV and reanalyze all samples since last successful calibration verification.
Calibration blank	Before beginning a sample run, after every 10 samples and at end of the analysis sequence	No analytes detected > ½ RL	Correct problem then analyze calibration blank and previous 10 samples.
Low-level calibration check standard (at or below RL)	Daily, after initial calibration. Not required if multi-point calibration (3 or more points) with low std at or below RL is performed	All analyte(s) with ± 20% of expected value	Correct problem then reanalyze.
Linear range calibration (high) check standard	Every three months	Analyte within ± 10% of expected value	Correct problem then reanalyze or re-set linear range.
Method blank (Preparation blank)	One per analytical batch	No analytes detected > ½ RL	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.
Interference check solutions (ICS-A and ICS-AB)	At the beginning of an analytical run or once during an 12-hour period, whichever is more frequent	Within ± 20% of expected value	Terminate analysis; locate and correct problem; reanalyze ICS; reanalyze all affected samples.
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: See Appendix B	Correct problem then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.

TABLE E-6
Summary of Minimum Calibration and Quality Control Procedures for Metals by Inductively Coupled Plasma/Mass Spectrometry

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
Dilution test	Each matrix in a analytical batch (only applicable for analytes with concentrations ≥ 100X MDL)	Fivefold (1+4) dilution must agree within ± 10% of the original determination.	Perform post digestion spike addition.
Post digestion spike addition	When dilution test fails or if an analyte's concentration for all samples in a batch is less than 100X MDL	Recovery within 75–125% of expected results	Check for instrumental problem then reanalyze post digestion spike addition if appropriate. If both dilution test and post digestion spike fail, narrate matrix interference..
MS/MSD	One MS/MSD per every 20 project samples per matrix	Acceptance criteria: See Appendix B	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to the prime contractor so an evaluation can be made with respect to the PQOs.
Internal Standards (ISs)	Every sample	IS intensity within 30-120% of intensity of the IS in the initial calibration	Perform corrective action as described in Method SW6020, Section 8.3.
IDL study	At initial setup	Detection limits established Shall be ≤ MDL.	None
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample..
Equipment Rinsate Blank	One per day per piece of reusable sampling equipment (or per sampling plan)	No analytes greater than ½ RL.	Equipment rinsate blanks that contain analytes above ½ RL require inspection of sampling and decontamination techniques to ascertain source of residual contamination. Project action required when excessive contamination is observed in equipment rinsate blanks.

[a] All corrective actions shall be documented, and all records shall be maintained by the laboratory.

[b] Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

TABLE E-7
Summary of Minimum Calibration and Quality Control Procedures for Metals by Cold Vapor Atomic Absorption Spectroscopy

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
ICAL	Daily initial calibration prior to sample analysis	Correlation coefficient ≥0.995 for linear regression	Correct problem then repeat initial calibration.
ICV	Once per ICAL	Analyte within ± 10% of expected value	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat initial calibration.
Calibration blank	Before beginning a sample run, after every 10 samples and at end of the analysis sequence	No analytes detected ½ >RL	Correct problem then analyze calibration blank and previous 10 samples.
CCV	After every 10 samples and at the end of the analysis sequence	Analyte within ± 20% of expected value	Correct problem then repeat CCV and reanalyze all samples since last successful calibration verification.
Method blank	One per analytical batch	No analytes detected > ½ RL	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.
Dilution Test	Each matrix in a analytical batch (only applicable for samples with concentrations ≥25X MDL)	Fivefold (1+4) dilution must agree within ± 10% of the original determination	None
LCS	One LCS per analytical batch	Acceptance criteria: See Appendix B	Correct problem then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.
MS/MSD	One MS/MSD per every 20 project samples per matrix	Acceptance criteria: See Appendix B	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to the prime contractor so an evaluation can be made with respect to the PQOs.
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample..

TABLE E-7
Summary of Minimum Calibration and Quality Control Procedures for Metals by Cold Vapor Atomic Absorption Spectroscopy

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
Equipment Rinsate Blank	One per day per piece of reusable sampling equipment (or per sampling plan)	No analytes greater than ½ RL.	Equipment rinsate blanks that contain analytes above ½ RL require inspection of sampling and decontamination techniques to ascertain source of residual contamination. Project action required when excessive contamination is observed in equipment rinsate blanks.

[a] All corrective actions shall be documented, and all records shall be maintained by the laboratory.

[b] Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed.

TABLE E-8
Summary of Minimum Calibration and Quality Control Procedures for Inorganic Parameters

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
Hexavalent Chromium			
ICAL	Daily initial calibration prior to sample analysis	Correlation coefficient ≥0.995 for linear regression	Correct problem then repeat initial calibration.
ICV	Before beginning a sample run.	Value within ± 15% of expected value (initial source)	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration.
CCV	After every 15 samples and at the end of the analysis sequence	Value within ± 15% of expected value	Correct problem then repeat CCV and reanalyze all samples since last successful calibration verification.
Method blank	One per analytical batch	No analyte detected > ½ RL	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.
LCS	One LCS per analytical batch	Acceptance criteria: See Appendix B	Correct problem then reanalyze If still out, reprep and reanalyze the LCS and all samples in the affected batch.
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample..
Equipment Rinsate Blank	One per day per piece of reusable sampling equipment (or per sampling plan)	No analytes greater than ½ RL.	Equipment rinsate blanks that contain analytes above ½ RL require inspection of sampling and decontamination techniques to ascertain source of residual contamination. Project action required when excessive contamination is observed in equipment rinsate blanks.
MS/MSD	One MS/MSD per every 20 project samples per matrix	Acceptance criteria: See Appendix B	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to the prime contractor so an evaluation can be made with respect to the PQOs.
Hardness			
Titrant Standardization	Once per preparation batch and analytical run	Value within ±5% of expected value	Repeat standardization
Method blank	One per analytical batch	No analytes detected > RL	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.
Sample duplicate (replicate)	Once per every 10 project samples	% D of duplicate within + 50% of sample	Correct problem and reanalyze sample and duplicate.

TABLE E-8
Summary of Minimum Calibration and Quality Control Procedures for Inorganic Parameters

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
Total Suspended Solids and Total Dissolved Solids			
Two-point balance calibration	Daily	± 10% of true value	Recalibrate balance If still out, repair balance and recalibrate
Method blank	One per analytical batch	No analytes detected > RL	Reanalyze method blank If noncompliant and sample analyte concentration <RL or >10 times blank concentration, report results If noncompliant and sample analyte concentration is between RL and 10 times blank concentration, reprepare and reanalyze affected samples.
LCS	One LCS per analytical batch	Acceptance criteria: See Appendix B	Correct problem then reanalyze If still out, reprep and reanalyze the LCS and all samples in the affected batch.
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample..
Laboratory duplicate	Once per every 20 project samples	% D of duplicate within ±20% of sample	Correct problem and reanalyze sample and duplicate.
Anions			
ICAL	Initial calibration prior to sample analysis	linear – least squares regression r $\geq$ 0.995 for each analyte.	Correct problem then repeat initial calibration.
Retention time window verified for each analyte	Each calibration verification	Analyte within established window	Correct problem then reanalyze all samples analyzed since the last acceptable retention time check.
ICV and CCV	ICV: Daily, before sample analysis, unless ICAL performed on same day When effluent is changed	All analytes within ± 5% of expected value (%D)	ICV: Correct problem, rerun ICV. If that fails, repeat initial calibration.
	CCV: After every 10 samples At the end of the analysis sequence		CCV: Correct problem then repeat CCV. Reanalyze all samples since last successful calibration verification.
Method blank	One per analytical batch	No analytes detected > ½ RL	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.

TABLE E-8
Summary of Minimum Calibration and Quality Control Procedures for Inorganic Parameters

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: See Appendix B	Correct problem, then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample..
Equipment Rinsate Blank	One per day per piece of reusable sampling equipment (or per sampling plan)	No analytes greater than ½ RL.	Equipment rinsate blanks that contain analytes above ½ RL require inspection of sampling and decontamination techniques to ascertain source of residual contamination. Project action required when excessive contamination is observed in equipment rinsate blanks.
MS/MSD	One MS/MSD per analytical batch	Acceptance criteria: See Appendix B	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to the prime contractor so an evaluation can be made with respect to the PQOs.
Alkalinity			
Titrant standardization	Daily	Within ± 5% of expected value (%D)	Repeat standardization
Method blank	One per analytical batch	No analytes detected > RL	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.
Equipment blank	One per analytical batch	No analytes detected > RL	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: See Appendix B	Correct problem, then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample..
MS/MSD	One MS/MSD per analytical batch	Acceptance criteria: See Appendix B	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to the prime contractor so an evaluation can be made with respect to the PQOs.

TABLE E-8
Summary of Minimum Calibration and Quality Control Procedures for Inorganic Parameters

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
Nitrate/Nitrogen			
ICAL	Initial calibration prior to sample analysis	linear – least squares regression r $\geq$ 0.995 for each analyte.	Correct problem then repeat initial calibration.
ICV and CCV	ICV: Daily, before sample analysis, unless ICAL performed on same day When effluent is changed	All analytes within ± 15% of expected value (%D)	ICV: Correct problem, rerun ICV. If that fails, repeat initial calibration.
	CCV: After every 10 samples At the end of the analysis sequence		CCV: Correct problem then repeat CCV. Reanalyze all samples since last successful calibration verification.
Method blank	One per analytical batch	No analytes detected > RL	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.
Equipment Rinsate Blank	One per day per piece of reusable sampling equipment (or per sampling plan)	No analytes greater than ½ RL.	Equipment rinsate blanks that contain analytes above ½ RL require inspection of sampling and decontamination techniques to ascertain source of residual contamination. Project action required when excessive contamination is observed in equipment rinsate blanks.
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: See Appendix B	Correct problem, then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample..
MS/MSD	One MS/MSD per analytical batch	Acceptance criteria: See Appendix B	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to the prime contractor so an evaluation can be made with respect to the PQOs.
Sulfide			
Method blank	One per analytical batch	No analytes detected > RL	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.

TABLE E-8
Summary of Minimum Calibration and Quality Control Procedures for Inorganic Parameters

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: See Appendix B	Correct problem, then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample..
Equipment Rinsate Blank	One per day per piece of reusable sampling equipment (or per sampling plan)	No analytes greater than ½ RL.	Equipment rinsate blanks that contain analytes above ½ RL require inspection of sampling and decontamination techniques to ascertain source of residual contamination. Project action required when excessive contamination is observed in equipment rinsate blanks.
MS/MSD	One MS/MSD per analytical batch	Acceptance criteria: See Appendix B	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to the prime contractor so an evaluation can be made with respect to the PQOs.
Cyanide			
ICAL	Initial daily calibration prior to sample analysis	Correlation coefficient ≥0.995 for linear regression	Correct problem then repeat initial calibration. Note: Plot of absorbance versus concentration may be nonlinear.
Distilled standards (one high and one low)	Once per ICAL	Value within ± 15% of true value	Correct problem then repeat distilled standards.
ICV	Once after ICAL	Value within ± 15% of expected value	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration.
Method blank	One per analytical batch	No analytes detected > RL	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: See Appendix B	Correct problem then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.
MS/MSD	One MS/MSD per every 20 project samples per matrix	Acceptance criteria: See Appendix B	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to the prime contractor so an evaluation can be made with respect to the PQOs.
Sample duplicate (replicate)	Once per every 20 project samples	% D of duplicate within ± 20% of sample	Correct problem and reanalyze sample and duplicate.

TABLE E-8
Summary of Minimum Calibration and Quality Control Procedures for Inorganic Parameters

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a,b]
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample..
Equipment Rinsate Blank	One per day per piece of reusable sampling equipment (or per sampling plan)	No analytes greater than ½ RL.	Equipment rinsate blanks that contain analytes above ½ RL require inspection of sampling and decontamination techniques to ascertain source of residual contamination. Project action required when excessive contamination is observed in equipment rinsate blanks.
Total Organic Carbon			
ICAL	Initial calibration prior to sample analysis	One standard and one blank, no criteria	None
CCV	Once per 10 samples and at the end of each batch	± 20% of expected value	Reanalyze CCV If still out, identify and correct problem Recalibrate and reanalyze affected samples. All data should be bounded by compliant CCVs
Method blank	One per analytical batch	No analytes detected > RL	Assess data. Correct problem. If necessary, reprep and analyze method blank and all samples processed with the contaminated blank.
Equipment Rinsate Blank	One per day per piece of reusable sampling equipment (or per sampling plan)	No analytes greater than ½ RL.	Equipment rinsate blanks that contain analytes above ½ RL require inspection of sampling and decontamination techniques to ascertain source of residual contamination. Project action required when excessive contamination is observed in equipment rinsate blanks.
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: See Appendix B	Correct problem, then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.
Field Duplicate	One per every 10 samples	Appendix B	None-Field duplicates are collected to provide information on overall precision and ability of sampling techniques to produce a representative sample...
MS/MSD	One MS/MSD per analytical batch	Acceptance criteria: See Appendix B	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to the prime contractor so an evaluation can be made with respect to the PQOs.

[a] All corrective actions shall be documented, and all records shall be maintained by the laboratory.

[b] Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

Appendix F
Data Review and Validation Worksheets

APPENDIX F

Sample Data Review and Validation Worksheet

Laboratory Report Number:	**Method:**
SITE NAME:	**Laboratory Name:**
Part I: Sample Summary	
Method: Matrix: Sample Identifications: _____, Matrix Spike Parent Sample: _____, _____, _____,	
Part II: Field Quality Control Summary	
Field Quality Control Samples: _____ Type _____ ;_____ Type _____;_____ Type _____ Analytes Detected in Field Blanks: Blank Identification: _____ Target Analytes Detected:	
Field Quality Control Samples: _____ Type _____ ;_____ Type _____;_____ Type _____ Analytes Detected in Field Blanks: Blank Identification: _____ Target Analytes Detected:	
Field Quality Control Samples: _____ Type _____ ;_____ Type _____;_____ Type _____ Analytes Detected in Field Blanks: Blank Identification: _____ Target Analytes Detected:	

Laboratory Report Number:		**Method:**			
SITE NAME:		**Laboratory Name:**			
Part III: Laboratory Quality Control Summary					
Quality Parameter	Project Requirements Met	Project Requirements Not Met	Affected Samples	Recommended Action	Data Usable
Preservation and Holding Times					Yes/No
Instrument Performance Check					
Initial Calibration					
Continuing Calibration					
Blanks					
Surrogate Recovery (Organic Methods Only)					
Internal Standards					
Laboratory Control Sample/Laboratory Control Sample Recovery					
Matrix Spike/Matrix Spike Duplicate Recovery					
Target Compound Identification					
Compound Quantitation and Reporting Limits					
Additional Comments					