The State of California's

Surface Water Ambient Monitoring Program

Quality Assurance Program Plan

Version 1.0

Originated by:

The Surface Water Ambient Monitoring Program Quality Assurance Team
Quality Assurance Research Group
Moss Landing Marine Laboratories
San José State University Research Foundation

(September 1, 2008)

Introduction

This quality assurance program plan (QAPrP) serves as an umbrella document for use by each of the Surface Water Ambient Monitoring Program's (SWAMP's) contributing projects. It describes the program's quality system in terms of organizational structure; the functional responsibilities of management and staff; the lines of authority; and the interfaces for those planning, implementing, and assessing all activities conducted.

Purpose

This QAPrP identifies the quality assurance (QA) and quality control (QC) procedures of SWAMP. Its primary purpose is to:

- Ensure that SWAMP activities adhere to the QA policies in the State Water Resources Control Board's (State Board's) draft quality management plan (QMP);
- Specify the quality systems of SWAMP; and
- Serve as a guidance document for projects that are required to be or desire to be SWAMP-comparable

This document applies to the collection of surface water ambient monitoring data, and addresses neither ambient groundwater data, nor effluent data collected as part of National Pollution Discharge Elimination System (NPDES) permitting or waste discharge requirements. Instead, use of this QAPrP is:

- Required for SWAMP-funded projects
- Required for state programs with a SWAMP-comparability mandate
- Encouraged for projects external to SWAMP

Comparability

The U.S. Environmental Protection Agency (EPA) defines comparability as the measure of confidence with which one data set, element, or method can be considered as similar to another. Comparability is an especially important consideration with SWAMP data, which represents a wide variety of objectives, organizations, and procedures over many years. To minimize the effect of this variability, SWAMP has established certain universal guidelines that must be adopted by those seeking or requiring SWAMP comparability.

Functionally, SWAMP comparability is defined as adherence to two key programmatic documents: this QAPrP, and the *Surface Water Ambient Monitoring Program Information Management Plan*. The latter document addresses the database component of SWAMP comparability. It is independent of this QAPrP, and is maintained and implemented by the Data Management Team (DMT) at the Moss Landing Marine Laboratories (MLML).

Additional information on QA and data management comparability is available online or through the SWAMP Help Desk (see Appendix G: *Online Resources*).

Waiver System

While certain universal requirements are the foundation of SWAMP comparability, such requirements may conflict with the unique objectives of each project contributor. At the discretion of the SWAMP Coordinator, a waiver may be obtained for project-relevant adjustments to programmatic requirements. Waiver applications must be submitted in writing to the SWAMP QA Team (QAT), and must detail why the specified requirement is not applicable to the project's quality objectives. The SWAMP Coordinator, in conjunction with the QAT, determines whether or not each waiver will be granted. All associated correspondences are archived by the SWAMP QAT for a period of five years. The standard operating procedure (SOP): *Waiver System for the Surface Water Ambient Monitoring Program Quality Assurance Program Plan* is currently under development.

Group A: Program Management

Element A1: Title and Approval Sheet

Program Title State of California's Surface Water Ambient Monitoring Program

Lead Organization California State Water Resources Control Board
Office of Information Management and Analysis
Surface Water Ambient Monitoring Program Unit
1001 "I" St, 15th Floor
Sacramento, CA 95814

Primary Contact Emilie Reyes, Surface Water Ambient Monitoring Program Coordinator
Phone Number: 916-341-5556
Email Address: ereyes@waterboards.ca.gov

Effective Date September 1, 2008

Approvals

The approvals below were submitted separately, preventing their inclusion in this signature block. Instead, they appear in Appendix H: *Approval Signatures* of this document. Originals are kept on file by the Surface Water Ambient Monitoring (SWAMP) Quality Assurance Team (QAT) according to Element A9: *Documents and Records*.

Emilie Reyes, State Water Resources Control Board, Surface Water Ambient Monitoring Program Coordinator, Office of Information Management and Analysis, Surface Water Ambient Monitoring Program Unit

_____On File_____ _____July 15, 2008_____
Signature Date

William Ray, State Water Resources Control Board, Quality Assurance Office Manager, Office of Information Management and Analysis

_____On File_____ _____July 14, 2008_____
Signature Date

Beverly H. van Buuren, Moss Landing Marine Laboratories, Surface Water Ambient Monitoring Program Quality Assurance Officer, Quality Assurance Research Group

_____On File_____ _____July 21, 2008_____
Signature Date

**Rich Fadness, Quality Assurance Officer (or Designee),
Regional Water Quality Control Board 1 (North Coast Region)**

_____On File_____ _____July 10, 2008_____
Signature Date

**Wil Bruhns, Quality Assurance Officer (or Designee),
Regional Water Quality Control Board 2 (San Francisco Bay Region)**

_____On File_____ _____July 21, 2008_____
Signature Date

**Karen Worcester, Quality Assurance Officer (or Designee),
Regional Water Quality Control Board 3 (Central Coast Region)**

_____On File_____ _____July 17, 2008_____
Signature Date

**Jau Ren Chen, Quality Assurance Officer (or Designee),
Regional Water Quality Control Board 4 (Los Angeles Region)**

_____On File_____ _____July 15, 2008_____
Signature Date

**Leticia Valadez, Quality Assurance Officer (or Designee),
Regional Water Quality Control Board 5 (Central Valley Region)**

_____On File_____ _____July 15, 2008_____
Signature Date

**Bruce Warden, Quality Assurance Officer (or Designee),
Regional Water Quality Control Board 6 (Lahontan Region)**

_____On File_____ _____July 30, 2008_____
Signature Date

**Jeff Geraci, Quality Assurance Officer (or Designee),
Regional Water Quality Control Board 7 (Colorado River Basin Region)**

_____On File_____ _____September 14, 2008____
Signature Date

**Pavlova Vitale, Quality Assurance Officer (or Designee),
Regional Water Quality Control Board 8 (Santa Ana Region)**

_____On File_____ _____July 21, 2008_____
Signature Date

**Dat Quach, Quality Assurance Officer (or Designee),
Regional Water Quality Control Board 9 (San Diego Region)**

_____On File_____ _____September 26, 2008____
Signature Date

Element A2: Table of Contents

Element A3: Distribution List

While this quality assurance program plan (QAPrP) will be publicly available online, it will be officially distributed to Surface Water Ambient Monitoring (SWAMP) representatives from the State Water Resources Control Board (State Board) and Regional Water Quality Control Boards (Regional Boards), contractors under state master contracts, and other organizations. Associated contact information follows in Table 1: *Primary Contact Information for Surface Water Ambient Monitoring Program Representatives.*

Table 1: Primary Contact Information for Surface Water Ambient Monitoring Program Representatives

State Water Resources Control Board	
Contact Information	**Organization's Mailing Address**
Main Contact: Emilie Reyes Position: SWAMP Coordinator Phone: 916-341-5556 Email: ereyes@waterboards.ca.gov	State Water Resources Control Board Office of Information Management and Analysis 1001 "I" Street, 15th Floor Sacramento, CA 95814
Main Contact: William Ray Position: QA Program Manager Phone: (916) 341-5583 Email: bray@waterboards.ca.gov	State Water Resources Control Board Office of Information Management and Analysis 1001 "I" Street, 15th Floor Sacramento, CA 95814

Regional Water Quality Control Boards	
Contact Information	**Organization's Mailing Address**
Main Contact: Rich Fadness Position: Engineering Geologist Phone: (707) 576-6718 Email: rfadness@waterboards.ca.gov Main Contact:Rebecca Fitzgerald Position: Environmental Scientist Phone: (707) 576-2650 Email: rfitzgerald@waterboards.ca.gov QA Officer: Rich Fadness	RWQCB/Region 1 (North Coast Region) 5550 Skylane Boulevard, Suite A Santa Rosa, CA 95403
Main Contact: Karen Taberski Position: Environmental Scientist Phone: (510) 622-2424 Email: ktaberski@waterboards.ca.gov QA Officer: Wil Bruhns Phone: (510) 622-2327 Email: wbruhns@waterboards.ca.gov	RWQCB/Region 2 (San Francisco Bay Region) 1515 Clay Street, Suite 1400 Oakland, Ca. 94612
Main Contact: Karen Worcester Position: Environmental Scientist Phone: (805) 549-3333 Email: kworcester@waterboards.ca.gov QA Officer: Karen Worcester	RWQCB/Region 3 (Central Coast Region) 895 Aerovista Place, Suite 101 San Luis Obispo, CA 93401

Main Contact: Michael Lyons Position: Environmental Scientist Phone: (213) 576-6718 Email: mlyons@waterboards.ca.gov QA Officer: Jau Ren Chen Phone: (213) 576-6656 Email: jrchen@waterboards.ca.gov	RWQCB/Region 4 (Los Angeles Region) 320 West Fourth Street, Suite 200 Los Angeles, CA 90013

Main Contact: Jeanne Chilcott Position: Senior Environmental Scientist Phone: (916) 464-4788 Email: jchilcott@waterboards.ca.gov QA Officer: Leticia Valadez Phone: (916) 464-4634 Email: lvaladez@waterboards.ca.gov	RWQCB/Region 5 – Sacramento Office (Main) (Central Valley Region) 11020 Sun Center Drive, Suite 200 Rancho Cordova, CA 95670-6114

Main Contact: Jeanne Chilcott Position: Senior Environmental Scientist Phone: (916) 464-4788 Email: jchilcott@waterboards.ca.gov QA Officer: Leticia Valadez Phone: (916) 464-4634 Email: lvaladez@waterboards.ca.gov	RWQCB/Region 5 – Sacramento Office (Lower) (Central Valley Region) 11020 Sun Center Drive, Suite 200 Rancho Cordova, CA 95670-6114

Main Contact: Jeanne Chilcott Position: Senior Environmental Scientist Phone: (916) 464-4788 Email: jchilcott@waterboards.ca.gov QA Officer: Leticia Valadez Phone: (916) 464-4634 Email: lvaladez@waterboards.ca.gov	RWQCB/Region 5 – Sacramento Office (San Joaquin) (Central Valley Region) 11020 Sun Center Drive, Suite 200 Rancho Cordova, CA 95670-6114

Main Contact: Dennis Heimann Position: Environmental Scientist Phone: (530) 224-4851 Email: dheimann@waterboards.ca.gov QA Officer: Leticia Valadez Phone: (916) 464-4634 Email: lvaladez@waterboards.ca.gov	RWQCB/Region 5 – Redding Office (Central Valley Region) 415 Knollcrest Drive, Suite 100 Redding, CA 96002

Main Contact: Steven Hulbert Position: Environmental Scientist Phone: (559) 444-2502 Email: shulbert@waterboards.ca.gov QA Officer: Leticia Valadez Phone: (916) 464-4634 Email: lvaladez@waterboards.ca.gov	RWQCB/Region 5 – Fresno Office (Central Valley Region) 1685 "E" Street Fresno, CA 93706-2007

Main Contact: Thomas Suk Position: Environmental Scientist Phone: (530) 542-5419 Email: tsuk@waterboards.ca.gov QA Officer: Bruce Warden Phone: (530) 542-5416 Email: bwarden@waterboards.ca.gov	RWQCB/Region 6 (Lahontan Region) 2501 Lake Tahoe Boulevard South Lake Tahoe, CA 96150

Main Contact: Doug Vu Position: Environmental Scientist Phone: (760) 776-8944 Email: dvu@waterboards.ca.gov QA Officer: Jeff Geraci Phone: (760) 346-7491 Email: jgeraci@waterboards.ca.gov	RWQCB/Region 7 (Colorado River Basin Region) 73-720 Fred Waring Drive, Suite 100 Palm Desert, CA 92260

Main Contact: Pavlova Vitale Position: Environmental Scientist Phone: (951) 782-4920 Email: pvitale@waterboards.ca.gov QA Officer: Pavlova Vitale	RWQCB/Region 8 (Santa Ana Region) 3737 Main Street, Suite 500 Riverside, CA 92501-3339

Main Contact: Cynthia Gorham-Test Position: Environmental Scientist Phone: (858) 637-7139 Email: ctest@waterboards.ca.gov QA Officer: Dat Quach Phone: (858) 467-2978 Email: dquach@waterboards.ca.gov	RWQCB/Region 9 (San Diego Region) 9174 Sky Park Court, Suite 100 San Diego, CA 92124-1324

San José State University Foundation	
Contact Information	**Organization's Mailing Address**
Main Contact: Russell Fairey Position: Program Manager Phone: (831) 771-4161 Email: fairey@mlml.calstate.edu	Marine Pollution Studies Laboratory Moss Landing Marine Laboratories 7544 Sandholt Road Moss Landing, CA 95039

Main Contact: Cassandra Lamerdin Position: Data Management Coordinator Phone: (831) 771-4163 Email: clamerdin@mlml.calstate.edu	Marine Pollution Studies Laboratory Moss Landing Marine Laboratories 7544 Sandholt Road Moss Landing, CA 95039

Main Contact: Beverly H. van Buuren Position: SWAMP Quality Assurance Officer Phone: (206) 297-1378 Email: bvanbuuren@mlml.calstate.edu	Quality Assurance Research Group Moss Landing Marine Laboratories PO Box 46425 Seattle, WA 98146

Main Contact: Amara F. Vandervort Position: SWAMP Quality Assurance Coordinator Phone: (206) 362-1930 Email: avandervort@mlml.calstate.edu	Quality Assurance Research Group Moss Landing Marine Laboratories PO Box 46425 Seattle, WA 98146

Department of Fish and Game - Granite Canyon	
Contact Information	**Organization's Mailing Address**
Main Contact: Max Puckett Position: Director Phone: (707) 768-1999 Email: mpuckett@hughes.net	Granite Canyon Aquatic Pollution Studies Laboratory California Department of Fish & Game c/o 4580 Blufftop Lane Hydesville, CA 95547

University of California at Davis	
Contact Information	**Organization's Mailing Address**
Main Contact: John Hunt Position: Coordinator Phone: (831) 624-0947 Email: jwhunt@ucdavis.edu	Marine Pollution Studies Laboratory University of California at Davis 34500 Coast Route 1 Monterey, CA 93940

Element A4: Program/Task Organization

Program Management

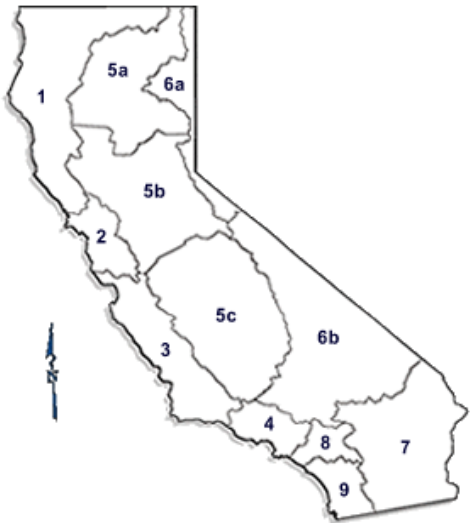
The Surface Water Ambient Monitoring Program (SWAMP) is administered by the State Water Resources Control Board (State Board). However, responsibility for implementation of regional monitoring activities often resides with the nine Regional Water Quality Control Boards (Regional Boards) that have jurisdiction over specific geographical areas of the state (See Figure 1: *Regional Water Quality Control Board Jurisdictions*). Statewide monitoring programs are implemented at the state level in coordination with the regions. SWAMP monitoring is conducted through State Board master contracts and Regional Board monitoring contracts.

Figure 1: Regional Water Quality Control Board Jurisdictions

Regional Board 1: North Coast Region
Regional Board 2: San Francisco Bay Region
Regional Board 3: Central Coast Region
Regional Board 4: Los Angeles Region
Regional Board 5: Central Valley Region
- **(5a): Redding Office**
- **(5b): Sacramento Office**
- **(5c): Fresno Office**

Regional Board 6: Lahontan Region
- **(6a): South Lake Tahoe Office**
- **(6b): Victorville Office**

Regional Board 7: Colorado River Basin Region
Regional Board 8: Santa Ana Region
Regional Board 9: San Diego Region



Coordination of SWAMP is achieved through monthly meetings of the SWAMP Roundtable, which consists of State and Regional Board representatives, as well as representatives from other agencies and organizations. Roundtable members provide programmatic, technical, and logistical support, as well as guidance on SWAMP's implementation. The Roundtable also makes recommendations to the State Board regarding annual SWAMP budget allocations. This is done through a majority vote or, lacking a majority, the approval of the SWAMP Coordinator. An organizational chart of SWAMP is provided in Figure 2 below.

Quality Assurance

In December 2002, the SWAMP Quality Assurance (QA) Program was formalized to develop and implement the quality systems specified in the *Quality Assurance Management Plan for the State of California's Surface Water Ambient Monitoring Program* (2002). The program consists of quality

assurance representatives from the State and Regional Boards, as well as contractors from the Moss Landing Marine Laboratories (MLML).

State Water Resources Control Board

Ultimately, SWAMP's quality system is overseen by the State Board's QA Program. As part of its SWAMP oversight, this program:

- Creates, implements, and maintains the State Board's draft quality management plan (QMP);
- Ensures that SWAMP operates in a manner consistent with the State Board's QMP;
- Formally reviews SWAMP's quality system every three years (see Element C2: *Reports to Management*);
- Ensures that SWAMP operates in a manner consistent with Scientific Panel and Review Committee (SPARC) reports (see Element C2: *Reports to Management*);
- Coordinates with the U.S. Environmental Protection Agency (EPA) and CalEPA as necessary; and
- Reviews and approves this quality assurance program plan (QAPrP)

Regional Water Quality Control Boards

Some components of SWAMP's QA system are implemented at the Regional Board level. Each of these tasks is managed by the Regional Board's QA representative to SWAMP - a role often assumed by the region's primary SWAMP contact (see Element A3: *Distribution List*). As part of its SWAMP involvement, this program:

- Creates, implements, and maintains regional QA documents, as necessary;
- Provides general and SWAMP-specific QA guidance;
- Monitors the effectiveness of project- and region-specific QA activities;
- Monitors and participates in QA and technical training; and
- Reviews and approves this QAPrP

Moss Landing Marine Laboratories

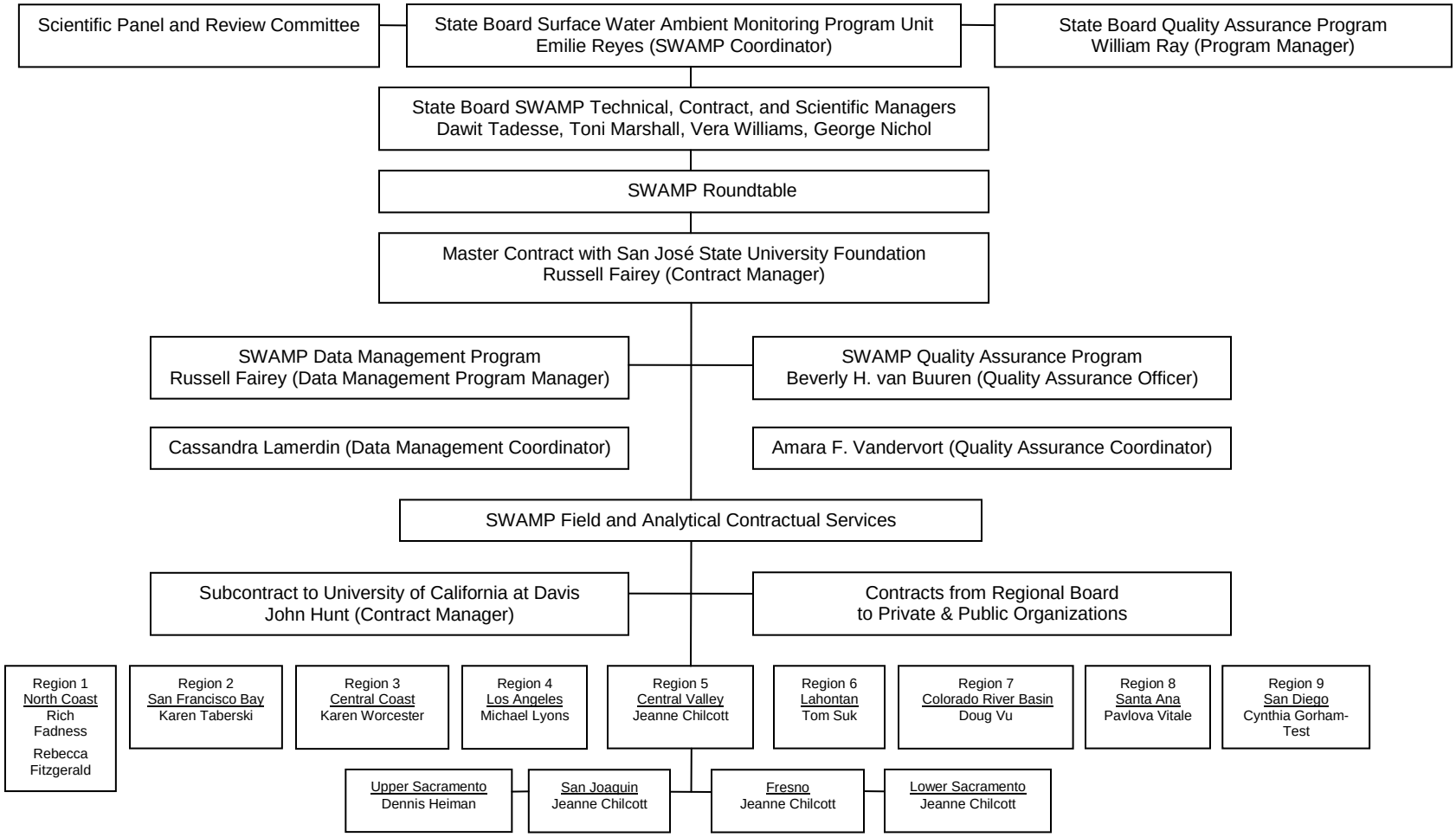
SWAMP's QA Program is implemented primarily by its QA Team (QAT), which is staffed by the QA Research Group at MLML. This group consists of a QA Officer, QA Coordinator, and QA Specialists. The QA Officer leads, while the QA Coordinator manages QA Specialists in completing

required tasks. These include, but are not limited to:

- Quality document creation, implementation, and maintenance;
- State and Regional Board consultation;
- SWAMP Roundtable representation;
- Regional and laboratory audits; and
- Quality system training

The SWAMP QAT operates at the programmatic level, and is therefore completely independent of data production. This relationship is shown in Figure 2: *Organizational Chart of the Surface Water Ambient Monitoring Program*.

Figure 2: Organizational Chart of the Surface Water Ambient Monitoring Program



Element A5: Problem Definition/Background

In 1999, the Surface Water Ambient Monitoring Program (SWAMP) was proposed in California Assembly Bill (AB) 982 to integrate existing water quality monitoring activities of the State Water Resources Control Board (State Board) and its nine Regional Water Quality Control Boards (Regional Boards).

Monitoring conducted under SWAMP was initially proposed to include a combination of statewide monitoring and site-specific monitoring. Statewide monitoring examines the status and trends in water quality. Site-specific monitoring employs a more targeted monitoring approach to better characterize clean and problem locations. Currently, only the site-specific monitoring portion of this program is being implemented.

Element A6: Program/Task Description

The Surface Water Ambient Monitoring Program (SWAMP) is a statewide monitoring effort designed to assess the conditions of surface waters throughout the State of California. Ambient monitoring refers to any activity in which information about the status of the physical, chemical, and biological characteristics of the environment is collected to answer specific questions about the status and trends in those characteristics. For the purposes of SWAMP, ambient monitoring refers to these activities as they relate to the characteristics of water quality.

SWAMP also hopes to capture monitoring information collected under other programs of the State Water Resources Control Board (State Board) and Regional Water Quality Control Boards (Regional Boards). This includes, but is not limited to Board programs such as the State's Total Maximum Daily Load (TMDL), Nonpoint Source (NPS), and Watershed Project support programs. SWAMP does not conduct effluent or discharge monitoring, which is covered under National Pollutant Discharge Elimination System (NPDES) permits and waste discharge requirements.

SWAMP is administered by the State Board. Responsibility for implementation of monitoring activities resides with the nine Regional Water Quality Control Boards that have jurisdiction over their specific geographical areas of the state (see Element A4: *Program/Task Organization*).

Element A7: Quality Objectives and Criteria for Measurement Data

In coordination with the State Water Resources Control Board (State Board), each Regional Water Quality Control Board (Regional Board) establishes monitoring priorities for the water bodies within its jurisdiction. The Surface Water Ambient Monitoring Program (SWAMP) compiles data from California's nine Regional Boards. This monitoring is performed in accordance with protocols and methodologies laid out in this quality assurance program plan (QAPrP). SWAMP seeks to meet the following four objectives:

- Create an ambient monitoring program that addresses all of California's hydrologic units using consistent and objective monitoring, sampling, and analytical methods; consistent data quality assurance (QA) protocols; and centralized data management.
- Document ambient water quality conditions in potentially clean and polluted areas. The scale for these assessments ranges from site-specific to statewide.
- Identify specific water quality problems preventing the State Board, the Regional Boards, and the public from realizing beneficial uses of water in targeted watersheds.
- Provide data to evaluate the overall effectiveness of regulatory water quality programs in protecting beneficial uses of California's waters.

Three of these SWAMP objectives relate to documenting water quality conditions and identifying problem areas where beneficial uses are not being attained. In as much as state standards provide the benchmark for such assessments, the analytical methods employed should be sufficient to allow the evaluation of SWAMP against state standards (e.g., the California Toxic Rule, Regional Board Basin Plans, and the California Ocean Plan).

The remaining objective, consistency in SWAMP monitoring, is achieved through the application of universal measurement quality objectives (MQOs – see Appendix A: *Measurement Quality Objectives*). As defined by the U.S Environmental Protection Agency (EPA), these are acceptance criteria for the quality attributes such as precision, accuracy, and sensitivity. Adherence to SWAMP MQOs ensures that data generated by the program will be of known and documented quality. SWAMP offers a waiver system for instances where mandated MQOs conflict with a project's objectives (see *Introduction*).

Element A8: Special Training and Certification

Training

Organizations and individuals involved in the Surface Water Ambient Monitoring Program (SWAMP) are expected to have familiarity with the quality documents described in this quality assurance program plan (QAPrP). SWAMP has also developed training tools to ensure data comparability among program participants. Information about tool availability is published on the SWAMP web site (see Appendix G: *Online Resources*).

Projects operating under their own QAPP must describe personnel training and its documentation in Element A8: *Special Training and Certifications.* Such training may apply to technical or administrative protocols, and should be provided prior to the initiation of any procedure. Training strategies and documentation will be evaluated during SWAMP regional and laboratory audits.

Permits

All SWAMP participants must obtain appropriate permission for their field activities. *California Scientific Collecting Permits* from the Department of Fish and Game (DFG) must be obtained for all biological collections. These permits must be in possession during all collection activities. Additional permits for collecting threatened or endangered species may also be required. During the planning stages of any project, SWAMP participants are to request permission from landowners to access sites on private property. Keys may be needed to access certain locations on government property.

Element A9: Documents and Records

The Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance (QA) Program utilizes quality documents and records at the state, regional, programmatic, and project levels, as well as the laboratory and field levels. This element describes the creation, maintenance, and archival of each of these documents. Per the Government Paperwork Elimination Act of 1998, SWAMP encourages the use of electronic signatures, maintenance, and submission when practical.

As appropriate, updates to SWAMP QA documents are communicated to program participants using the following process:

1. The interested party issues a memo to the SWAMP QA Team (QAT) describing and justifying the proposed update.
2. Once finalized, the memo is officially approved by the SWAMP Coordinator.
3. Approved updates are presented publicly online at the Moss Landing Marine Laboratories' SWAMP website (see Appendix G: *Online Resources*).
4. Approved updates are presented to the SWAMP Roundtable by the SWAMP QAT.
5. As requested, approved updates are presented via email by the SWAMP QAT.

SWAMP participants interested in these email updates must register for the "SWAMP Water Quality Monitoring" portion of the State Water Resources Control Board (State Board's) online mailing list (see Appendix G: *Online Resources*).

State Water Resources Control Board Documents and Records

State Water Resources Control Board Quality Management Plan

The State Board's draft quality management plan (QMP) proposes five policies that are pertinent to SWAMP and incorporated by reference:

- All State Board and Regional Water Quality Control Board (Regional Board) programs generating, using, or receiving environmental data will adhere to the policies outlined in the State Board's draft QMP.
- All data generated by or for the State Board and the Regional Boards will be of known and documented quality.

- Environmental data submitted to the State Board and the Regional Boards by other agencies, contractors, grant recipients, and regulated parties will be of known and documented quality.
- The intended use of environmental data and the level of data quality necessary to support decisions will be established by State Board and Regional Board staff prior to the design and initiation of all data collection activities.
- Adequate resources and staff will be provided by the State Board and the Regional Boards to meet the QA and quality control (QC) requirements of the State Board's draft QMP.

SWAMP Documents and Records

The SWAMP Quality Assurance Program Plan

This Quality Assurance Program Plan (QAPrP) was created and is maintained by the SWAMP QAT. Updates to this plan must be approved and signed by the SWAMP Coordinator, the State Board QA Officer, The SWAMP QA Officer, and the QA Officer or designee of each Regional Board. It is to be revised every five years, or when major changes to SWAMP's mission or organization occur. The document is publicly available online (See Appendix G: *Online Resources*), and replaces the *Quality Assurance Management Plan for the State of California's Surface Water Ambient Monitoring Program* (Puckett 2002).

Currently, this document's scope retains the chemistry focus seen in the original plan. However, bioassessment and toxicity testing will receive full coverage in future iterations of this QAPrP. In the meantime, toxicity testing is addressed in Appendix A: *Measurement Quality Objectives*, while bioassessment is addressed in the standard operating procedure (SOP): *Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California*, and on the State Board's SWAMP website (see Appendix G: *Online Resources*).

SWAMP Regional Reports

The SWAMP Data Management Team (DMT) and QAT have created templates for the QA section of each annual *SWAMP Regional Report* (see Appendix G: *Online Resources*). These templates include a narrative and table to ensure consistent presentation and reporting of QA information. Both templates should be incorporated into the report, but each region may determine their location. They may be included in the body of the report or as an appendix.

Regions requiring assistance with their annual report may contact the DMT or QAT. They should

submit a list of datasets (by fiscal year) to be incorporated in the report and an estimated completion date for the narrative. The availability of assistance is dependent on the workload at the time of request.

Standard Operating Procedures

SWAMP creates a variety of scientific, technical, and administrative standard operating procedures (SOPs) for use by program staff and data contributors. SWAMP SOPs are based on the recommendations of U.S. Environmental Protection Agency (EPA) Quality System document QA/G-6: *Guidance for Preparing Standard Operating Procedures* (EPA 2001b - see Appendix G: *Online Resources*).

Signature approval by the SWAMP QA Officer indicates that a program SOP has been both reviewed and approved by the SWAMP Coordinator. Whenever procedures are changed, SWAMP SOPs are updated and re-approved. SOPs are also systematically reviewed on a periodic basis to ensure that policies and procedures remain current and appropriate. Current SOPs are publicly available online (see Appendix G: *Online Resources*). These include:

- *Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California (February 2007)*
- *Conducting Field Measurements and Field Collections of Water and Bed Sediment Samples in the Surface Water Ambient Monitoring Program (October 15, 2007)*
- *Data Loading And Verification Of The Surface Water Ambient Monitoring Program Database (March 3, 2005)*
- *Field Data Verification Of The Surface Water Ambient Monitoring Program Database (January 1, 2005)*
- *Surface Water Ambient Monitoring Program Quality Assurance Program Contract Laboratory Data Verification And Validation (March 11, 2005)*
- *Surface Water Ambient Monitoring Program Quality Assurance Program On-Site Systems Assessment for Contract Laboratories (March 3, 2005)*
- *Toxicity Data Verification Of The Surface Water Ambient Monitoring Program Database (March 3, 2005)*

The following SOPs are in the draft stage, and will be officially released upon completion:

- *Division of Financial Assistance Quality Assurance Project Plan Review*

- *Surface Water Ambient Monitoring Program Quality Assurance Program* Corrective Action
- *Surface Water Ambient Monitoring Program Quality Assurance Program Data Classification System*
- *Surface Water Ambient Monitoring Program Quality Assurance Program On-Site Systems Assessment For Regional Boards*
- *Surface Water Ambient Monitoring Program Review and Approval Procedure for Monitoring Plans and Research Proposals*
- *Waiver System for the Surface Water Ambient Monitoring Program Quality Assurance Program Plan*

Retired SOPs are removed from circulation and electronically archived by the SWAMP QAT for a minimum of five years.

Project Documents and Records

Quality Assurance Project Plans

Applicable components of the above programmatic documents may then be incorporated into a quality assurance project plan (QAPP). A QAPP is a document that describes the intended technical activities and project procedures that will be implemented to ensure that the results will satisfy the stated performance or acceptance criteria.

A QAPP is required for certain large, ongoing, or special projects conducted by the Regional Boards or contractors under SWAMP. Each must reference this QAPrP in their generation of a project-specific QAPP. To streamline this process, SWAMP encourages the use of EPA Quality System document QA/G-5: *Guidance for Quality Assurance Project Plans* (EPA 2001c), as well as its own standardized review checklist, online QAPP template, and *SWAMP Advisor* Expert System (see Appendix G: *Online Resources*).

Prior to sample collection or field measurements, The SWAMP QAT evaluates each QAPP against a program-specific checklist and related EPA guidance. The products of this review include the completed checklist, a related narrative, and consultation pertaining to necessary corrective actions. Regardless of their scope, QAPPs completing this standardized review process may then be applied to SWAMP's common end use. Each QAPP is to be distributed according to its own Element A3: *Distribution List*. Project management must remove retired QAPPs from circulation before physically or electronically storing them for a minimum of five years.

Other Project Documents and Records

Prior to sample collection or field measurements, project contributors may reference this QAPrP in their generation of a project-specific field sampling plan, and sampling and analysis plan. These documents are then evaluated using the peer-review process described in the SWAMP SOP: *Review and Approval Procedure for Monitoring Plans and Research Proposals* (see Appendix G: *Online Resources*). In this process, the SWAMP Coordinator selects a pair of independent reviewers with expertise reflecting the submitted document. The document is then accepted, or re-reviewed following the resolution of outstanding issues.

Laboratory and Field Documents and Records

Standard Operating Procedures

Each SWAMP data producer is required to use an established method, or create and maintain SOPs that detail their own technical and administrative protocols. While no specific SOP content or format is mandated by SWAMP, assistance is available in the form of EPA Quality System document QA/G-6: *Guidance for Preparing Standard Operating Procedures* (EPA 2001b - see Appendix G: *Online Resources*).

Laboratory and field SOPs must follow the approval and maintenance processes of the programmatic SOPs described above.

Group B: Data Generation and Acquisition

Element B1: Sampling Process Design

Given the number and variety of projects contributing to the Surface Water Ambient Monitoring Program (SWAMP), it is not appropriate to mandate a specific sampling design at the programmatic level. Instead, Regional Water Quality Control Board (Regional Board) SWAMP Work Plans outline each region's overall goals for the program. These include:

- Details of specific monitoring objectives for the year
- A summary of existing information regarding water bodies to be sampled during the year
- Site-specific lists of all planned monitoring locations
- Planned measurement parameters for monitoring
- A site-specific summary of planned sampling frequencies for the year

Annual SWAMP Work Plans are available on the State Water Resources Control Board's (State Board's) SWAMP web page (see Appendix G: *Online Resources*). For projects operating under a quality assurance project plan (QAPP), project-specific sampling design information may be found in Element B1: *Sampling Process Design*.

Element B2: Sampling Methods

The Surface Water Ambient Monitoring Program (SWAMP) involves the collection of samples for a variety of analytes in water, sediment, tissue, and biota. Collections are conducted by multiple organizations using a variety of sampling protocols.

In the interest of programmatic comparability, SWAMP participants may reference the California Department of Fish and Game - Marine Pollution Studies Laboratory (DFG-MPSL) standard operating procedure (SOP), *Conducting Field Measurements and Field Collections of Water and Bed Sediment Samples in the Surface Water Ambient Monitoring Program*. This SOP is not required by SWAMP, and is provided for informational purposes only.

Bioassessment sampling must be conducted according to the SOP: *Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California*.

Both SOPs are available according to Appendix G: *Online Resources*. For projects operating under a quality assurance project plan (QAPP), project-specific sampling procedure information may be found in Element B2: *Sampling Methods*.

Element B3: Sample Handling and Custody

Proper handling of water, sediment, tissue, and biological samples is essential to the production of Surface Water Ambient Monitoring Program (SWAMP) data. Appendix B: *Sample Handlin*g identifies recommended sample containers, volumes, and preservations, as well as holding time requirements. For projects operating under a quality assurance project plan (QAPP), related information may be found in Element B1: *Sampling Handling and Custody.*

Additional technical information may be found in the California Department of Fish and Game - Marine Pollution Studies Laboratory (DFG-MPSL) standard operating procedure (SOP), *Conducting Field Measurements and Field Collections of Water and Bed Sediment Samples in the Surface Water Ambient Monitoring Program*. This SOP is not required by SWAMP, and is provided for informational purposes only.

Bioassessment sampling must be conducted according to the SOP: *Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California*. Both SOPs are available according to Appendix G: *Online Resources*.

Element B4: Analytical Methods

The Surface Water Ambient Monitoring Program (SWAMP) compiles data from a wide variety of projects – each with differing data needs. Consequently, it would be inappropriate for the program to mandate specific analytical methods for field or laboratory use. Instead, the program has adopted a performance-based approach to promote comparability.

Measurement Quality Objectives

One component of SWAMP-comparability is adherence to a common set of measurement quality objectives (MQOs). The U.S. Environmental Protection Agency (EPA) defines MQOs as acceptance criteria for the quality attributes measured by project data quality indicators such as precision, bias, representativeness, completeness, comparability, and sensitivity. SWAMP-specific MQOs are defined in Appendix A: *Measurement Quality Objectives*.

Reporting Limits

Another key component of SWAMP comparability is the application of reporting limits that are universal to all program participants. A reporting limit is the minimum value below which chemistry data are documented as non-detected. In SWAMP, these values are assigned on an analyte- and matrix-specific basis (see Appendix C: *Reporting Limits*).

It is apparent that program-mandated reporting limits may fit the objectives of some projects, while placing unnecessary restrictions on others. As a result, SWAMP participants must establish their own RLs as part of project planning. These values should reflect their own unique objectives, and may be based on analytical methods, method detection limits (MDLs), or expected levels of target analyte. If a project's RLs exceed those presented in Appendix C, ~~a waiver must be completed~~ there is no need to obtain a waiver as described in the introduction to this document.[1]

[1] Please see the October 8, 2008 addendum *Retraction of Programmatic Reporting Limits (*Appendix J: *Document Addenda)*

Element B5: Quality Control

This element describes the various laboratory and field quality control samples associated with Surface Water Ambient Monitoring Program (SWAMP) data. Coverage below does not imply a programmatic requirement. Rather, necessary quality control (QC) samples, frequency requirements, and control limits are defined in Appendix A: *Measurement Quality Objectives*.

Laboratory Quality Control

Laboratory QC samples must satisfy SWAMP measurement quality objectives (MQOs) and frequency requirements. MQOs are specified in Appendix A: *Measurement Quality Objectives*. Frequency requirements are provided on an analytical batch level. SWAMP defines an analytical batch as 20 or fewer samples and associated quality control that are processed by the same instrument within a 24-hour period (unless otherwise specified by method). Details regarding sample preparation are method- or standard operating procedure- (SOP-) specific, and may consist of extraction, digestion, or other techniques.

Calibration and Working Standards

All calibration standards must be traceable to a certified standard obtained from a recognized organization. If traceable standards are not available, procedures must be implemented to standardize the utilized calibration solutions (e.g., comparison to a certified reference material (CRM – see below). Standardization of calibration solutions must be thoroughly documented, and is only acceptable when pre-certified standard solutions are not available.

Working standards are dilutions of stock standards prepared for daily use in the laboratory. Working standards are used to calibrate instruments or prepare matrix spikes, and may be prepared at several different dilutions from a common stock standard. Working standards are diluted with solutions that ensure the stability of the target analyte. Preparation of the working standard must be thoroughly documented such that each working standard is traceable back to its original stock standard. Finally, the concentration of all working standards must be verified by analysis prior to use in the laboratory.

Instrument Calibration

Prior to sample analysis, utilized instruments must be calibrated following the procedures outlined in the relevant analytical method or SOP. Each method or SOP must specify acceptance criteria that demonstrate instrument stability and an acceptable calibration. If instrument calibration does not meet the specified acceptance criteria, the analytical process is not in control and must be halted. The instrument must be successfully recalibrated before samples may be analyzed.

Calibration curves will be established for each analyte covering the range of expected sample concentrations. Only data that result from quantification within the demonstrated working calibration range may be reported unflagged by the laboratory. Quantification based on extrapolation is not acceptable. Data reported outside of the calibration range must be flagged as "Detected not Quantified". Alternatively, if the instrumentation is linear over the concentration ranges to be measured in the samples, the use of a calibration blank and one single standard that is higher in concentration than the samples may be appropriate. Samples outside the calibration range will be diluted or concentrated, as appropriate, and reanalyzed.

Initial Calibration Verification

The initial calibration verification (ICV) is a mid-level standard analyzed immediately following the calibration curve. The source of the standards used to calibrate the instrument and the source of the standard used to perform the ICV must be independent of one another. This is usually achieved by the purchase of standards from separate vendors. Since the standards are obtained from independent sources and both are traceable, analyses of the ICV functions as a check on the accuracy of the standards used to calibrate the instrument. The ICV is not a requirement of all SOPs or methods, particularly if other checks on analytical accuracy are present in the sample batch.

Continuing Calibration Verification

Continuing calibration verification (CCV) standards are mid-level standards analyzed at specified intervals during the course of the analytical run. CCVs are used to monitor sensitivity changes in the instrument during analysis. In order to properly assess these sensitivity changes, the standards used to perform CCVs must be from the same set of working standards used to calibrate the instrument. Use of a second source standard is not necessary for CCV standards, since other QC samples are designed to assess the accuracy of the calibration standards. Analysis of CCVs using the calibration standards limits this QC sample to assessing only instrument sensitivity changes. The acceptance criterion and required frequency for CCVs are detailed in Appendix A: *Measurement Quality Objectives*. If a CCV falls outside the acceptance limits, the analytical system is not in control, and immediate corrective action must be taken.

Data obtained while the instrument is out of control is not reportable, and all samples analyzed during this period must be reanalyzed. If reanalysis is not an option, the original data must be flagged with the appropriate qualifier and reported. A narrative must be submitted listing the results that were generated while the instrument was out of control, in addition to corrective actions that were applied.

Laboratory Blanks

Laboratory blanks (also called extraction blanks, procedural blanks, or method blanks) are used to assess the background level of target analyte resulting from sample preparation and analysis. Laboratory blanks are carried through precisely the same procedures as the field samples. For both organic and inorganic analyses, a minimum of at least one laboratory blank must be prepared and analyzed in every analytical batch. Some methods may require more than one laboratory blank with each analytical run.

Acceptance criteria for laboratory blanks are detailed in Appendix A: *Measurement Quality Objectives*. Blanks that are too high require corrective action to bring the concentrations down to acceptable levels. This may involve changing reagents, cleaning equipment, or even modifying the utilized methods or SOPs.

Although acceptable laboratory blanks are important for obtaining results for low-level samples, improvements in analytical sensitivity have pushed detection limits down to the point where some amount of analyte will be detected in even the cleanest laboratory blanks. The magnitude of the blanks must be evaluated against the concentrations of the samples being analyzed and against project objectives.

Reference Materials and Demonstration of Laboratory Accuracy

Evaluation of the accuracy of laboratory procedures is achieved through the preparation and analysis of reference materials with each analytical batch. Ideally, the reference materials selected are similar in matrix and concentration range to the samples being prepared and analyzed. The acceptance criteria for reference materials are listed in Appendix A: *Measurement Quality Objectives*.

The accuracy of an analytical method can be assessed using CRMs only when certified values are provided for the target analytes. When possible, reference materials that have certified values for the target analytes should be used. This is not always possible, and often times certified reference values are not available for all target analytes. Many reference materials have both certified and non-certified (or reference) values listed on the certificate of analysis. Certified reference values are clearly distinguished from the non-certified reference values on the certificate of analysis.

Reference Materials vs. Certified Reference Materials

The distinction between a reference material and a certified reference material does not involve how the two are prepared, rather with the way that the reference values were established. Certified values are determined through replicate analyses using two independent measurement techniques for verification. The certifying agency may also provide “non-certified or “reference” values for other

target analytes. Such values are determined using a single measurement technique that may introduce bias.

When available, it is preferable to use reference materials that have certified values for all target analytes. This is not always an option, and therefore it is acceptable to use materials that have reference values for these analytes.

Note: Standard Reference Materials (SRMs) are essentially the same as CRMs. The term "Standard Reference Material" has been trademarked by the National Institute of Standards and Technology (NIST), and is therefore used only for reference materials distributed by NIST.

Laboratory Control Samples

While reference materials are not available for all analytes, a way of assessing the accuracy of an analytical method is still required. Laboratory control samples (LCSs) provide an alternate method of assessing accuracy. An LCS is a specimen of known composition prepared using contaminant-free reagent water or an inert solid spiked with the target analyte at the midpoint of the calibration curve or at the level of concern. The LCS must be analyzed using the same preparation, reagents, and analytical methods employed for regular samples. If an LCS needs to be substituted for a reference material, the acceptance criteria are the same as those for the analysis of reference materials. These are detailed in Appendix A: *Measurement Quality Objectives*.

Prioritizing Certified Reference Materials, Reference Materials, and Laboratory Control Samples

Certified reference materials, reference materials, and laboratory control samples all provide a method to assess the accuracy at the mid-range of the analytical process. However, this does not mean that they can be used interchangeably in all situations. When available, SWAMP requires the analysis of one certified reference material per analytical batch. Certified values are not always available for all target analytes. If no certified reference material exists, reference values may be used. If no reference material exists for the target analyte, an LCS must be prepared and analyzed with the sample batch as a means of assessing accuracy.

The hierarchy is as follows: analysis of a CRM is favored over the analysis of a reference material, and analysis of a reference material is preferable to the analysis of an LCS. Substitution of an LCS is not acceptable if a certified reference material or reference material is available.

Matrix Spikes

A matrix spike (MS) is prepared by adding a known concentration of the target analyte to a field

sample, which is then subjected to the entire analytical procedure. Matrix spikes are analyzed in order to assess the magnitude of matrix interference and bias present. Because matrix spikes are analyzed in pairs, the second spike is called the matrix spike duplicate (MSD). The MSD provides information regarding the precision of the matrix effects. Both the MS and MSD are split from the same original field sample.

In order to properly assess the degree of matrix interference and potential bias, the spiking level should be approximately 2-5x the ambient concentration of the spiked sample. To establish spiking levels prior to sample analysis, laboratories should review any relevant historical data. In many instances, the laboratory will be spiking samples blind and will not meet a spiking level of 2-5x the ambient concentration.

In addition to the recoveries, the relative percent difference (RPD) between the MS and MSD is calculated to evaluate how matrix affects precision. The MQO for the RPD between the MS and MSD is the same regardless of the method of calculation. These are detailed in Appendix A: *Measurement Quality Objectives*.

Recovery data for matrix spikes provides a basis for determining the prevalence of matrix effects in the samples collected and analyzed for SWAMP. If the percent recovery for any analyte in the MS or MSD is outside of the limits specified in Appendix A: *Measurement Quality Objectives*, the chromatograms (in the case of trace organic analyses) and raw data quantitation reports should be reviewed. Data should be scrutinized for evidence of sensitivity shifts (indicated by the results of the CCVs) or other potential problems with the analytical process. If associated QC samples (reference materials or LCSs) are in control, matrix effects may be the source of the problem. If the standard used to spike the samples is different from the standard used to calibrate the instrument, it must be checked for accuracy prior to attributing poor recoveries to matrix effects.

Laboratory Duplicates

In order to evaluate the precision of an analytical process, a field sample is selected and prepared in duplicate. Specific requirements pertaining to the analysis of laboratory duplicates vary depending on the type of analysis. The acceptance criteria for laboratory duplicates are specified in Appendix A: *Measurement Quality Objectives*.

Laboratory Duplicates vs. Matrix Spike Duplicates

Although the laboratory duplicate and matrix spike duplicate both provide information regarding precision, they are unique measurements. Laboratory duplicates provide information regarding the precision of laboratory procedures. The matrix spike duplicate provides information regarding how

the matrix of the sample affects both the precision and bias associated with the results. It also determines whether or not the matrix affects the results in a reproducible manner. Because the two concepts cannot be used interchangeably, it is unacceptable to analyze only an MS/MSD when a laboratory duplicate is required.

Replicate Analyses

For the purpose of SWAMP, replicate analyses are distinguished from duplicate analyses based simply on the number of involved analyses. Duplicate analyses refer to two sample preparations, while replicate analyses refer to three or more. Analysis of replicate samples is not explicitly required by SWAMP.

Surrogates

Surrogate compounds accompany organic measurements in order to estimate target analyte losses during sample extraction and analysis. The selected surrogate compounds behave similarly to the target analytes, and therefore any loss of the surrogate compound during preparation and analysis is presumed to coincide with a similar loss of the target analyte.

Surrogate compounds must be added to field and QC samples prior to extraction, or according to the utilized method or SOP. Surrogate recovery data is to be carefully monitored. If possible, isotopically labeled analogs of the analytes are to be used as surrogates. The SWAMP recommended surrogates for pollutant-matrix combinations are provided in the tables in Appendix B of this document.

Internal Standards

To optimize gas chromatography mass spectrometry (GC-MS) and Inductively Coupled Plasma Mass Spectrometry (ICP-MS) analyses, internal standards (also referred to as “injection internal standards”) may be added to field and QC sample extracts prior to injection. Use of internal standards is particularly important for analysis of complex extracts subject to retention time shifts relative to the analysis of standards. The internal standards can also be used to detect and correct for problems in the GC injection port or other parts of the instrument. The analyst must monitor internal standard retention times and recoveries to determine if instrument maintenance or repair or changes in analytical procedures are indicated. Corrective action is initiated based on the judgment of the analyst. Instrument problems that affect the data or result in reanalysis must be documented properly in logbooks and internal data reports, and used by the laboratory personnel to take appropriate corrective action. Performance criteria for internal standards are established by the method or laboratory SOP.

Dual-Column Confirmation

Due to the high probability of false positives from single-column analyses, dual column confirmation should be applied to all gas chromatography and liquid chromatography methods that do not provide definitive identifications. It should not be restricted to instruments with electron capture detection (ECD).

Dilution of Samples

Final reported results must be corrected for dilution carried out during the process of analysis. In order to evaluate the QC analyses associated with an analytical batch, corresponding batch QC samples must be analyzed at the same dilution factor. For example, the results used to calculate the results of matrix spikes must be derived from results for the native sample, matrix spike, and matrix spike duplicate analyzed at the same dilution. Results derived from samples analyzed at different dilution factors must not be used to calculate QC results.

Laboratory Corrective Action

Failures in laboratory measurement systems include, but are not limited to: instrument malfunction, calibration failure, sample container breakage, contamination, and QC sample failure. If the failure can be corrected, the analyst must document it and its associated corrective actions in the laboratory record and complete the analysis. If the failure is not resolved, it is conveyed to the respective supervisor who should determine if the analytical failure compromised associated results. The nature and disposition of the problem must be documented in the data report that is sent to the SWAMP Project Manager. Specific laboratory corrective actions are detailed in Appendix D: *Corrective Action*.

Field Quality Control

Field QC results must meet the SWAMP MQOs and frequency requirements specified in Appendix A: *Measurement Quality Objectives*, where frequency requirements are provided on a sample batch level. SWAMP defines a sample batch as 20 or fewer field samples prepared and analyzed with a common set of QC samples.

Specific field quality control samples may also be required by the method or SOP selected for sample collection and analysis. If SWAMP MQOs conflict with those prescribed in the utilized method or SOP, the more rigorous of the objectives must be met.

Travel Blanks

Travel blanks are used to determine if there is any cross-contamination of volatile constituents between sample containers during shipment from the field to the laboratory. One volatile organic

analysis (VOA) sample vial with reagent water known to be free of volatile contaminants is transported to the site with the empty sample containers. The list of volatile organic compounds (VOCs) includes methyl tert-butyl ether (MTBE); and benzene, toluene, ethylbenzene, and xylenes (BTEX). This vial must be handled like a sample (but never opened) and returned to the laboratory with the other samples. Travel blanks are not required (unless explicitly required by the utilized method or SOP), but are encouraged as possible and appropriate.

Equipment Blanks

Equipment blanks are generated by the personnel responsible for cleaning sampling equipment. Equipment blanks must be analyzed before the equipment is shipped to the sampling site. In order to accommodate any necessary corrective action, equipment blank results should be available well in advance of the sampling event.

To ensure that sampling equipment is contaminant-free, water known to be low in the target analyte(s) must be processed though the equipment as during sample collection. The specific type of water used for blanks is selected based on the information contained in the relevant sampling or analysis methods. The water must be collected in an appropriate sample container, preserved, and analyzed for the target analytes (in other words, treated as an actual sample).

The inclusion of field blanks is dependent on the requirements specified in the relevant MQO tables, or in the sampling method or SOP. Typically, equipment blanks are collected when new equipment, equipment that has been cleaned after use at a contaminated site, or equipment that is not dedicated for surface water sampling is used. An equipment blank must be prepared for metals in water samples whenever a new lot of filters is used.

Field Blanks

A field blank is collected to assess potential sample contamination levels that occur during field sampling activities. Field blanks are taken to the field, transferred to the appropriate container, preserved (if required by the method), and treated the same as the corresponding sample type during the course of a sampling event. The inclusion of field blanks is dependent on the requirements specified in the relevant MQO tables or in the sampling method or SOP.

Field blanks for other media and analytes should be conducted upon initiation of sampling. If field blank performance is acceptable, further collection and analysis of field blanks should be performed on an as-needed basis. Acceptable levels for field blanks are specified in Appendix A: *Measurement Quality Objectives*.

The water used for field blanks must be free of target analyte(s) and appropriate for the analysis being conducted.

Field Duplicates

Field samples collected in duplicate provide precision information as it pertains to the sampling process. The duplicate sample must be collected in the same manner and as close in time as possible to the original sample. This effort is to attempt to examine field homogeneity as well as sample handling, within the limits and constraints of the situation.

Field Corrective Action

The field organization is responsible for responding to failures in their sampling and field measurement systems. If monitoring equipment fails, personnel are to record the problem according to their documentation protocols. Failing equipment must be replaced or repaired prior to subsequent sampling events. It is the combined responsibility of all members of the field organization to determine if the performance requirements of the specific sampling method have been met, and to collect additional samples if necessary. Associated data is entered into the SWAMP Information Management System (IMS) and flagged accordingly. Specific field corrective actions are detailed in Appendix D: *Corrective Actions*.

Element B6: Instrument/Equipment Testing, Inspection, and Maintenance

The wide variety of contributing instruments and equipment make it inappropriate for the Surface Water Ambient Monitoring program (SWAMP) to mandate specific procedures for testing, inspection, and maintenance. Instead, the program defers to the manufacturer guidelines accompanying each field and laboratory device.

For projects operating under a quality assurance project plan (QAPP), Element B6: *Instrument/Equipment Testing, Inspection, and Maintenance* addresses more specific aspects of these systems and their associated documentation, assessment, and corrective action.

Element B7: Instrument/Equipment Calibration and Frequency

The wide variety of contributing instruments and equipment make it inappropriate for the Surface Water Ambient Monitoring Program (SWAMP) to mandate universal calibration requirements for the field or laboratory. Instead, the program defines these requirements on an analyte- and matrix-specific basis (see Appendix A: *Measurement Quality Objectives)*.

For projects operating under a quality assurance project plan (QAPP), *Element B7: Instrument/Equipment Calibration and Frequency* addresses more specific aspects of these processes and their associated documentation, assessment, and corrective action.

Element B8: Inspection/Acceptance of Supplies and Consumables

The Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance (QA) Program does not oversee the execution of procurement activities conducted by SWAMP participants. Purchases of goods and services made by State Water Resources Control Board (State Board) and Regional Water Quality Control Board (Regional Board) must follow the rules for purchasing found in the State Board's *Contract Information Manual*, and applicable purchasing rules set forth by the Department of General Services.

Contracts Requesting Laboratory Analytical Services

A significant portion of contracted services will involve the collection, processing, and analysis of environmental samples. Since the information generated from these activities is critical, generated data must meet the requirements of this quality assurance program plan. This must be reflected in each statement of work (SOW), and helps define acceptance criteria for the services performed.

In addition, individual projects must indicate requirements, technical specifications, evaluation criteria, and certifications necessary to meet and fulfill a contract. For projects operating under a quality assurance project plan (QAPP), these details must be communicated to potential contractors in Element B8: *Inspection and Acceptance of Supplies and Consumables*. Many of these project-specific requirements are communicated to potential contractors in the SOW that is included as part of a request for proposal (RFP). Each RFP defines the minimum qualifications necessary to be awarded the contract, in addition to the requirements that must be fulfilled in order for the submitted work to be considered acceptable.

Project details must be documented on a standard contract form, with attachments, which is reviewed and approved by the appropriate State or Regional Board Manager. Changes to contracts undergo the same review and approval sequence. Contract Managers must attend beginning and refresher training in order to receive and maintain Contract Manager status.

Whether it is to be made at the State or Regional Board, procurement of the requested laboratory services must be undertaken by the Contract Manager, according to State Board policy and regulations detailed in the Board's *Contract Information Manual*. The procurement process is documented in the contract file pertaining to the particular action.

Laboratory services contracts must have QA and quality control (QC) requirements integrated into the SOW. The existence of any quality management plans (QMPs), QAPPs, sampling and analysis

plans, or field sampling plans pertinent to the work requested is communicated to the contractor. The State Board QA Program reviews contract language and is often part of the proposal review team. When subcontractors are involved, the prime contractor must maintain responsibility. Therefore, there is no direct oversight responsibility by the Contract Manager.

Contracts Requesting Data Quality Support Services

State and Regional Board personnel must seek services from qualified vendors for data quality support, such as statistical consulting and performance test samples. All contractual requirements noted above are to be followed, including the establishment of quality criteria in the work statement. Review and assessment of compliance with all contractual quality criteria must also be as above.

Grant Agreements with the U.S. Environmental Protection Agency

The State and Regional Boards are to adhere to all U.S. Environmental Protection Agency (EPA) contractual requirements, especially those calling for data quality planning documents.

Grant Recipient Agreements

State and Regional Board staff members oversee the disbursement of grant and bond funds for projects to improve or remediate water quality. As above, all contracts must stipulate quality planning documents and adherence to applicable State or Regional Board quality planning documents. The State Board QA Program will review and approve these planning documents, and oversee their implementation by the grant or bond recipient.

Oversight of Quality

The Contract Manager for the contract or grant must establish inspection and acceptance criteria into contract SOWs or work plans. They are responsible for oversight and for ensuring that products delivered meet contract or grant requirements.

Oversight of the contractor's QA and QC products is accomplished mainly by the efforts of the State Board QA Program. This body reviews contractor quality planning documents to ensure that State and Regional Board policy and contractual QA requirements are being met. The State Board QA Program generates comments on contractor documents, which are then provided, with State Board QA Program Manager approval, to the Contract Manager responsible for the particular contract or work assignment. These individuals then relay review feedback to the contractor and track the contractor's response.

Element B9: Non-Direct Measurements

Water quality monitoring data from sources other than Surface Water Ambient Monitoring Program- (SWAMP-) funded monitoring activities will not be entered into the information management system (IMS) database. Future programmatic funding and staffing provisions may allow for the inclusion of this data.

However, the use of non-direct measurements is highly encouraged in SWAMP planning efforts to produce annual work plans, and for SWAMP data assessment and interpretation activities. Regional Water Quality Control Board (Regional Board) SWAMP staff must use their professional discretion when using data for such purposes. When possible, these data are obtained in electronic format and reviewed in their raw form by automated data editing procedures. These data are also reviewed by Regional Board SWAMP staff before data reduction and interpretation.

Non-direct measurements may also be produced by a calculation involving multiple direct measurements. The involved project or organization must maintain and implement a procedure for the verification of these calculations. This procedure ensures that a consistent calculation is used and that results are transcribed correctly.

Element B10: Data Management

SWAMP Information Management System

One major challenge in conducting a statewide monitoring effort is the development of a unified data system. In many cases, Surface Water Ambient Monitoring Program (SWAMP) participants have previously developed data management systems of their own, or for their own specific objectives. These systems vary in the types of data captured, the software systems in which they are stored, and the degree of data documentation. In order to meet the SWAMP goal of centralized data management, a cooperative Information Management System (IMS) is necessary to ensure that collected data can be shared effectively among participants.

The IMS has been developed in recognition that SWAMP represents an initial effort toward data standardization among regions, agencies, and laboratories; and that adopted protocols may later be used for other purposes beyond this program. The system was constructed primarily to serve Regional Water Quality Control Board (Regional Board) staff and technical committees, but it has also been designed to supply data to non-project scientists and the interested public.

The SWAMP IMS database is maintained by the Data Management Team (DMT) at the Moss Landing Marine Laboratories (MLML). The IMS is the central depository of all data collected for SWAMP. It is the ultimate goal of the DMT to:

- Provide standardized data management;
- Provide data of known and documented quality;
- Make information available to all stakeholders in a timely manner;
- Facilitate the use of data for decision-making processes; and
- Create and document systems that ensure data comparability

It is also a goal of SWAMP to be as "paperless" as possible, and to develop a database that will allow internet access to all parties interested in the data, findings, and technical reports produced through program studies.

Process

Laboratory and field data and associated quality control (QC) is submitted in standardized formats to the DMT for loading into the IMS using automated loading programs. Once data are loaded onto the temporary side of the centralized database, the DMT, along with Regional Board staff, check the field and laboratory information for completeness against the contractual requirements for a given project year. The DMT also confirms that station information, including

National Hydrography Dataset (NHD); CalWater v2.21; and Regional Water Board Basin Plan numbers, target latitudes, and longitudes, are complete.

Finally, the DMT verifies all SWAMP data according to three SWAMP standard operating procedures (SOPs): *Field Data Verification of the Surface Water Ambient Monitoring Program Database, Data Loading and Verification of the Surface Water Ambient Monitoring Program Database, and Toxicity Data Verification of the Surface Water Ambient Monitoring Program Database* (see Appendix G: *Online Resources*). Data verification SOPs for biological assessments and tissue will be introduced as these data types and procedures are finalized in the SWAMP IMS.

Data is verified against the measurement quality objectives (MQOs) presented in this QAPrP, rather than those found in methods, SOPs, or approved quality assurance project plan (QAPP). Based on the SWAMP SOP: *Data Classification System*, a summary compliance code (i.e., Compliant, Estimated, Historical, or Rejected) is then assigned to each individual data result in the database. The DMT also performs routine checks to ensure that all data on the temporary and permanent sides of the database are comparable at a global and an analytical batch level. These processes are detailed in this document's Element D1: *Data Review, Verification, and Validation*; and Element D2: *Verification and Validation Methods.*

After the previous steps are completed, data is transferred to the permanent side of the IMS and checked for transfer completeness and accuracy. It is then available for assessment and interpretive reporting by Regional and State Water Resources Control Board (State Board) staff.

Features

The IMS is based on a centralized data storage model. A centralized system was selected because SWAMP is an integrated program, and the typical data user is interested in obtaining synoptic data sets from discrete hydrologic units or large geographical regions of the state. A distributed system linked through a server or series of file transfer protocol (FTP) sites would require sophisticated tools to enable user access. There is also valid concern over the difficulty of maintaining a linked-distributed system for an extended number of years. Current budget allocations make the centralized system a more achievable model for handling data in SWAMP.

The centralized IMS was developed using standardized data transfer protocols (SDTPs) for data exchange, and *Data Entering/Editing Forms* for field data and observations. The SDTPs detail the information to be submitted with each sample collection or sample processing element, the

units and allowable values for each parameter, and the order in which that information will be submitted. They ensure that data submitted by the participants are comparable and easily merged without significant effort or assumptions by the organization responsible for maintaining the centralized data system.

The SWAMP IMS is organized through a relational structure. The central database is called the replicate master and contains a temporary and permanent side. The relational structure involves the use of multiple data tables linked through one or more common fields or primary keys. A relational structure minimizes the possibility of data loss by allowing data created at different times (e.g., laboratory data vs. field data) to be entered at the time of data production. This relational structure also minimizes redundant data entry by allowing data that are recorded only once (e.g., station location) to be entered into separate tables rather than to be repeated in every data record.

The data table structure of the SWAMP IMS was designed around a sample-driven model. One distinct feature of this database captures a target position of the station (latitude/longitude) that is stored in the *Geometry* table while still capturing an "actual" position of each sample. This is important because many different organizations will be occupying a station at different times to collect different samples. The IMS structure is designed with surface water, bed sediment, tissue, and biological assessment sampling in mind. However, it also captures information collected at multiple depths in the water column more commonly observed in marine and freshwater lake sampling systems. In addition, the IMS contains data tables for toxicity, physical habitat, and tissue compositing data.

This effort includes monitoring information from many existing data pools (see Figure 3: *The Interactions of the Surface Water Ambient Monitoring Program*).

Figure 3: The Interactions of the Surface Water Ambient Monitoring Program

BDAT:
Bay-Delta and Tributaries

CEDEN:
California Environmental Data Exchange Network

DFG:
Department of Fish and Game

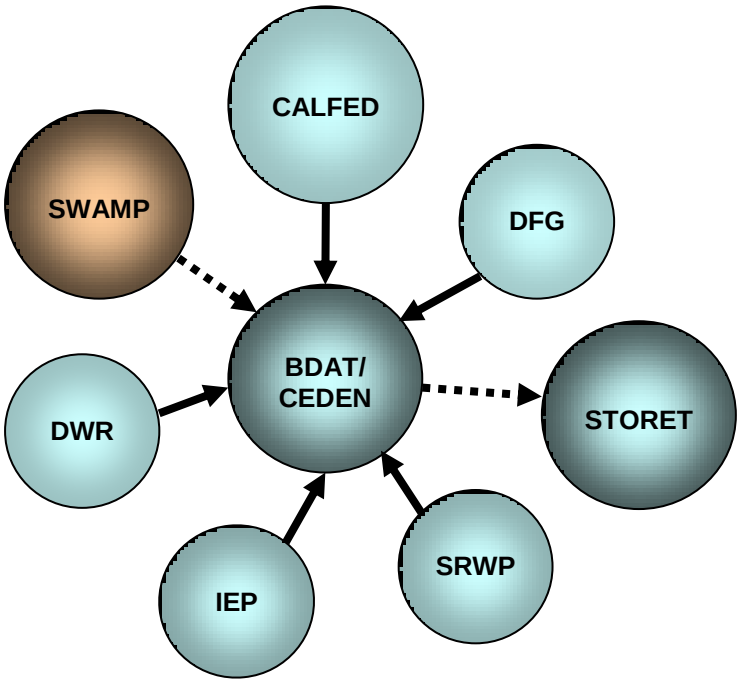
DWR:
Department of Water Resources

IEP:
Interagency Ecological Program

SRWP:
Sacramento River Watershed Program

STORET:
Storage and Retrieval

SWAMP:
Surface Water Ambient Monitoring Program



General Structure

The SWAMP IMS currently contains 100 data tables: 50 entry-level data tables and 50 permanent-level data tables, both containing similar content. The main table is the *Sample* table, which includes a single data record for each sampling event. Samples created can be laboratory samples (laboratory-generated), analytical samples (field-generated), field observations, or field results. This sample is linked in a "one:many" relationship with all subsequent data tables.

The combination of the fields *StationCode, EventCode, ProtocolCode SampleDate, AgencyCode and Project Code* ensures that each record in the *Sample* table is unique. Sample records need to be linked with all results data and thus become the foundation of the SWAMP IMS. In the chemistry results table, all analytical data are captured at the level of the individual replicate, rather than in a summarized form. Toxicity data are stored with statistical summaries as well as with the individual replicates.

Form Entry/Editing Protocols

Key enterers of data (limited number per Regional Board or contracted entity) enter field data into a replicate of the central SWAMP IMS on data entry and editing forms provided to them by the DMT. Limited analytical data can also be entered through the form entry system. The DMT

provides training and support for use of these forms. The individual replicates are synchronized with the central SWAMP IMS. Recommended QC for form entry includes the key enterer confirmation of at least 20% of data, and range checks of the *Field Results* table. Data are next submitted to the DMT for synchronization to the replicate master.

Standardized Data Transfer Protocols

The data formats for the SDTP table submissions are detailed in the *Required Lab Format Training* document (see Appendix G: *Online Resources*). These data formats include lookup lists that are required in order for the data to be loaded into the IMS. The DMT works with analytical laboratories on an individual basis to make this process as seamless as possible. Fields for summary QC information are also included.

Upon receipt, the DMT updates a data submission log to document the data received from each submitting organization. The DMT then initiates a series of error checks to ensure that data meet SWAMP and project measurement quality objectives (MQOs), contain all required fields, have encoded valid values from constrained lookup lists where specified, and are in correct format (e.g., text in text fields, values in numeric fields). If there are a limited number of minor errors, the DMT makes the necessary changes. These changes are only made with the consent of the data generator, with a list sent back to the data generator documenting the changes. If there are numerous errors, or corrections that are difficult to implement, the DMT sends the data file back to the submitting organization with a list of necessary corrections. The submitting organization makes the corrections and resubmits the file to the DMT, who will subject the file to error checking once again. Each of these paths is documented by the DMT as part of the submittal tracking process.

Schedule

The schedule for data submission varies by data type. Data collected in the field is due first, while data produced through laboratory analysis is produced on a schedule consistent with nominal laboratory processing times. Key data enterers provide their data to the DMT so that there is sufficient time for the DMT to resolve any data discrepancies, and to ensure that the data are in the proper format for the addition of the batch input data.

Data Sheets

To assist organizations in meeting the data entry forms and improving the efficiency of data input, the DMT has created a series of data sheets. While these sheets follow closely with the data entry forms, data gatherers are not required to use them (see Appendix G: *Online*

Resources).

California Environmental Data Exchange Network

SWAMP data are publicly available on a web interface through the California Environmental Data Exchange Network (CEDEN - see Appendix G: *Online Resources*). SWAMP's data contributions to CEDEN are facilitated by its own IMS.

At least twice annually, SWAMP uploads data for incorporation into CEDEN. After data is transferred from the SWAMP database, the DMT verifies that the transfer occurred without errors. CEDEN is a collaborative data sharing effort among multiple agencies and data providers, with no one entity responsible for all aspects of the system. Instead, data quality is the responsibility of each individual data provider and program. No formal quality oversight occurs within CEDEN.

The State Board is currently developing a "tiered" system that will define and categorize data from participating programs and projects. When the system is complete, each data submission will include a code that reflects the rigor and documentation of its associated quality control, verification, and validation. CEDEN will not assign these data codes. Instead, they will be assigned by the submitting program or project based on State Board guidance.

Group C: Assessment and Oversight

Element C1: Assessments and Response Actions

Regional and Laboratory Audits

The Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Team (QAT) performs periodic quality system assessments of the program's master contract laboratories and nine contributing Regional Water Quality Control Boards (Regional Boards). A desktop assessment may be scheduled in lieu of an onsite assessment. To promote consistency among multiple assessors, a standardized checklist is completed by each before being compiled into a single document.

Communication

Six weeks in advance, the lead assessor or a designee notifies the involved contract laboratory or Regional Board of their intent to audit. They may then request materials for a desktop assessment - a remote audit of hardcopy or electronic quality documents and materials. The desktop assessment may stand alone, or may precede an onsite assessment.

The onsite assessment adheres to an agenda and includes an opening meeting, a review of quality processes and systems, and a closing meeting. The onsite assessment involves an evaluation of procedures, personnel, equipment, and facilities against the requirements of this quality assurance program plan (QAPrP).

Assessment Summary

Following a regional or laboratory assessment, the lead assessor compiles notes and checklists into a single document. This summary details findings, observations, and recommendations; supporting evidence for each; and references to this SWAMP QAPrP or other applicable requirements. It is acceptable for the assessment report to include recommendations for corrective actions and their associated due dates.

Assessment Response

The assessed organization is then required to prepare a written response to the evaluation. An assessment response includes detailed plans for corrective actions and due dates for completion of those corrective actions. Corrective actions must be well documented, and must include a follow-up plan to ensure the effectiveness of each action.

Upon receipt, the completed assessment response is reviewed by the lead assessor and the SWAMP QA Officer. If the response is satisfactory, the lead assessor sends a letter of acceptance. If the response is not satisfactory, the lead assessor or the SWAMP QA Officer contacts the organization to work toward an acceptable response. Assessment summaries remain confidential, and are only available to the SWAMP QA Team (QAT), the SWAMP Coordinator, and the assessed organization. Completed documents will be electronically archived by the SWAMP QAT for a minimum of five years (see Element A9: *Documents and Records*).

Element C2: Reports to Management

Quality Assurance Reports

Following each year of monitoring, a *Quality Assurance Report* will be prepared by the Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Team (QAT). This report will provide updates on program documents, assessments, corrective actions, and quality control (QC), as well as proposed activities for the upcoming year. It will be submitted to the State Water Resources Control Board (State Board) Quality Assurance (QA) Program for incorporation into its annual report to the U.S. Environmental Protection Agency (EPA). *Quality Assurance Reports* will be electronically archived by the SWAMP QAT for a minimum of five years. In addition, the QAT holds regular internal meetings that are summarized to the SWAMP Roundtable.

Scientific Panel and Review Committee

In response to a request from the State Board, SWAMP has organized an external scientific panel, the Scientific Planning and Review Committee (SPARC), to review study design, approaches, and indicators. SPARC comprises independent scientific and technical experts including, but not limited to, representatives from federal and state agencies and academics with expertise in fields such as monitoring program management, monitoring design, ecology, chemistry, QA, pathogens, toxicology, and statistics. Reports from SPARC's triennial meetings are available online (see Appendix G: *Online Resources*).

State Board Review

Every three years, the State Board's QA Program Manager formally reviews SWAMP's quality system. Their report is issued six months following each SPARC meeting, and uses these meetings and the State Board's draft quality management plan (QMP) as a basis for its content.

If a quality system failure is identified within SWAMP, the State Board QA Program Manager meets with SWAMP's Coordinator and QA Officer to create a mutually acceptable resolution. The resolution is retained by the State Board QA Program in a policy, memorandum of agreement, or planning document. Follow-up is performed by the State Board QA Program to ensure that the resolution reached has been implemented.

Corrective Action File

Within SWAMP, corrective action is required in response to administrative or technical failures at the programmatic level. Any corrective action required of program staff is implemented and

documented according to SWAMP standard operating procedure (SOP) *Corrective Action*. Summarily, the party reporting the corrective action must complete a standardized form. Upon review of this form, the SWAMP QA Officer may revise proposed corrective actions as appropriate. Once the corrective action is approved, the SWAMP QAT will issue a memorandum to the SWAMP Coordinator, the State Board QA Program Manager, the SWAMP Roundtable, or directly affected parties as appropriate. The QAT will then initiate a follow-up review of corrective actions approximately six months after the memorandum is issued.

A copy of the corrective action must be kept on file by the reporting party for at least two years. In addition, an electronic logbook of all completed corrective action forms will be maintained by the SWAMP QAT. The resulting file is reviewed at least annually, and is archived by the QAT for a minimum of five years. Corrective actions are included in the scope of each annual *Quality Assurance Report.*

Group D: Data Validation and Usability

Element D1: Data Review, Verification, and Validation

Review of Surface Water Ambient Monitoring Program (SWAMP) data consists of two discrete steps: verification and validation.

Data Verification is the process of evaluating the correctness, conformance, compliance, and completeness of a specific data set against method, procedural, or contractual requirements. In SWAMP, data verification is the responsibility of Regional Water Quality Control Board (Regional Board) staff, the Data Management Team (DMT), and the reporting laboratory or field organization.

Data Validation is an analyte- and sample-specific process that evaluates the information after the verification process to determine analytical quality and any limitations. In SWAMP, data validation is the responsibility of the QA Team (QAT) and the Regional Board reporting the data.

Procedures for data verification and validation are detailed in Element D2: *Verification and Validation Methods*. Related corrective actions and reporting procedures are described in Group C: *Assessment and Oversight* of this document. Associated standard operating procedures (SOPs) can be found online at (see Appendix G: *Online Resources*).

Ultimately, verified and validated data is stored in the SWAMP Information Management System (IMS), which includes both a temporary and permanent side. Data on the temporary side remains inaccessible via the web but is accessible to State Water Resources Control Board (State Board) and Regional Board staff. Compilation and interpretation of this temporary data is made possible through Microsoft Access features, as well as specialized tools developed by the DMT. Data on the permanent side of the IMS will be accessible to the public through a web interface (see Appendix G: *Online Resources*).

Element D2: Verification and Validation Methods

Verification and validation of data entered into the Surface Water Ambient Monitoring Program (SWAMP) Information Management System (IMS) is the shared responsibility of the submitting party, the Data Management Team (DMT), and the Quality Assurance Team (QAT). These processes are detailed in this quality assurance program plan (QAPrP), the *SWAMP Database Training Manual*, and various SWAMP standard operating procedures (SOPs) referenced below and in Appendix G: *Online Resources*. While these SOPs detail specific tasks performed during the verification and validation processes, responsibility for these tasks is generally assigned as follows:

- Contract laboratories and field organizations are ultimately responsible for the verification and validation of the data they generate.
- The SWAMP DMT is responsible for performing a cursory verification of the submitted data. This process is described in this QAPrP element and in each of the SWAMP data verification SOPs.
- The SWAMP QAT is responsible for analyzing trends in data, and for updating SWAMP verification and validation procedures as appropriate.

Verification Scope

SWAMP performs two levels of data verification: cursory verification and full verification. These processes are defined as follows:

Cursory Verification

This level of verification involves the review of Microsoft Excel files submitted by laboratories and field organizations. Specifics of the cursory verification are dependent on the type of data submitted, and are detailed in the relevant SOPs. Cursory verification is performed by the SWAMP DMT on all data submitted to the IMS.

Full Verification

Full data verification includes the entire scope of cursory verification, with the addition of hardcopy data package verification. These packages include summarized data as well as supporting raw data. Full verification is applied to a statistical representation of IMS data, and is currently performed by the participating laboratory or field organization. Time and budget constraints prevent hardcopy data packages from being submitted to the SWAMP DMT.

Field Data Verification

Following field data entry, it must be reviewed by the submitting agency according to the SWAMP SOP: *Field Data Verification of the Surface Water Ambient Monitoring Program Database*. The query database provided by the SWAMP Data Management Team (DMT) is a tool that can be used to complete this process (see Appendix G: *Online Resources*).

Laboratory Data Verification

It is the responsibility of laboratories to report data that is comparable to SWAMP measurement quality objectives (MQOs - see Appendix A: *Measurement Quality Objectives*), and to the required SWAMP data formats available online (see Appendix G: *Online Resources*). Laboratories are responsible for the accuracy of data submitted to the DMT. The submitting entity is expected to follow the SWAMP SOP: *Contract Laboratory Data Verification and Validation* for chemical analyses and *Toxicity Data Verification of the Surface Water Ambient Monitoring Program Database* for toxicity testing.

Information Management System Data Verification

The DMT transfers temporary data to the permanent side of the IMS according to the SWAMP SOP *Data Loading and Verification of the Surface Water Ambient Monitoring Program Database*. Data is held on the temporary side of the database until the verification procedures outlined in the SWAMP SOPs have been conducted. Following verification, the data is moved to the permanent side of the SWAMP IMS.

Data Validation

Laboratories and field organizations are responsible for confirming that submitted data meets the criteria specified in this QAPrP. After data is loaded into the temporary side of the IMS, The DMT again reviews it against SWAMP criteria associated with the following:

- Completeness
- Holding times
- Matrix spike/matrix spike duplicates (MS/MSDs)
- Laboratory duplicates
- Surrogates
- Certified reference material (CRMs)
- Laboratory control samples (LCSs)

- Method blanks
- Field QC samples
- Reporting limits (RLs)

Focused Data Assessment

The SWAMP QAT conducts focused assessments of data on the permanent side of the IMS. Assessment procedures are detailed in the SWAMP SOP *Surface Water Ambient Monitoring Program Quality Assurance Program Database Systems Assessment* (see Appendix G: *Online Resources*).

The assessment begins by sorting data that has been flagged as “Estimated” in the IMS. This data is further sorted by *QA Code,* revealing trends in data qualification. Trends are then further investigated by sorting each *QA Code* category by the following headings:

- Date
- Region
- Laboratory
- Matrix
- Analyte

Results of these routine investigations may suggest the need for additional sorting (e.g., season). Trends noted within IMS data may include holding time violations, QC sample failures, and missing QC samples.

Element D3: Reconciliation with User Requirements

During the development of the Surface Water Ambient Monitoring Program (SWAMP), the State Water Resources Control Board (State Board) and Regional Water Quality Control Boards (Regional Boards) focused on site-specific monitoring to better characterize problem sites or clean locations (reference sites) that meet the needs of the Total Maximum Daily Load (TMDL) and other core regulatory programs.

In addition, SWAMP data contributes to a variety of reports. These reports provide an analysis and interpretation of collected data; and include fact sheets, data reports, quality assurance reports, interpretative reports, and the 305(b)/303(d) Integrated Report. Technical reports have written descriptions of the study design; methods used; graphical, statistical, and textual descriptions of data; and data interpretation, including comparisons to relevant water quality goals. Technical reports summarized in fact sheets capture key findings in a more readable format. Ultimately, SWAMP end-users must ensure that program data is of the appropriate type, quantity, and quality for its intended purpose.

Appendix A: Measurement Quality Objective Tables

Table of Contents

Introduction

Tables A1-A25 below identify all parameters currently compiled by the Surface Water Ambient Monitoring Program (SWAMP). These tables are divided by analytical category, and therein by analyte. Each relevant quality control (QC) sample type is identified, as well as its associated frequency requirements and measurement quality objectives (MQOs). Element B5: *Quality Control* defines and summarizes field and laboratory QC samples.

- When available, SWAMP requires the analysis of one certified reference material (CRM) per analytical batch. However, certified values are not always available for all target analytes. If no CRM exists, reference values may be used. If no reference value exists for the target analyte, a laboratory control sample (LCS) must be prepared and analyzed with the sample batch as a means of assessing accuracy. Substitution of an LCS is not acceptable if a certified reference material or reference material is available.
- Although the laboratory duplicate and matrix spike duplicate (MSD) both provide information regarding precision, they are unique measurements. Laboratory duplicates provide information regarding the precision of the laboratory procedures. The MSD provides information regarding how the matrix of the sample affects both the precision and bias associated with the results. It also determines whether or not the matrix affects the results in a reproducible manner. Because the two concepts cannot be used interchangeably, it is unacceptable to analyze only an MSD pair when a laboratory duplicate is required.
- Completeness is a measure of the amount of valid data obtained from a measurement system as compared to the expected amount - usually expressed as a percentage. The theoretical MQO of 100% must be corrected for inevitable data loss (e.g., analyst error, insufficient sample volume, shipping difficulty, field conditions, data rejection). Because it is universal, SWAMP's completeness MQO of 90% does not appear in the following analyte-specific tables.
- Percent moisture should be reported with each batch of sediment and tissue samples. Percent lipids should be reported with each batch of organic tissue samples. Sediment and bivalve tissue data must be reported on a dry weight basis. Fish tissue data must be reported on a wet weight basis.
- The formulas below may be used to calculate results for the specified quality control samples.

Reference Materials and Laboratory Control Samples

$$\%\ \text{recovery} = \frac{V_{analyzed}}{V_{certified}} \times 100$$

Where:

$v_{analyzed}$: the analyzed concentration of the reference material or laboratory control sample (LCS)

$v_{certified}$: the certified concentration of the reference material or LCS

Matrix Spikes

$$\%\ \text{recovery} = \frac{\left(V_{MS} - V_{ambient}\right)}{V_{spike}} \times 100$$

Where:

v_{MS}: the concentration of the spiked sample

$v_{ambient}$: the concentration of the original (unspiked) sample

v_{spike}: the concentration of the spike added

Matrix Spike Duplicates

$$RPD = \left| \frac{\left(V_{MS} - V_{MSD}\right)}{mean} \right| \times 100$$

There are two different ways to calculate this RPD, depending on how the samples are spiked.

1) The samples are spiked with the same concentration of analyte. In this case,
   v_{MS}: the concentration for the matrix spike

   v_{MSD}: the concentration of the matrix spike duplicate

   mean: the mean of the two concentrations (MS + MSD)

2) The samples are spiked with differing concentrations of analyte. In this case,
   v_{MS}: the recovery associated with the matrix spike

   v_{MSD}: the recovery associated with matrix spike duplicate

mean: the mean of the two recoveries ($recovery_{MS}$ + $recovery_{MSD}$)

Laboratory Duplicates and Field Duplicates

$$RPD = \left| \frac{\left(v_{sample} - v_{duplicate} \right)}{mean} \right| \times 100$$

Where:

v_{sample}: the concentration of the original sample

$v_{duplicate}$: the concentration of the duplicate sample

mean: the mean concentration of both samples

Replicate Analyses

$$RSD = \frac{Stdev(v_1, v_2, \ldots, v_n)}{mean} \times 100$$

Where:

Stdev(v_1,v_2,…,v_n): the standard deviation of the values (concentrations) of the replicate analyses.

mean: the mean of the values (concentrations) of the replicate analyses.

Table A1: Measurement Quality Objectives* - Conventional Analytes in Water

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Continuing Calibration Verification	Per 10 analytical runs	80-120% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent (chlorophyll: n/a)	80-120% recovery RPD<25% for duplicates
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent (chlorophyll: per method)	RPD<25% (n/a if native concentration of either sample<RL)
Internal Standard	Accompanying every analytical run as method appropriate	Per method
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	RPD<25% (n/a if native concentration of either sample<RL)
Field Blank, Travel Blank, Equipment Blank	Per method	<RL for target analyte

*Unless method specifies more stringent requirements

Table A2: Measurement Quality Objectives* – Conventional Analytes in Water – Solids

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	RPD<25% (n/a if native concentration of either sample<RL)
Field Blank, Equipment Blank	Per method	<RL for target analyte

*Unless method specifies more stringent requirements

Table A3: Measurement Quality Objectives* – Conventional Analytes in Water - Pathogens

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Calibration	Check temperatures in incubators twice daily with a minimum of 4 hours between each reading	Per analytical method or manufacturer's specifications
Filter Sterility Check	Perform one filter sterility check each day samples are analyzed	No growth on filter
Laboratory Blank	Per batch of bottles or reagents	No growth on filter
Filtration Blank	Per 20 samples or per analytical batch, whichever is more frequent	No growth on filter
Reference Material	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery
Positive Control	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery
Negative Control	Per 20 samples or per analytical batch, whichever is more frequent	No growth on filter
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count (coliforms: one per 25 tube dilution tests)	RPD<25% (n/a if native concentration of either sample<RL; coliforms: within 95% confidence interval as defined by IDEXX Laboratories)
Field Blank, Travel Blank, Equipment Blank	Per method	Blanks<RL for target analyte

*Unless method specifies more stringent requirements

Table A4: Measurement Quality Objectives* - Conventional Analytes in Sediments

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Continuing Calibration Verification	Per 10 analytical runs (as applicable)	80-120% recovery
Laboratory Blank	TOC only: one per analytical batch (n/a for others)	<RL or <30% of lowest sample
Reference Material	TOC only: one per 20 samples or per analytical batch, whichever is more frequent (n/a for others)	80-120% recovery
Matrix Spike	n/a	n/a
Matrix Spike Duplicate	n/a	n/a
Laboratory Duplicate	One per analytical batch	RPD<25% (n/a if native concentration of either sample<RL)
Surrogate or Internal Standard	n/a	n/a
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	RPD<25% (n/a if native concentration of either sample<RL)
Field Blank, Travel Blank, Equipment Blank	Per method	<RL or <30% of lowest sample

*Unless method specifies more stringent requirements

Table A5: Measurement Quality Objectives* – Inorganic Analytes in Water, Sediment, and Tissue

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Continuing Calibration Verification	Per 10 analytical runs	80-120% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for MMHg)
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for MMHg)
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery (70-130% for MMHg); RPD<25%
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)
Internal Standard	Accompanying every analytical run when method appropriate	60-125% recovery
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	RPD<25% (n/a if native concentration of either sample<RL), unless otherwise specified by method
Field Blank, Equipment Blank	Per method	Blanks<RL for target analyte

*Unless method specifies more stringent requirements

Table A6: Measurement Quality Objectives* – Volatile Organic Compounds in Water and Sediment

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Continuing Calibration Verification	Per 12 hours	RF for SPCCs same as initial calibration; RF of CCVs must be within 20% of initial calibration
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Method Validation: as many as required to assess accuracy and precision of method before routine analysis of samples; Routine Accuracy Assessment: per 20 samples or per analytical batch (preferably blind)	70-130% recovery if certified; otherwise 50-150% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	50-150% recovery, or based on 3x the standard deviation of laboratory's actual method recoveries
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25%
Laboratory Duplicate	Per method	Per method
Surrogate or Internal Standard	Per method	Per method
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	Per method
Field Blank, Travel Blank, Equipment Blank	Per method	<RL for target analyte

*Unless method specifies more stringent requirements

Table A7: Measurement Quality Objectives* – Semi-Volatile Organic Compounds in Water and Sediment

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Continuing Calibration Verification	Per 12 h	RF for SPCCs same as initial calibration; RF of CCVs must be within 20% of initial calibration
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Method Validation: as many as required to assess accuracy and precision of method before routine analysis of samples; Routine Accuracy Assessment: per 20 samples or per analytical batch (preferably blind)	70-130% recovery if certified; otherwise, 50-150% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	50-150% recovery, or based on 3x the standard deviation of laboratory's actual method recoveries
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25%
Laboratory Duplicate	Per method	Per method
Surrogate or Internal Standard	Per method	Per method
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	Per method
Field Blank, Travel Blank, Equipment Blank	Per method	<RL for target analyte

*Unless method specifies more stringent requirements

Table A8: Measurement Quality Objectives* – Synthetic Organic Compounds in Water, Sediment and Tissue

Laboratory Quality Control	Frequency of Analysis	Measurement Quality Objective
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Continuing Calibration Verification	Per 10 analytical runs	Water: 85-115% recovery Sediment: 85-115% recovery Tissue: 75-125%
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analytes
Reference Material	Method Validation: as many as required to assess accuracy and precision of method before routine analysis of samples; Routine Accuracy Assessment: per 20 samples or per analytical batch (preferably blind)	70-130% recovery if certified; otherwise, 50-150% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	50-150% recovery, or based on 3x the standard deviation of laboratory's actual method recoveries
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25%
Laboratory Duplicate	Per method	Water: RPD<25% (n/a if native concentration of either sample<RL) Sediment: Per method Tissue: Per method
Surrogate or Internal Standard	Per method	Per method
Field Quality Control	**Frequency of Analysis**	**Measurement Quality Objective**
Field Duplicate	5% of total project sample count	Per method
Field Blank, Travel Blank, Equipment Blank	Per method	<RL for target analytes

* Unless method specifies more stringent requirements. ELISA results must be assessed against kit requirements

Table A9: Measurement Quality Objectives* - Toxicity Testing (General)

Negative Controls	Frequency of Analysis	Control Limits
Laboratory Control Water	Laboratory Control Water consistent with Section 7 of the appropriate EPA method must be tested with each analytical batch.	Laboratory Control Water must meet all test acceptability criteria (Please refer to Section 7 of the EPA manuals) for the species of interest.
Conductivity Control Water	A conductivity control must be tested with each analytical batch when the conductivity of any freshwater ambient sample approaches the species' tolerance for conductivity per method.	Follow EPA guidance on interpreting data.
Additional Control Water	Additional method blanks are required whenever manipulations are performed on one or more of the ambient samples within each analytical batch (e.g. pH adjustments, continuous aeration, etc.).	No statistical difference between the laboratory control water and each additional control water within an analytical batch.
Sediment Control	Sediment Control consistent with those described in Section 7 of the EPA manual must be tested with each analytical batch of sediment toxicity tests.	Sediment Control must meet all data acceptability criteria (Please refer to Section 7 of the EPA manuals) for the species of interest.
Positive Controls	**Frequency of Analysis**	**Control Limits**
Reference Toxicant Tests	Reference Toxicant Tests must be conducted monthly for species that are raised within a laboratory. Reference Toxicant Test must be conducted per analytical batch for species from commercial supplier settings. Reference Toxicant Tests must be conducted concurrently for test species or broodstocks that are field collected.	Last plotted data point must be within 2 SD of the cumulative mean (n=20). (Reference toxicant tests that fall outside of recommended control chart limits are evaluated to determine the validity of associated effluent and receiving water tests. An out of control reference toxicant test result does not necessarily invalidate associated test results. More frequent and/or concurrent reference toxicant testing may be advantageous if recent problems have been identified in testing.)
Field Quality Control	**Frequency of Analysis**	**Control Limits**
Field Duplicate	5% of total project sample count	According to method
Field Blanks	Per method or project requirements	No statistical difference between the laboratory control water (or sediment control) and the field blank within an analytical batch
Equipment Blanks	Per method or project requirements	No statistical difference between the Laboratory Control Water and the Equipment Blank within an analytical batch

*Unless method specifies more stringent requirements.

The measurement quality objectives for water quality parameters (pH, dissolved oxygen, conductivity, temperature, unionized ammonia, salinity, alkalinity and hardness) are detailed in the Field Measurement and Conventional Analytes tables of this Appendix.

In special cases where the criteria listed in the following tables cannot be met, EPA minimum criteria may be followed. The affected data should be qualified accordingly.

Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.

Deviations from the summary of recommended test conditions must be evaluated on a project specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result depending on the degree of the departure and the objective of the test. The reviewer should consider the degree of the deviation and the potential or observed impact of the deviation on the test result before rejecting or accepting a test result is valid. For example, if dissolved oxygen is measured below 4.0 mg/L in one test chamber, the reviewer should consider whether any observed mortality in that test chamber corresponded with the drop in dissolved oxygen.

Table A10: Measurement Quality Objectives - 7-Day *Pimephales promelas* Survival and Growth Toxicity Tests

Method Recommendation	
EPA/821/R-02/013 (Test Method 1000.0) or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	80% or greater survival in controls and an average dry weight per surviving organism in control chambers equals or exceeds 0.25 mg
Data Qualification	
Test Conditions	*Required*
Test Type	Static renewal (required)
Age at Test Initiation	Newly-hatched larvae <24hoursold. If shipped, <48hours old with a 24-hour age range
Replication at Test Initiation	4 (minimum)
Organisms/Replicate	10 (minimum)
Food Source	Newly-hatched *Artemia* nauplii (<24hoursold)
Renewal Frequency	Daily
Test Duration	7 days
Endpoints	Survival and biomass
Test Conditions	*Recommended***
Temperature Range	25 ± 1.0 °C (+/- 3 °C required)
Light Intensity	10 – 20 µE/m^2/s or 50 – 100 ft-c
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	>500 mL or per method specific requirements
Replicate Volume	>250 mL or per method specific requirements
Feeding Regime	< 2 times per day
Laboratory Control Water	Moderately hard water prepared in accordance with EPA protocols
Minimum Sample Volume	7 L for one-time grab sample
Sensitivity	*Performance Criteria*
Minimum Significant Difference	<30% MSD If the percent minimum significant difference (PMSD) measured for the test exceeds the upper criterion and toxicity is found at the permitted receiving water concentration (RWC) based upon the value of the effect concentration estimate (NOEC or LOEC), then the test shall be accepted, unless other test review steps raise serious doubts about its validity. If toxicity is not found at the permitted RWC based upon the value of the effect concentration estimate (NOEC or LOEC) and the PMSD measured for the test exceeds the upper PMSD bound, then the test shall not be accepted, and a new test must be conducted promptly on a newly collected sample.
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, SC, pH, and temperature measurement per sample and per dilution
Initial Unionized Ammonia	One measurement per sample (recommended)
Initial Hardness and Alkalinity	One measurement per sample
Daily Water Chemistry	One DO and one pH measurement per sample
Final Water Chemistry	One DO, pH, and temperature measurement and per sample and per dilution (one DO per renewal)
Test Parameter	*Recommended Criteria*
Initial DO Range	4.0 - 8.6 mg/L
Initial pH Range	6.0 - 9.0
Conductivity Controls	Per method - recommend including appropriate controls when sample conductivities are below 100 or above 2500 µS/cm
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Conductivity Tolerance	<3000 µS/cm
Relevant Media	Water column
Sample Container Type	Amber glass or plastic (per method)
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	<48 hours@ 0 - 6 °C; dark

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.

**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A11: Measurement Quality Objectives - Chronic *Ceriodaphnia dubia* Toxicity Tests

Method Recommendation	
EPA/821/R-02/013 (Test Method 1002.0) or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	80% or greater survival of al control organisms and an average of 15 or more young per surviving female. 60% of the surviving control females must produce three broods.
Data Qualification	
Test Conditions	*Required*
Test Type	Static renewal (required)
Age at Test Initiation	<24 hours old and all released within an 8-h period
Replication at Test Initiation	>10
Organisms/Replicate	One (assigned using blocking by known parentage)
Food Source	YCT and *Selenastrum* or comparable food
Renewal Frequency	Daily
Test Duration	<8 days
Endpoints	Survival and reproduction
Test Conditions	*Recommended***
Temperature Range	25 ± 1.5 °C (+/- 3 °C required)
Light Intensity	10 – 20 µE/m^2/s OR 50 – 100 ft-c
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	20 - 40 mL
Replicate Volume	>15 mL
Feeding Regime	Daily
Laboratory Control Water	Moderately hard water prepared in accordance with EPA protocols
Minimum Sample Volume	2 L for one-time grab sample
Sensitivity	*Performance Criteria*
Minimum Significant Difference	<47% MSD If the percent minimum significant difference (PMSD) measured for the test exceeds the upper criterion and toxicity is found at the permitted receiving water concentration (RWC) based upon the value of the effect concentration estimate (NOEC or LOEC), then the test shall be accepted, unless other test review steps raise serious doubts about its validity. If toxicity is not found at the permitted RWC based upon the value of the effect concentration estimate (NOEC or LOEC) and the PMSD measured for the test exceeds the upper PMSD bound, then the test shall not be accepted, and a new test must be conducted promptly on a newly collected sample.
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, SC, pH, and temperature measurement per sample and per dilution
Initial Unionized Ammonia	One measurement per sample
Initial Hardness and Alkalinity	One measurement per sample
Daily Water Chemistry	Two DO , one pH and one temperature per 24-h period in one sample per concentration and in the control
Final Water Chemistry	One DO, pH, and temperature measurement per sample and per dilution (One DO per renewal)
Test Parameter	*Recommended Criteria*
Initial DO Range	4.0 - 8.6 mg/L
Initial pH Range	6.0 - 9.0
Conductivity Controls	Include appropriate controls when sample conductivities are <100 or >2000 µS/cm
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Conductivity Tolerance	2500 µS/cm
Relevant Media	Water column
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	<48 hours@ 0 - 6 °C; dark

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A12: Measurement Quality Objectives - 96-Hour (48- and 24-Hour) *Ceriodaphnia dubia* Toxicity Tests

Method Recommendation	
EPA/821/R-02/012 (Test Method 2002.0) or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	>90% survival in controls
Data Qualification	
Test Conditions	*Required*
Test Type	Static non-renewal or static renewal
Age at Test Initiation	<24hours
Replication at Test Initiation	>4
Organisms/Replicate	>5
Food Source	YCT and *Selenastrum* or comparable food
Renewal Frequency	Daily (unless otherwise specified by method)
Test Duration	96hours(48hoursor 24hoursoptional)
Endpoints	Survival
Test Conditions	*Recommended***
Temperature Range	25 ± 1 °C (+/- 3 °C required)
Light Intensity	10 – 20 µE/m^2/s OR 50 – 100 ft-c
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	20 - 40 mL
Replicate Volume	>15 mL
Feeding Regime	Feed while holding prior to test and 2hoursprior to test solution renewal
Laboratory Control Water	Moderately hard water prepared in accordance with EPA protocols
Minimum Sample Volume	1 L
Sensitivity	*Performance Criteria*
Minimum Significant Difference	No MSD available
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, SC, pH, and temperature measurement per sample and per dilution
Initial Unionized Ammonia	One measurement per sample
Initial Hardness and Alkalinity	One measurement per sample
Daily Water Chemistry	One DO and one temperature measurement per sample
Final Water Chemistry	One DO, pH, and temperature measurement per sample and per dilution (One DO per renewal)
Test Parameter	*Recommended Criteria*
Initial DO Range	4.0 - 8.6 mg/L
Initial pH Range	6.0 - 9.0
Conductivity Controls	Include appropriate controls when sample conductivities are <100 or >2500 µS/cm
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Conductivity Tolerance	<2500 µS/cm
Relevant Media	Water column
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	< 48 hours@ 0 - 6 °C; dark

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A13: Measurement Quality Objectives - 10-Day *Hyalella azteca* Water Toxicity Tests

Method Recommendation	
EPA/821/R-02/013 (Test Method 1002.0) or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	90% or greater survival in controls
Data Qualification	
Test Conditions	*Required*
Test Type	Static renewal
Age at Test Initiation	7 – 14 days old
Replication at Test Initiation	5
Organisms/Replicate	10
Food Source	YCT
Renewal Frequency	80% renewal on Day 5
Test Duration	10 days
Endpoints	Survival
Test Conditions	*Recommended***
Temperature Range	23 ± 1.0 °C
Light Intensity	500 - 1000 lux
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	300 mL
Replicate Volume	100 mL water
Feeding Regime	1.5 mL YCT every other day
Laboratory Control Water	Moderately hard water prepared in accordance with EPA protocols
Minimum Sample Volume	1L
Sensitivity	*Performance Criteria*
Minimum Significant Difference	No MSD available
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, SC, pH, and temperature measurement per sample and per dilution
Initial Unionized Ammonia	One measurement per sample
Initial Hardness and Alkalinity	One measurement per sample
Daily Water Chemistry	Temperature
Final Water Chemistry	One DO, EC, pH, and temperature measurement and per sample and per dilution (DO, EC, pH per renewal)
Test Parameter	*Recommended Criteria*
Initial DO Range	4.7 - 8.92 mg/L
Initial pH Range	6.0 - 9.0
Conductivity Controls	Include appropriate controls when sample conductivities are below or above levels in method
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Conductivity Tolerance	<15 ppt
Relevant Media	Water
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field; 0 - 6 °C refrigeration in laboratory; dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	<48 hours@ 0 - 6 °C; dark

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A14: Measurement Quality Objectives - 10-Day *Hyalella azteca* Sediment Toxicity Tests

Method Recommendation	
EPA/600/R-99/064 (Test Method 100.1) or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	Mean control survival of >80% and measurable growth in the controls
Data Qualification	
Test Conditions	*Required*
Test Type	Whole sediment toxicity test with renewal of overlying water
Age at Test Initiation	7 – 14 days old
Replication at Test Initiation	8
Organisms/Replicate	10
Food Source	YCT
Renewal Frequency	Twice daily
Test Duration	10 days
Endpoints	Survival and growth
Test Conditions	*Recommended***
Temperature Range	23 ± 1.0 °C
Light Intensity	500 - 1000 lux
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	300 mL
Replicate Volume	Sediment volume 100 mL; Overlying water volume 175 mL
Feeding Regime	Daily
Laboratory Control Water	Moderately hard water prepared in accordance with EPA protocols
Sediment Control	Control sediment as listed in method (Control sediment should follow EPA requirements for formulated sediments)
Minimum Sample Volume	6 L for one-time grab sample
Sensitivity	*Performance Criteria*
Minimum Significant Difference	No MSD available
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, SC, pH, and temperature measurement per sample
Initial Unionized Ammonia	One measurement per sample
Initial Hardness and Alkalinity	One measurement per sample
Daily Water Chemistry	One DO and one temperature measurement per sample
Final Water Chemistry	One DO, pH, and temperature measurement per sample
Test Parameter	*Recommended Criteria*
Initial DO Range	4.7 - 8.92 mg/L
Initial pH Range	6.0 - 9.0
Conductivity Controls	Include appropriate controls when sample conductivities are below or above levels listed in method
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Conductivity Tolerance	<15 ppt
Relevant Media	Sediment
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	< 14 days (recommended) or <8 weeks (required) @ 0 - 6 °C; dark; Do not freeze

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A15: Measurement Quality Objectives - 96-Hour *Selenastrum capricornutum* Growth Toxicity Tests

Method Recommendation	
EPA/821/R-02/013 (Test Method 1003.0) or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	Mean cell density of at least 1 X 10^6 cells/mL in the controls and variability (CV%) among control replicates less than or equal to 20% (non-EDTA: Mean cell density of at least 1 X 106 cells/mL in the controls; and variability (CV%) among control replicates less than or equal to 20% (required)
Data Qualification	
Test Conditions	*Required*
Test Type	Static non-renewal
Age at Test Initiation	4 - 7 days
Replication at Test Initiation	10,000 cells/mL (recommended)
Organisms/Replicate	>4
Food Source	n/a
Renewal Frequency	None
Test Duration	96 h
Endpoints	Growth
Test Conditions	*Recommended***
Temperature Range	25 ± 1 °C (+/- 3 °C required)
Light Intensity	86 ± 8.6 µE/m^2/s OR 400 ± 40 ft-c
Photoperiod	Continuous Illumination (“cool white” fluorescent lighting)
Test Chamber Size	125 mL or 250 mL
Replicate Volume	50 mL or 100 mL
Feeding Regime	None
Nutrient Media	Media prepared in accordance with EPA protocols
EDTA Addition	EDTA required per method
Laboratory Control Water	Moderately hard water prepared in accordance with EPA protocols
Minimum Sample Volume	1 L for one-time grab sample
Sensitivity	*Performance Criteria*
Minimum Significant Difference	<29% MSD If the percent minimum significant difference (PMSD) measured for the test exceeds the upper criterion and toxicity is found at the permitted receiving water concentration (RWC) based upon the value of the effect concentration estimate (NOEC or LOEC), then the test shall be accepted, unless other test review steps raise serious doubts about its validity. If toxicity is not found at the permitted RWC based upon the value of the effect concentration estimate (NOEC or LOEC) and the PMSD measured for the test exceeds the upper PMSD bound, then the test shall not be accepted, and a new test must be conducted promptly on a newly collected sample.
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, SC, pH, and temperature measurement per sample and per dilution
Initial Unionized Ammonia	One measurement per sample
Initial Hardness and Alkalinity	One measurement per sample
Daily Water Chemistry	One pH and one temperature measurement per sample
Final Water Chemistry	One DO, pH, and temperature measurement and per sample and per dilution (One DO per renewal)
Test Parameter	*Recommended Criteria*
Initial DO Range	4.0 - 8.6 mg/L
Initial pH Range	6.0 - 9.0
Conductivity Controls	Include appropriate controls when sample conductivities are <100 or >2000 µS/cm
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species’ Conductivity Tolerance	<3000 µS/cm
Relevant Media	Water column
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	< 48 hours@ 0 - 6 °C; dark

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test

results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A16: Measurement Quality Objectives - 7-Day *Atherinops affinis* Larval Survival and Growth Tests

Method Recommendation	
EPA/600/R-95/136 (Test Method 1006.0) or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	≥80% survival in controls, 0.85 mg average weight of control larvae (9 days old)
Data Qualification	
Test Conditions	*Required*
Test Type	Static renewal
Age at Test Initiation	9 – 15 days post-hatch
Replication at Test Initiation	5
Organisms/Replicate	5
Food Source	Newly-hatched *Artemia* nauplii
Renewal Frequency	Daily
Test Duration	7 days
Endpoints	Survival and biomass
Test Conditions	*Recommended***
Temperature Range	20 ± 1.0 °C
Light Intensity	10 – 20 µE/m^2/s OR 50 – 100 ft-c
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	600 mL
Replicate Volume	200 mL
Feeding Regime	Twice daily
Laboratory Control Water	Dilution water should be 1-µ filtered natural seawater of hyper-saline brine prepared from uncontaminated natural sweater plus reagent water
Minimum Sample Volume	8 L for one-time grab sample
Sensitivity	*Performance Criteria*
Minimum Significant Difference	<25% MSD for survival and <50% MSD for growth
Reference Toxicant Results	LC_{50} with copper must be ≤205 µg/L
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, SC, pH, and temperature measurement per sample and per dilution
Initial Unionized Ammonia	One measurement per sample
Initial Salinity	One measurement per sample
Daily Water Chemistry	One temperature measurement per sample
Final Water Chemistry	One DO, pH, and temperature measurement and per sample and per dilution (One DO per renewal)
Test Parameter	*Recommended Criteria*
Initial DO Range	4.0 - 9.0 mg/L
Initial pH Range	6.0 - 9.0
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Salinity Tolerance	5 – 36‰
Relevant Media	Water column
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	<48 hours@ 0 - 6 °C; dark

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A17: Measurement Quality Objectives - 10-Day *Ampelisca abdita* Sediment Toxicity Tests

Method Recommendation	
EPA/600/R-94/025 or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	Minimum mean control survival of 90% in the controls
Data Qualification	
Test Conditions	*Required*
Test Type	Whole sediment toxicity test, static
Size at Test Initiation	3 – 5 mm (no mature males of females)
Replication at Test Initiation	4 (minimum)
Organisms/Replicate	20
Food Source	Do not feed
Renewal Frequency	None
Test Duration	10 days
Endpoints	Survival
Test Conditions	*Recommended***
Temperature Range	20 ± 1.5 °C
Light Intensity	500 – 1000 lux
Photoperiod	Continuous luminance
Test Chamber Size	1 L
Replicate Volume	Sediment volume 175 mL; Overlying water volume 800 mL
Feeding Regime	Do not feed
Laboratory Control Water	Clean, natural seawater diluted to the appropriate salinity with distilled (or similar) water
Sediment Control	Control sediment listed in method (Control sediment should follow EPA requirements for formulated sediments)
Minimum Sample Volume	2 L for one-time grab sample
Sensitivity	*Performance Criteria*
Minimum Significant Difference	No MSD available
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, salinity, pH, and temperature measurement per sample
Initial Unionized Ammonia	One measurement per sample
Daily Water Chemistry	One temperature measurement per sample
Final Water Chemistry	One DO, pH, and temperature measurement per sample
Test Parameter	*Recommended Criteria*
Initial DO Range	6.45 - 7.8 mg/L
Initial pH Range	6.0 - 9.0
Conductivity Controls	n/a
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Salinity Tolerance	Overlying water salinity should be >10‰
Relevant Media	Sediment
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	< 14 days (recommended) or <8 weeks (required) @ 0 - 6 °C; dark; Do not freeze

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A18: Measurement Quality Objectives - 10-Day *Eohaustorius estuarius* Sediment Toxicity Tests

Method Recommendation	
EPA/600/R-94/025 or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	Minimum mean survival of 90% in controls
Data Qualification	
Test Conditions	*Required*
Test Type	Whole sediment toxicity test, static
Size at Test Initiation	3 – 5 mm (no mature males of females)
Replication at Test Initiation	4 (minimum)
Organisms/Replicate	20
Food Source	Do not feed
Renewal Frequency	None
Test Duration	10 days
Endpoints	Survival
Test Conditions	*Recommended***
Temperature Range	15 ± 1.0 °C
Light Intensity	500 – 1000 lux
Photoperiod	Continuous luminance
Test Chamber Size	1 L
Replicate Volume	Sediment volume 175 mL; Overlying water volume 800 mL
Feeding Regime	Do not feed
Laboratory Control Water	Clean, 1-µ filtered natural seawater diluted to the appropriate salinity with distilled (or similar) water
Sediment Control	Control sediment listed in method (Control sediment should follow EPA requirements for formulated sediments)
Minimum Sample Volume	2 L for one-time grab sample
Sensitivity	*Performance Criteria*
Minimum Significant Difference	No MSD available
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, salinity, pH, and temperature measurement per sample
Initial Unionized Ammonia	One measurement per sample
Daily Water Chemistry	One temperature measurement per sample
Final Water Chemistry	One DO, pH, and temperature measurement per sample
Test Parameter	*Recommended Criteria*
Initial DO Range	6.45 - 7.8 mg/L
Initial pH Range	6.0 - 9.0
Conductivity Controls	n/a
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Salinity Tolerance	Overlying water salinity should be 0 - 34%
Relevant Media	Sediment
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	< 14 days (recommended) or <8 weeks (required) @ 0 - 6 °C; dark; Do not freeze

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A19: Measurement Quality Objectives - 48-Hour *Haliotis rufescens* Larval Development Tests

Method Recommendation	
EPA/600/R-95/136 (Test Method 995) or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	≥80% normal shell development in the controls
Data Qualification	
Test Conditions	*Required*
Test Type	Static non-renewal
Age at Test Initiation	n/a
Replication at Test Initiation	5 – 10 per mL
Organisms/Replicate	5
Food Source	Do not feed
Renewal Frequency	None
Test Duration	48 h
Endpoints	Normal shell development
Test Conditions	*Recommended***
Temperature Range	15 ± 1.0 °C
Light Intensity	10 µE/m^2/s or 50 ft-c
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	600 mL
Replicate Volume	200 mL or per method
Feeding Regime	Do not feed
Laboratory Control Water	Dilution water should be 1-µ filtered natural seawater of hyper-saline brine prepared from uncontaminated natural seawater plus reagent water
Minimum Sample Volume	2 L for one-time grab sample
Sensitivity	*Performance Criteria*
Minimum Significant Difference	<20% MSD
Reference Toxicant Results	Larval development NOEC (statistical significant effect) must be <56 µg/L zinc
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, salinity, pH, and temperature measurement per sample
Initial Unionized Ammonia	One measurement per sample
Daily Water Chemistry	One temperature measurement per sample
Final Water Chemistry	One DO, pH, and temperature measurement per sample
Test Parameter	*Recommended Criteria*
Initial DO Range	4.0 - 8.5 mg/L
Initial pH Range	6.0 - 9.0
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Salinity Tolerance	31 - 36‰
Relevant Media	Water column, pore water
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	< 48 hours@ 0 - 6 °C; dark

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A20: Measurement Quality Objectives - 7-Day Holmesimysis costata Growth and Survival Tests

Method Recommendation	
EPA/600/R-95/136 (Test Method 1007.0) or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	≥75% survival, average dry weight ≥0.40 µg in the controls
Data Qualification	
Test Conditions	*Required*
Test Type	Static renewal
Age at Test Initiation	3 - 4 days post-hatch juveniles
Replication at Test Initiation	5
Organisms/Replicate	5
Food Source	Newly hatched *Artemia* nauplii (< 24hoursold)
Renewal Frequency	75% renewal at 48hoursand 96 h
Test Duration	7 days
Endpoints	Survival and biomass
Test Conditions	*Recommended***
Temperature Range	15 ± 1.5 °C
Light Intensity	10 – 20 µE/m^2/s OR 50 – 100 ft-c
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	1000 mL
Replicate Volume	200 mL
Feeding Regime	Twice per day
Laboratory Control Water	Dilution water should be 1-µ filtered natural seawater of hyper-saline brine prepared from uncontaminated natural seawater plus reagent water
Minimum Sample Volume	3 L for one-time grab sample
Sensitivity	*Performance Criteria*
Minimum Significant Difference	<40% MSD for survival and <50 µg MSD for growth
Reference Toxicant Results	Survival and growth NOECs must be <100 µg/L with zinc
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, SC, pH, salinity and temperature measurement per sample and per dilution
Initial Unionized Ammonia	One measurement per sample
Daily Water Chemistry	One temperature measurement per sample
Final Water Chemistry	One DO, pH, and temperature measurement per sample and per dilution (One DO per renewal)
Test Parameter	*Recommended Criteria*
Initial DO Range	4.0 - 8.5 mg/L
Initial pH Range	6.0 - 9.0
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Salinity Tolerance	32 - 36‰
Relevant Media	Water column
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	< 48 hours@ 0 - 6 °C; dark

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A21: Measurement Quality Objectives - 48-hour Mytilus galloprovincialis Embryo-Larval Development Tests

Method Recommendation	
EPA/600/R-95/136 or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	≥50% survival, ≥90% of those must have normal shell development
Data Qualification	
Test Conditions	*Required*
Test Type	Static non-renewal
Age at Test Initiation	Within 4hoursof fertilization
Replication at Test Initiation	4
Organisms/Replicate	150 – 300 (15-30/mL)
Food Source	Do not feed
Renewal Frequency	None
Test Duration	48 h
Endpoints	Survival of normal live prossidoconch larvae
Test Conditions	*Recommended***
Temperature Range	15 ± 1.5 °C
Light Intensity	10 – 20 µE/m^2/s OR 50 – 100 ft-c
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	20 mL
Replicate Volume	10 mL
Feeding Regime	Do not feed
Laboratory Control Water	Dilution water should be 1-µ filtered natural seawater of hyper-saline brine prepared from uncontaminated natural seawater plus reagent water
Minimum Sample Volume	1000 mL for one-time grab sample
Sensitivity	*Performance Criteria*
Minimum Significant Difference	<25% MSD
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, salinity, pH, and temperature measurement per sample
Initial Unionized Ammonia	One measurement per sample
Daily Water Chemistry	One temperature measurement per sample
Final Water Chemistry	One DO, pH, and temperature measurement per sample
Test Parameter	*Recommended Criteria*
Initial DO Range	>4.0
Initial pH Range	6.0 - 9.0
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Salinity Tolerance	28 - 36‰
Relevant Media	Water column, pore water
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	< 48 hours@ 0 - 6 °C; dark

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A22: Measurement Quality Objectives - 96-Hour Strongylocentrotus purpuratus Embryo Development Tests

Method Recommendation	
EPA/600/R-95/136 or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	≥80% normal shell development in the controls
Data Qualification	
Test Conditions	*Required*
Test Type	Static non-renewal
Age at Test Initiation	Not available
Replication at Test Initiation	250 embryos
Organisms/Replicate	4
Food Source	Do not feed
Renewal Frequency	None
Test Duration	96 h
Endpoints	Normal development; survival can be included
Test Conditions	*Recommended***
Temperature Range	15 ± 1.0 °C
Light Intensity	10 – 20 µE/m^2/s OR 50 – 100 ft-c
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	30 mL
Replicate Volume	10 mL
Feeding Regime	Do not feed
Laboratory Control Water	Dilution water should be 1-µ filtered natural seawater of hyper-saline brine prepared from uncontaminated natural seawater plus reagent water
Minimum Sample Volume	1 L for one-time grab sample
Sensitivity	*Performance Criteria*
Minimum Significant Difference	<25% MSD
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, salinity, pH, and temperature measurement per sample
Initial Unionized Ammonia	One measurement per sample
Daily Water Chemistry	One temperature measurement per sample
Final Water Chemistry	One DO, pH, and temperature measurement per sample
Test Parameter	*Recommended Criteria*
Initial DO Range	4.0 - 8.5 mg/L
Initial pH Range	6.0 - 9.0
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Salinity Tolerance	32 - 36‰
Relevant Media	Water column, pore water
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	<48 hours@ 0 - 6 °C; dark

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A23: Measurement Quality Objectives - 20-Minute Strongylocentrotus purpuratus Fertilization Tests

Method Recommendation	
EPA/600/R-95/136 or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	≥70% egg fertilization and appropriate sperm counts in controls
Data Qualification	
Test Conditions	*Required*
Test Type	Static non-renewal
Age at Test Initiation	n/a
Replication at Test Initiation	4
Organisms/Replicate	~1,120 eggs from not more than four females and <3,360,000 sperm from not more than four males per test tube
Food Source	Do not feed
Renewal Frequency	None
Test Duration	40 min (20 min plus 20 min)
Endpoints	Fertilization of egg
Test Conditions	*Recommended***
Temperature Range	12 ± 1.0 °C
Light Intensity	10 – 20 µE/m^2/s OR 50 – 100 ft-c
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	16 x 100 or 16 x 125 mm
Replicate Volume	5 mL
Feeding Regime	Do not feed
Laboratory Control Water	Dilution water should be 1-µ filtered natural seawater of hyper-saline brine prepared from uncontaminated natural seawater plus reagent water
Minimum Sample Volume	1 L for one-time grab sample
Sensitivity	*Performance Criteria*
Minimum Significant Difference	<25% MSD
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, salinity, pH, and temperature measurement per sample
Initial Unionized Ammonia	One measurement per sample
Daily Water Chemistry	One temperature measurement per sample
Final Water Chemistry	One DO, pH, and temperature measurement per sample
Test Parameter	*Recommended Criteria*
Initial DO Range	4.0 - 9.1 mg/L
Initial pH Range	6.0 - 9.0
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Salinity Tolerance	31 - 36‰
Relevant Media	Water column, pore water
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	< 48 hours@ 0 - 6 °C; dark

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A24: Measurement Quality Objectives - 48-Hour Macrocystis pyrifera Germination and Germ-Tube Length Tests

Method Recommendation	
EPA/600/R-95/136 (Test Method 1009.0) or validated and SWAMP-approved alternative method	
Data Acceptability Requirements	
Parameter	*Criteria*
Test Acceptability Criteria*	≥70% germination in the controls, ;≥10 µm germ-tube length in the controls
Data Qualification	
Test Conditions	*Required*
Test Type	Static non-renewal
Age at Test Initiation	n/a
Replication at Test Initiation	5
Organisms/Replicate	7500 spores/mL of test solution
Food Source	Do not feed
Renewal Frequency	None
Test Duration	48 h
Endpoints	Germination and germ-tube length
Test Conditions	*Recommended***
Temperature Range	15 ± 1.0 °C
Light Intensity	50 ± 10 µE/m^2/s
Photoperiod	16 hours of ambient laboratory light, 8 hours dark
Test Chamber Size	600 mL
Replicate Volume	200 mL
Feeding Regime	Do not feed
Laboratory Control Water	Dilution water should be 1-µ filtered natural seawater of hyper-saline brine prepared from uncontaminated natural seawater plus reagent water
Minimum Sample Volume	2 L for one-time grab sample
Sensitivity	*Performance Criteria*
Minimum Significant Difference	<20% MSD
Reference Toxicant Results	NOEC must be <35 µg/L in the reference toxicant test
Water Chemistry	
Test Parameter	*Required Frequency*
Initial Water Chemistry	One DO, salinity, pH, and temperature measurement per sample
Initial Unionized Ammonia	One measurement per sample
Daily Water Chemistry	One temperature measurement per sample
Final Water Chemistry	One DO, pH, and temperature measurement per sample
Test Parameter	*Recommended Criteria*
Initial DO Range	4.0 - 8.5 mg/L
Initial pH Range	6.0 - 9.0
Sample Handling/Collection	
Test Parameter	*Recommended Conditions*
Species' Salinity Tolerance	32 - 36‰
Relevant Media	Water column
Sample Container Type	Amber glass
Sample Preservation	Wet or blue ice in field, 0 - 6 °C refrigeration in laboratory, dark at all times
Sample Receipt Temperature	0 - 6 °C
Holding Time	< 48 hours@ 0 - 6 °C; dark

*Test data are reviewed to verify that the test acceptability criteria (TAC) requirements for a valid test have been met. Any test not meeting the minimum test acceptability criteria is considered invalid. All invalid tests must be repeated with the newly collected sample.
**Deviations from the summary of recommended test conditions must be evaluated on a project-specific basis to determine the validity of test results. Deviations from recommended conditions may or may not invalidate a test result, depending on the degree of the departure and the objective of the test.

Table A25: Measurement Quality Objectives* - Field Measurements**

Water Quality Parameter	Recommended Device	Units	Resolution	Reporting Limit	"Electronic Specs" Accuracy**
Depth	Stadia Rod/Staff Gauge	m	0.01	0.02	n/a
Dissolved Oxygen	Polarographic or Luminescence Quenching	mg/L	0.1	0.2	± 0.2
pH	Electrode	None	0.1	n/a	± 0.2
Salinity	Refractometer or Conductivity Cell	‰	2	2	± 2
Specific Conductivity	Conductivity Cell	µS/cm	1	2	± 2
Temperature	Thermistor or Bulb	°C	0.1 or 0.5	n/a	± 0.1
Total Chlorophyll	Optical Fluorescence Chlorophyll Probe	µg/L	0.1	n/a	n/a
Turbidity	Portable Turbidimeter or Optical Probe	NTU	1	5	± 1
Velocity	Flow Meter	ft/s	0.05	0.1	Follow manufacturer's instructions

* Unless method specifies more stringent requirements
** This table may not include all field analyses. Please refer to method or manufacturer instructions for guidance

Appendix B: Sample Handling

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Table B1: Sampling and Preservation - Conventionals in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Alkalinity (as $CaCO_3$)	mg/L	Polyethylene Bottles	300 mL	Cool to 6 °C and store in the dark	14 days
Ammonia (as N)	mg/L	Polyethylene Bottles	500 mL	Cool to 6 °C and store in the dark. Samples may be preserved with 2 mL of $H2SO_4$ per L	48 hours; 28 days if acidified
Biochemical Oxygen Demand	mg/L	4-L cubitainer	4000 mL	Add 1 g FAS crystals per liter if residual Cl present; Cool to 6 °C and store in the dark	48 hours
Boron	mg/L	Polyethylene Bottles Only plastic apparatus should be used when the determinations of boron and silica are critical.	600 mL	Acidify with (1+1) HNO_3 to pH <2	6 months
Calcium	mg/L	Polyethylene Bottles Glass or plastic filtering apparatus are recommended to avoid possible contamination.	600 mL	Acidify with (1+1) HNO_3 to pH <2	6 months
Chemical Oxygen Demand (Titrametric)	mg/L	1-L cubitainer Collect the samples in glass bottles, if possible. Use of plastic containers is permissible if it is known that no organic contaminants are present in the containers.	1000 mL	Preserve to pH <2 with ~2 mL of conc. H_2SO_4; Cool to 6 °C and store in the dark	28 days Biologically active samples should be tested as soon as possible. Samples containing settleable material must be well mixed, preferably homogenized, to permit removal of representative aliquots.
Chloride	mg/L	Polyethylene Bottles	300 mL	Cool to 6 °C and store in the dark	28 days
Chlorophyll a Pheophytin a	µg/L	Please refer to method requirements	500 mL	Centrifuge or filter as soon as possible after collection. If processing must be delayed, hold samples on ice or at 6 °C and store in the dark.	Samples must be frozen or analyzed within 4 hours of collection. Filters can be stored frozen for 28 days.
Cyanide	mg/L	1-L cubitainer	1000 mL	Preserve to pH>12 with ~ 2 mL 1:1 NaOH, Add 0.6 g $C_6H_8O_6$ if residual Cl present; Cool to 6 °C and store in the dark	14 days

Table B1: Sampling and Preservation - Conventionals in Water (continued)

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Fluoride	mg/L	Polyethylene Bottles	300 mL	Cool to 6 °C and store in the dark	28 days
Hardness (as $CaCO_3$)	mg/L	Polyethylene Bottles	300 mL	Cool to 6 °C and store in the dark. Acidify with HNO_3 to pH<2	6 months
Iron	mg/L	Please refer to method requirements	600 mL	Cool to 6 °C and acidify with (1+1) HNO_3 to pH <2	6 months
Kjeldahl Nitrogen (Total)	mg/L	Polyethylene Bottles	600 mL	Cool to 6 °C and store in the dark. Acidify with H_2SO_4 to pH<2	7 days or 28 days if acidified
Magnesium	mg/L	Polyethylene Bottles Glass or plastic filtering apparatus are recommended to avoid possible contamination.	600 mL	Acidify with (1+1) HNO_3 to pH <2	6 months
Nitrate (as N)	mg/L	Polyethylene Bottles	300 mL	Cool to 6 °C and store in the dark	48 hours unless calculated from nitrate + nitrite (as N) and nitrite (as N) analyses
Nitrate + Nitrite (as N)	mg/L	Polyethylene Bottles	150 mL	Cool to 6 °C and store in the dark. Acidify with H_2SO_4 to pH<2	48 hours or 28 days if acidified
Nitrite (as N)	mg/L	Polyethylene Bottles	150 mL	Cool to 6 °C and store in the dark	48 hours
Oil and Grease (HEM)	mg/L	1-L glass jar (w/Teflon lined lid and rinsed with hexane or methylene chloride)	1000 mL	Preserve to pH <2 with ~2 mL of conc. H_2SO_4 Cool to 6 °C and store in the dark	28 days
Organic Carbon (Total)	mg/L	40-mL glass vial	40 mL	Cool to 6 °C and store in the dark. If analysis is to occur more than two hours after sampling, acidify (pH < 2) with HCl or H_2SO_4.	28 days

Table B1: Sampling and Preservation - Conventionals in Water (continued)

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Organic Carbon (Dissolved)	mg/L	40-mL glass vial	40 mL	Cool to 6 °C and store in the dark	28 days
Orthophosphate (Total, as P)	mg/L	Polyethylene Bottles	150 mL	Cool to 6 °C and store in the dark	48 hours
Orthophosphate (Dissolved, as P) ***Soluble Reactive Phosphorus***	mg/L	Polyethylene Bottles	150 mL	Filter within 15 minutes of collection; Cool to 6 °C and store in the dark	48 hours
Perchlorate	µg/L	Plastic or glass	300 mL	Protect from temperature extremes	28 days
Phenols	mg/L	1-L glass jar w/ Teflon lined lid	1000 mL	Preserve to pH <2 with ~2 mL of concentrated H_2SO_4; Cool to 6 °C and store in the dark	Samples must be extracted within 7 days of collection, and analyzed within 28 days of extraction.
Phosphorus (Total, as P)	mg/L	Polyethylene Bottles	300 mL	Cool to 6 °C and store in the dark	28 days
Phosphorus (Dissolved, as P)	mg/L	Polyethylene Bottles	300 mL	Cool to 6 °C and store in the dark	28 days
Potassium	mg/L	Polyethylene Bottles	600 mL	Acidify with (1+1) HNO_3 to pH <2	6 months
Silica	mg/L	Only plastic apparatus should be used when the determinations of boron and silica are critical.	300 mL	Acidify with (1+1) HNO_3 to pH <2.	6 months
Specific Conductivity	µS/cm	Polyethylene Bottles	500 mL	Cool to 6 °C and store in the dark If analysis is not completed within 24 hours of sample collection, sample should be filtered through a 0.45 micron filter and stored in the dark at 6 °C.	28 days

Table B1: Sampling and Preservation - Conventionals in Water (continued)

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Sulfate	mg/L	Polyethylene Bottles	300 mL	Cool to 6 °C and store in the dark	28 days
Sodium	mg/L	Polyethylene Bottles Glass or plastic filtering apparatus are recommended to avoid possible contamination.	600 mL	Acidify with (1+1) HNO_3 to pH <2.	6 months
Turbidity	NTU	Polyethylene Bottles	300 mL	Cool to 6 °C and store in the dark	48 hours

Table B2: Sampling and Preservation - Conventionals in Water - Solids

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Fixed & Volatile Dissolved Solids (500-550 °C)	mg/L	Please refer to method.	None Specified	Refrigeration or icing to 6°C, to minimize microbiological decomposition of solids is recommended.	24 hours, maximum 7 days
Suspended Sediment Concentration	mg/L	125-mL amber glass jar or Polyethylene Bottles*	125 mL	Cool to 6 °C and store in the dark	7 days
Total Dissolved Solids	mg/L	Polyethylene Bottles*	1000 mL	Cool to 6 °C and store in the dark	7 days
Total Suspended Solids (103-105 °C)	mg/L	500-mL amber glass jar or Polyethylene Bottles*	1000 mL	Refrigeration or icing to 6°C, to minimize microbiological decomposition of solids, is recommended.	7 days
Volatile Suspended Solids	mg/L	Please refer to method.	None Specified	Refrigeration or icing to 6°C, to minimize microbiological decomposition of solids is recommended.	Analysis must begin as soon as possible.

Table B3: Sampling and Preservation - Conventionals in Water - Pathogens

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
E. Coli	MPN/100 mL	Factory-sealed, pre-sterilized, disposable Whirlpak bags or 125 mL sterile plastic (high density polyethylene or polypropylene) container	100 mL	Sodium thiosulfate is pre-added to the containers in the laboratory (chlorine elimination). Cool to 6 °C in the dark.	24 hours (6 hours for regulatory data)
Enterococcus	colonies/100 mL	Factory-sealed, pre-sterilized, disposable Whirlpak bags or 125 mL sterile plastic (high density polyethylene or polypropylene) container	100 mL	Sodium thiosulfate is pre-added to the containers in the laboratory (chlorine elimination). Cool to 6 °C in the dark.	24 hours (6 hours for regulatory data)
Fecal Coliform	MPN/100 mL	Factory-sealed, pre-sterilized, disposable Whirlpak bags or 125 mL sterile plastic (high density polyethylene or polypropylene) container	100 mL	Sodium thiosulfate is pre-added to the containers in the laboratory (chlorine elimination). Cool to 6 °C in the dark.	24 hours (6 hours for regulatory data)
Total Coliform	MPN/100 mL	Factory-sealed, pre-sterilized, disposable Whirlpak bags or 125 mL sterile plastic (high density polyethylene or polypropylene) container	100 mL	Sodium thiosulfate is pre-added to the containers in the laboratory (chlorine elimination). Cool to 6 °C in the dark.	24 hours (6 hours for regulatory data)
Streptococcus	MPN/100 mL	Factory-sealed, pre-sterilized, disposable Whirlpak bags or 125 mL sterile plastic (high density polyethylene or polypropylene) container	100 mL	Sodium thiosulfate is pre-added to the containers in the laboratory (chlorine elimination). Cool to 6 °C in the dark.	24 hours (6 hours for regulatory data)

Table B4: Sampling and Preservation - Conventionals in Sediment

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Sediment Grain Size Analysis	% fines, gravel, sand, silt, and clay (Wentworth scale)	125-mL clear glass jar; pre-cleaned**	125 mL	Cool to 6 °C in the dark up to 28 days. Do not freeze	Please refer to method
Sediment Total Organic Carbon	%OC (dry weight)	125-mL clear glass jar; pre-cleaned*	125 mL	Cool to 6 °C in the dark up to 28 days**	Please refer to method
Moisture	%	125-mL to 250-mL clear glass jar; pre-cleaned*	200 g***	Please refer to the method associated with the target analyte or parameter	Please refer to the method associated with the target analyte or parameter

*Sediment samples for TOC and grain size analysis can be combined in one 250-mL clear glass jar, and sub-sampled at the laboratory in order to utilize holding time differences for the two analyses. If this is done, the 250 mL combined sediment sample must be refrigerated only (not frozen) at 6 °C for up to 28 days, during which time the sub-samples must be aliquoted in order to comply with separate storage requirements (as shown above).

**Sediment samples for sediment TOC analysis can be held at 6 °C for up to 28 days, and must be analyzed within this 28 day period, but can be frozen at any time during the initial 28 days, for up to 1 year maximum at -20 °C.

***Split taken from sample for chemistry analyses

Table B5: Sampling and Preservation - Conventionals in Tissue

Analyte	Units	Recommended Container	Recommended Sample Volume*	Recommended Preservation	Required Holding Time
Lipids	%	125-mL to 250-mL clear glass jar; pre-cleaned**	200 g	Please refer to the method associated with the target analyte	Please refer to the method associated with the target analyte
Moisture	%	125-mL to 250-mL clear glass jar; pre-cleaned**	200 g	Please refer to the method associated with the target analyte	Please refer to the method associated with the target analyte

*Split taken from sample for chemistry analyses

Table B6: Sampling and Preservation - Inorganic Analytes in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Aluminum Arsenic Cadmium Chromium Copper Lead Manganese Nickel Selenium Silver Zinc (Total)	µg/L	60-mL acid-cleaned polyethylene bottle	60 mL	Cool to 6 ◦C in the dark; Acidify to pH<2 with pre-tested HNO_3 within 48 hours	6 months at room temperature following acidification
Aluminum Arsenic Cadmium Chromium Copper Lead Manganese Nickel Selenium Silver Zinc (Dissolved)	µg/L	60-mL acid-cleaned polyethylene bottle	60 mL	Filter within 15 minutes of collection; Cool to 6 ◦C in the dark; Acidify to pH<2 with pre-tested HNO_3 within 48 hours	6 months at room temperature after filtration and/or acidification
Mercury (Total)	ng/L	250-mL glass or acid-cleaned Teflon bottle	250 mL	Cool to 6 ◦C in the dark; Acidify to 0.5% with pre-tested HCl within 48 hours	6 months at room temperature following acidification
Mercury (Dissolved)	ng/L	250-mL glass or acid-cleaned Teflon bottle	250 mL	Filter within 15 minutes of collection; Cool to 6 ◦C in the dark; Acidify to 0.5% with pre-tested HCl within 48 hours	6 months at room temperature after filtration and/or acidification
Methylmercury (Total)	ng/L	250-mL glass or acid-cleaned Teflon bottle	250 mL	Cool to 6 ◦C in the dark; Acidify to 0.5% with pre-tested HCl within 48 hours; If salinity is >0.5 ppt, acidify with H_2SO_4	6 months at room temperature following acidification
Methylmercury (Dissolved)	ng/L	250-mL glass or acid-cleaned Teflon bottle	250 mL	Cool to 6 ◦C in the dark; Filter and acidify to 0.5% with pre-tested HCl within 48 hours. If salinity is >0.5 ppt, acidify with H_2SO_4	6 months at room temperature after filtration and/or acidification
Hexavalent Chromium (Filtered)	µg/L	600-mL polyethylene or glass bottle	600 mL	Cool to 6 ◦C in the dark	24 hours, must notify lab in advance

Table B7: Sampling and Preservation - Inorganic Analytes in Sediment

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
Aluminum **Arsenic** **Cadmium** **Chromium** **Copper** **Lead** **Manganese** **Mercury** **Nickel** **Selenium** **Silver** **Zinc**	mg/kg	60-mL I-Chem 300 or 200 series clear glass jar with Teflon lid-liner	100 g	Cool to 6 ˚C and in the dark	1 year at -20 ˚C; Samples must be analyzed within 14 days of collection or thawing.
Methylmercury	mg/kg	60-mL I-Chem 300 or 200 series clear glass jar with Teflon lid-liner	100 g	Freeze to ≤-20 °C immediately	1 year

Table B8: Sampling and Preservation - Inorganic Analytes in Tissue

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation*	Required Holding Time
Aluminum **Arsenic** **Cadmium** **Chromium** **Copper** **Lead** **Manganese** **Nickel** **Selenium** **Silver** **Zinc**	µg/g	Polyethylene bags, Teflon sheets in Ziplock bags, or I-Chem 300 or 200 series clear glass jars with Teflon lined lids; acid-cleaned polyethylene jars if only sampling for trace metals	20-50 g	Cool to 6 °C within 24 hours, then freeze to ≤-20 °C	1 year at -20 °C;
Mercury	µg/g	Teflon sheets in Ziplock bags, or glass jars with Teflon lined lids	20-50 g	Cool to 6 °C within 24 hours, then freeze to ≤-20 °C	1 year at -20 °C;
Methylmercury	µg/g	Teflon sheets in Ziplock bags, or glass jars with Teflon lined lids	20-50 g	Cool to 6 °C within 24 hours, then freeze to ≤-20 °C	1 year at -20 °C;

*Fish to be reported in wet weight; all other tissues to be reported in dry weight

Table B9: Sampling and Preservation - Volatile Organic Compounds in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
1,1-Dichloroethane **1,1-Dichloroethylene** **1,1-Dichloropropene** **1,1,1-Trichloroethane** **1,1,2-Trichloroethane** **1,1,1,2-Tetrachloroethane** **1,1,2,2-Tetrachloroethane** **1,2-Dibromo-3-chloropropane (DBCP)** **1,2-Dibromoethane** **1,2-Dichlorobenzene** **1,2-Dichloroethane** **1,2-Dichloropropane** **1,2-cis-Dichloroethylene** **1,2-trans-Dichloroethylene** **1,2,3-Trichlorobenzene** **1,2,3-Trichloropropane** **1,2,4-Trichlorobenzene** **1,2,4-Trimethylbenzene** **1,3-Dichlorobenzene** **1,3-Dichloropropane** **1,3,5-Trimethylbenzene** **1,4-Dichlorobenzene** **2-Chlorotoluene** **2,2-Dichloropropane** **4-Chlorotoluene** **Benzene** **Bromobenzene** **Bromochloromethane** **Bromodichloromethane** **Bromoform** **Carbon tetrachloride** **Chlorobenzene** **Chloroform** **Dibromochloromethane** **Dibromomethane** **Ethylbenzene** **Fluorobenzene** **Hexachlorobutadiene** **Isopropylbenzene** **Methyl tert-butyl ether (MTBE)** **m/p-Xylene** **Naphthalene** **n-Butylbenzene** **n-Propylbenzene** **o-Xylene** **p-Isopropyltoluene** **sec-Butylbenzene** **tert-Butylbenzene** **Tetrachloroethylene** **Toluene** **Trichloroethylene** **Xylene, total**	ug/L	40-mL VOA vials	120 mL (three VOA vials)	All vials are pre-acidified (50% HCl or H_2SO_4) at lab before sampling. Cool to 6 °C in the dark.	14 days at 6 °C, dark, and pH< 2; 7 days at 6 °C, dark, for non-acidified
Recommended Surrogate (% Recovery)					
4-Bromofluorobenzene, Chlorobenzene-d5, Dibromofluoromethane, Toluene-d8					

Table B10: Sampling and Preservation - Volatile Organic Compounds in Sediment

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
1,1-Dichloroethane **1,1-Dichloroethylene** **1,1-Dichloropropene** **1,1,1-Trichloroethane** **1,1,1,2-Tetrachloroethane** **1,1,2-Trichloroethane** **1,1,2,2-Tetrachloroethane** **1,2-Dibromo-3-chloropropane, (DBCP)** **1,2-Dibromomethane** **1,2-Dichlorobenzene** **1,2-Dichloroethane** **1,2-Dichloropropane** **1,2-cis-Dichloroethylene** **1,2-trans-Dichloroethylene** **1,2,3-Trichlorobenzene** **1,2,3-Trichloropropane** **1,2,4-Trichlorobenzene** **1,2,4-Trimethylbenzene** **1,3-Dichlorobenzene** **1,3-Dichloropropane** **1,3,5-Trimethylbenzene** **1,4-Dichlorobenzene** **2-Chlorotoluene** **2,2-Dichloropropane** **4-Chlorotoluene** **Benzene** **Bromobenzene** **Bromochloromethane** **Bromodichloromethane** **Bromoform** **Carbon tetrachloride** **Chlorobenzene** **Chloroform** **Dibromochloromethane** **Dibromomethane** **Ethylbenzene** **Fluorobenzene** **Hexachlorobutadiene** **Isopropylbenzene** **Methyl tert-butyl ether (MTBE)** **m/p-Xylene** **n-Butylbenzene** **n-Propylbenzene** **Naphthalene** **o-Xylene** **p-Isopropyltoluene** **sec-Butylbenzene** **tert-Butylbenzene** **Tetrachloroethylene** **Toluene** **Trichloroethylene** **Xylene, total**	ng/g	250-mL I-Chem 300-series amber glass jar with Teflon lid-liner; Pre-cleaned.	200 g	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be analyzed within 14 days of collection or thawing.
Recommended Surrogates (% Recovery)					
1,2-Dichloromethane-d4, 4-Bromofluorobenzene, Chlorobenzene-d5, Dibromofluoromethane, Toluene-d8					

Table B11: Sampling and Preservation - Semi-Volatile Organic Compounds* in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
1,2-Dichlorobenzene **1,2,4-Trichlorobenzene** **1,4-Dichlorobenzene** **2-Chloronaphthalene** **2-Chlorophenol** **2-Methylnaphthalene** **2-Methylphenol** **2-Nitroaniline** **2-Nitrophenol** **2,4-Dichlorophenol** **2,4-Dimethylphenol** **2,4-Dinitrophenol** **2,4-Dinitrotoluene** **2,4,5-Trichlorophenol** **2,4,6-Trichlorophenol** **2,6-Dinitrotoluene** **3-Nitroaniline** **3,4-Methylphenol** **4-Bromophenylphenylether** **4-Chloro-3-methylphenol** **4-Chloroaniline** **4-Chlorophenyl phenyl ether** **4-Nitroaniline** **4-Nitrophenol** **4,6-Dinitro-2-methylphenol** **Bis(2-chloroethoxy)methane** **Bis(2-chloroethyl) ether** **Bis(2-ethylhexyl) phthalate** **Butyl benzyl phthalate** **Carbazole** **Dibenzofuran** **Diethyl phthalate** **Dimethyl phthalate** **Di-n-butyl phthalate** **Di-n-octyl phthalate** **Hexachlorobenzene** **Hexachlorobutadiene** **Hexachlorocyclopentadiene** **Hexachloroethane** **Isophorone** **Nitrobenzene** **n-Nitrosodi-n-propylamine** **Pentachlorophenol** **Phenol** **Xylene, total**	µg/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL (Each sample type requires a separate 1000-mL container)	Cool to 6 °C in the dark.	Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.
Recommended Surrogate (% Recovery)					
2-Fluorobiphenyl, 2-Fluorophenol, 2,4,6-Tribromophenol, Nitrobenzene-d5, Phenol-d6, Terphenyl-d14					

*Information on polynuclear aromatic hydrocarbons may be found in Table B16.

Table B12: Sampling and Preservation - Semi-Volatile Organic Compounds in Sediment

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
1,2-Dichlorobenzene **1,4-Dichlorobenzene** **1,2,4-Trichlorobenzene** **2-Chloronaphthalene** **2-Chlorophenol** **2-Nitroaniline** **2-Nitrophenol** **2,4-Dichlorophenol** **2,4-Dimethylphenol** **2,4-Dinitrophenol** **2,4-Dinitrotoluene** **2,4,5-Trichlorophenol** **2,4,6-Trichlorophenol** **2,6-Dinitrotoluene** **3-Nitroaniline** **4-Bromophenyl phenyl ether** **4-Chloro-3-methylphenol** **4-Chloroaniline** **4-Chlorophenyl phenyl ether** **4-Nitroaniline** **4,6-Dinitro-2-methylphenol** **Acenaphthene** **Acenaphthylene** **Anthracene** **Benz[a]anthracene** **Benzo[a]pyrene** **Benzo[b]fluoranthene** **Benzo[g,h,i]perylene** **Benzo[k]fluoranthene** **Bis(2-chloroethoxy)methane** **Bis(2-chloroethyl) ether** **Bis(2-chloroisopropyl)ether** **Bis(2-ethylhexyl) phthalate** **Carbazole** **Chrysene** **Dibenzofuran** **Diethyl phthalate** **Dimethyl phthalate** **Di-n-butyl phthalate** **Naphthalene** **Nitrobenzene** **n-Nitrosodi-n-propylamine** **Pentachlorophenol** **Phenanthrene** **Phenol** **Pyrene** **Xylene, total**	ng/g	Pre-cleaned 250-mL I-Chem 300 Series amber glass jar with Teflon lid liner	200 g	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
2-Fluorobiphenyl, 2-Fluorophenol, 2,4,6-Tribromophenol, Nitrobenzene-d5, Phenol-d6, Terphenyl-d14					

Table B13: Sampling and Preservation - Synthetic Organic Compounds (Polychlorinated Biphenyls as Congeners/Aroclor) in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
PCB 5 **PCB 8** **PCB 15** **PCB 18** **PCB 27** **PCB 28** **PCB 29** **PCB 31** **PCB 33** **PCB 44** **PCB 49** **PCB 52** **PCB 56** **PCB 60** **PCB 66** **PCB 70** **PCB 74** **PCB 87** **PCB 137** **PCB 138** **PCB 141** **PCB 149** **PCB 151** **PCB 153** **PCB 156** **PCB 157** **PCB 158** **PCB 170** **PCB 174** **PCB 177** **PCB 180** **PCB 183** **PCB 187** **PCB 189** **PCB 194** **PCB 195** **PCB 200** **PCB 201** **PCB 203** **PCB 206** **PCB 209** **Aroclor 1248** **Aroclor 1254** **Aroclor 1260**	µg/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to 6 °C in the dark.	Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
PCB 209					

Table B14: Sampling and Preservation - Synthetic Organic Compounds (Polychlorinated Biphenyls as Congeners/Aroclor) in Sediment

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
PCB 8 **PCB 18** **PCB 27** **PCB 28** **PCB 29** **PCB 31** **PCB 33** **PCB 44** **PCB 49** **PCB 52** **PCB 56** **PCB 60** **PCB 66** **PCB 70** **PCB 74** **PCB 87** **PCB 95** **PCB 97** **PCB 99** **PCB 101** **PCB 105** **PCB 110** **PCB 114** **PCB 118** **PCB 128** **PCB 137** **PCB 138** **PCB 141** **PCB 149** **PCB 151** **PCB 153** **PCB 156** **PCB 157** **PCB 158** **PCB 170** **PCB 174** **PCB 177** **PCB 180** **PCB 183** **PCB 187** **PCB 189** **PCB 194** **PCB 195** **PCB 200** **PCB 201** **PCB 203** **PCB 206** **PCB 209** **Aroclor 1248** **Aroclor 1254** **Aroclor 1260**	ng/g	Pre-cleaned 250-mL I-Chem 300 Series amber glass jar with Teflon lid liner	500 g (two jars)	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
PCB 207					

Table B15: Sampling and Preservation - Synthetic Organic Compounds (Polychlorinated Biphenyl Congeners/Aroclor) in Tissue

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
PCB 8 **PCB 18** **PCB 27** **PCB 28** **PCB 29** **PCB 31** **PCB 33** **PCB 44** **PCB 49** **PCB 52** **PCB 56** **PCB 60** **PCB 66** **PCB 70** **PCB 74** **PCB 87** **PCB 95** **PCB 97** **PCB 99** **PCB 101** **PCB 105** **PCB 110** **PCB 114** **PCB 118** **PCB 128** **PCB 137** **PCB 138** **PCB 141** **PCB 149** **PCB 151** **PCB 153** **PCB 156** **PCB 157** **PCB 158** **PCB 170** **PCB 174** **PCB 177** **PCB 180** **PCB 183** **PCB 187** **PCB 189** **PCB 194** **PCB 195** **PCB 200** **PCB 201** **PCB 203** **PCB 206** **PCB 209** **Arochlor 1248** **Arochlor 1254** **Arochlor 1260**	ng/g	Polyethylene bags (Teflon sheets in zip bags) or glass jars with Teflon lids	200 g	Cool to 6 °C	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
PCB 207					

Table B16: Sampling and Preservation - Synthetic Organic Compounds (Polynuclear Aromatic Hydrocarbons) in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
1-Methylfluorene **1-Methylnaphthalene** **1-Methylphenanthrene** **2-Methylfluoranthene** **2-Methylnaphthalene** **2,3,5-Trimethylnaphthalene** **2,6-Dimethylnaphthalene** **3,6-Dimethylphenanthrene** **4-Methyldibenzothiophene** **Acenaphthene** **Acenaphthylene** **Anthracene** **Benz(a)anthracene** **Benzo(a)pyrene** **Benzo(b)fluoranthene** **Benzo(e)pyrene** **Benzo(g,h,i)perylene** **Benzo(k)fluoranthene** **Biphenyl** **C1-Chrysenes** **C1-Dibenzothiophenes** **C1-Fluorenes** **C1-Fluoranthene/ Pyrenes** **C1-Naphthalenes** **C1-Phenanthrene/ Anthracene** **C2-Chrysenes** **C2-Dibenzothiophenes** **C2-Fluorenes** **C2-Naphthalenes** **C2-Phenanthrene/Anthracene** **C3-Chrysenes** **C3-Dibenzothiophenes** **C3-Fluorenes** **C3-Naphthalenes** **C3-Phenanthrene/ Anthracene** **C4-Naphthalenes** **C4-Phenanthrene/ Anthracene** **Chrysenes** **Dibenz(a,h)anthracene** **Dibenzothiophene** **Fluoranthene** **Fluorene** **Indeno(1,2,3-c,d)pyrene** **Naphthalene** **Perylene** **Phenanthrene** **Pyrene**	µg/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to 6 °C in the dark.	Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
Acenaphthene-d10, Benz(a)anthracene-D12, Benzo(g,h,i)perylene-D12, Biphenyl-D10, Naphthalene-d8, Perylene-d12, Phenanthrene-d10, Pyrene-d10					

Table B17: Sampling and Preservation - Synthetic Organic Compounds (Polynuclear Aromatic Hydrocarbons) in Sediment

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
1-Methylfluorene **1-Methylnaphthalene** **1-Methylphenanthrene** **2-Methylfluoranthene** **2-Methylnaphthalene** **2,3,5-Trimethylnaphthalene** **2,6-Dimethylnaphthalene** **3,6-Dimethylphenanthrene** **4-Methyldibenzothiophene** **Acenaphthene** **Acenaphthylene** **Anthracene** **Benz(a)anthracene** **Benzo(a)pyrene** **Benzo(b)fluoranthene** **Benzo(e)pyrene** **Benzo(g,h,i)perylene** **Benzo(k)fluoranthene** **Biphenyl** **Chrysene** **C1-Chrysenes** **C1-Dibenzothiophenes** **C1-Fluorenes** **C1-Fluoranthene/ Pyrenes** **C1-Naphthalenes** **C1-Phenanthrene/ Anthracene** **C2-Chrysenes** **C2-Dibenzothiophenes** **C2-Fluorenes** **C2-Naphthalenes** **C2-Phenanthrene/ Anthracene** **C3-Chrysenes** **C3-Dibenzothiophenes** **C3-Fluorenes** **C3-Naphthalenes** **C3-Phenanthrene/ Anthracene** **C4-Phenanthrene/ Anthracene** **C4-Naphthalenes** **Dibenz(a,h)anthracene** **Dibenzothiophene** **Fluoranthene** **Fluorene** **Indeno(1,2,3-c,d)pyrene** **Naphthalene** **Perylene** **Phenanthrene** **Pyrene**	ng/g	Pre-cleaned 250-mL I-Chem 300 Series amber glass jar with Teflon lid liner	500 g (two jars)	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
Acenaphthene-d10, Benz(a)anthracene-D12, Benzo(g,h,i)perylene-D12, Biphenyl-D10, Naphthalene-d8, Perylene-d12, Phenanthrene-d10, Pyrene-d10					

Table B18: Sampling and Preservation - Synthetic Organic Compounds (Polynuclear Aromatic Hydrocarbons) in Tissue

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
1-Methylfluorene **1-Methylnaphthalene** **1-Methylphenanthrene** **2-Methylfluoranthene** **2-Methylnaphthalene** **2,3,5-Trimethylnaphthalene** **2,6-Dimethylnaphthalene** **3,6-Dimethylphenanthrene** **4-Methyldibenzothiophene** **Acenaphthene** **Acenaphthylene** **Anthracene** **Benz(a)anthracene** **Benzo(a)pyrene** **Benzo(b)fluoranthene** **Benzo(e)pyrene** **Benzo(g,h,i)perylene** **Benzo(k)fluoranthene** **Biphenyl** **C1-Chrysenes** **C1-Dibenzothiophenes** **C1 Fluoranthene/ Pyrenes** **C1-Fluorenes** **C1-Naphthalenes** **C1-Phenanthrene/ Anthracene** **C2-Chrysenes** **C2-Dibenzothiophenes** **C2-Fluorenes** **C2-Naphthalenes** **C2-Phenanthrene/ Anthracene** **C3-Chrysenes** **C3-Dibenzothiophenes** **C3-Fluorenes** **C3-Naphthalenes** **C3-Phenanthrene/ Anthracene** **C4-Naphthalenes** **C4-Phenanthrene/ Anthracene** **Chrysene** **Dibenz(a,h)anthracene** **Dibenzothiophene** **Fluoranthene** **Fluorene** **Indeno(1,2,3-c,d)pyrene** **Naphthalene** **Perylene** **Phenanthrene** **Pyrene**	ng/g	Polyethylene bags (Teflon sheets in zip bags) or glass jars with Teflon lids	200 g	Cool to 6 °C	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
Acenaphthene-d10, Benz(a)anthracene-D12, Benzo(g,h,i)perylene-D12, Biphenyl-D10, Naphthalene-d8, Perylene-d12, Phenanthrene-d10, Pyrene-d10					

Table B19: Sampling and Preservation - Synthetic Organic Compounds (Organochlorine Pesticides) in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Aldrin **cis-Chlordane** **trans-Chlordane** **Chlordene** **Dacthal** **DDD (o,p')** **DDD (p,p')** **DDE (o,p')** **DDE (p,p')** **DDMU (p,p')** **DDT (o,p')** **DDT (p,p')** **Dieldrin** **Endosulfan I** **Endosulfan II** **Endosulfan sulfate** **Endrin** **Endrin Aldehyde** **Endrin Ketone** **Alpha-HCH** **Beta-HCH** **Delta-HCH** **Gamma-HCH** **Heptachlor** **Heptachlor epoxide** **Hexachlorobenzene** **Methoxychlor** **Mirex** **cis-Nonachlor** **trans-Nonachlor** **Oxadiazon** **Oxychlordane** **Tedion** **Toxaphene**	µg/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to ≤6 °C in the dark; pH 5-9.	Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
Dibromoocta-fluorobiphenyl					

Table B20: Sampling and Preservation - Synthetic Organic Compounds (Organochlorine Pesticides) in Sediment

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
Aldrin **cis-Chlordane** **trans-Chlordane** **Dacthal** **DDD (o,p')** **DDD (p,p')** **DDE (o,p')** **DDE (p,p')** **DDMU (p,p')** **DDT (o,p')** **DDT (p,p')** **Dieldrin** **Endosulfan I** **Endosulfan II** **Endosulfan sulfate** **Endrin** **Alpha-HCH** **Beta-HCH** **Delta-HCH** **Gamma-HCH** **Heptachlor** **Heptachlor epoxide** **Hexachlorobenzene** **Methoxychlor** **Mirex** **Nonachlor, cis** **Nonachlor, trans** **Oxadiazon** **Oxychlordane** **Tedion** **Toxaphene**	ng/g	Pre-cleaned 250-mL I-Chem 300 Series amber glass jar with Teflon lid liner	500 g (two jars)	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
PCB 207, Dibromooctafluorobiphenyl, DDD (p,p'), DBCE					

Table B21: Sampling and Preservation - Synthetic Organic Compounds (Organochlorine Pesticides) in Tissue

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
Aldrin **cis-Chlordane** **trans-Chlordane** **Dacthal** **DDD (o,p')** **DDD (p,p')** **DDE (o,p')** **DDE (p,p')** **DDMU (p,p')** **DDT (o,p')** **DDT (p,p')** **Dieldrin** **Endosulfan I** **Endosulfan II** **Endosulfan sulfate** **Endosulfan sulfate** **Endrin** **Alpha-HCH** **Beta-HCH** **Gamma-HCH** **Heptachlor** **Heptachlor epoxide** **Hexachlorobenzene** **Methoxychlor** **Mirex** **cis-Nonachlor** **trans-Nonachlor** **Oxadiazon** **Oxychlordane** **Tedion** **Toxaphene**	ng/g	Polyethylene bags (Teflon sheets in zip bags) or glass jars with Teflon lids	200 g	Cool to 6 °C	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
PCB 207, Dibromoocta fluorobiphenyl, DDD (p,p'), DBCE					

Table B22: Sampling and Preservation - Synthetic Organic Compounds (Wastewater Organochlorine Pesticides) in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Chlorothalonil PCNB	ug/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to ≤6 °C in the dark; pH 5-9.	Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.

Table B23: Sampling and Preservation - Synthetic Organic Compounds (Wastewater Organochlorine Pesticides) in Sediment

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
Chlorothalonil	ng/g	Pre-cleaned 250-mL I-Chem 300 Series amber glass jar with Teflon lid liner	500 g (two jars)	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
PCNB	ng/g	Pre-cleaned 250-mL I-Chem 300 Series amber glass jar with Teflon lid liner	500 g (two jars)	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.

Table B24: Sampling and Preservation - Synthetic Organic Compounds (Organophosphate Pesticides) in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Aspon **Azinphos ethyl** **Carbophenothion** **Chlorfenvinphos** **Chlorpyrifos** **Chlorpyrifos methyl** **Ciodrin** **Coumaphos** **Demeton-S** **Diazinon** **Naled** **Dichlofenthion** **Dichlorvos** **Dicrotophos** **Dimethoate** **Dioxathion** **Disulfoton** **Ethion** **Famphur** **Fenchlorophos** **Fenitrothion** **Fensulfothion** **Fenthion** **Fonofos** **Azinphos methyl** **Leptophos** **Malathion** **Methidathion** **Parathion, ethyl** **Parathion, methyl** **Molinate** **Phorate** **Mevinphos** **Phosmet** **Phosphamidon** **Ethoprop** **Sulfotep** **Bolstar** **Terbufos** **Tetrachlorvinphos** **Thiobencarb** **Thionazin** **Tokuthion** **Merphos** **Trichlorfon** **Trichloronate**	µg/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to ≤6 °C in the dark; pH 5-9.	Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
Triphenyl phosphate					

Table B25: Sampling and Preservation - Synthetic Organic Compounds (Organophosphate Pesticides) in Sediment

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
Chlorpyrifos **Chlorpyrifos methyl** **Diazinon** **Dichlofenthion** **Dieldrin** **Dioxathion** **Ethion** **Fecnchlorphos** **Fenitrothion** **Fonofos** **Malathion** **Parathion, ethyl** **Parathion, methyl** **Phosphamidon** **Ethoprop** **Sulfotep** **Thionzion** **Tokuthion** **Merphos** **Trichloronate**	ng/g	Pre-cleaned 250-mL I-Chem 300 Series amber glass jar with Teflon lid liner	500 g (two jars)	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
Triphenyl phosphate					

Table B26: Sampling and Preservation - Synthetic Organic Compounds (Organophosphate Pesticides) in Tissue

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
Chlorpyrifos **Chlorpyrifos Methyl** **Diazinon** **Dichlofenthion** **Dioxathion** **Ethion** **Fenchchlorphos** **Fenitrothion** **Fenofos** **Malathion** **Parathion, Ethyl** **Parathion, Methyl** **Phosphamidon** **Ethoprop** **Sulfotep** **Thionazin** **Tokuthion** **Merphos** **Trichloronate**	ng/g	Polyethylene bags (Teflon sheets in zip bags) or glass jars with Teflon lids	200 g	Cool to 6 °C	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
Triphenyl phosphate					

Table B27: Sampling and Preservation - Synthetic Organic Compounds (Diesel Range Organics) in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Diesel Range Organics	ug/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to 6 °C in the dark.	Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
σ - Terphenyl					

Table B28: Sampling and Preservation - Synthetic Organic Compounds (Diesel Range Organics) in Sediment

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
Diesel Range Organics	ng/g	Pre-cleaned 250-mL I-Chem 300 Series amber glass jar with Teflon lid liner	500 g (two jars)	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
Σ - Terphenyl					

Table B29: Sampling and Preservation - Synthetic Organic Compounds (Pyrethroids/Pyrethrins) in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Bifenthrin **Cyfluthrin, Total** **Cypermethrin, Total** **Deltamethrin** **Esfenvalerate/ Fenvalerate, Total** **lambda-Cyhalothrin, Total** **cis-Permethrin** **trans-Permethrin**	ug/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to 6 °C in the dark.	Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
Dibromoocta-fluorobiphenyl					

Table B30: Sampling and Preservation - Synthetic Organic Compounds (Pyrethroids/Pyrethrins) in Sediment

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
Bifentrhin **Cyfluthrin, Total** **Cypermethrin, Total** **Deltamethrin, Total** **Esfenvalerate/ Fenvalerate, Total** **Lambda-cyhalothrin, Total** **cis-Permethrin** **trans-Permethrin**	ng/g	Pre-cleaned 250-mL I-Chem 300 Series amber glass jar with Teflon lid liner	500 g (two jars)	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
Dibromooctafluorobiphenyl					

Table B31: Sampling and Preservation - Synthetic Organic Compounds (Phenols) in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Pentachloro-phenol	ug/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to ≤6 °C in the dark; pH 5-9.	Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.
2,3,5,6-Tetrachlorophenol	ug/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to 6 °C in the dark.	Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
2,4,6-Trimethylphenol					

Table B32: Sampling and Preservation - Synthetic Organic Compounds (Glyphosate) in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Glyphosate	ug/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to 6 °C in the dark.	6 months at -20 °C; Samples must be analyzed within 7 days of collection or thawing
AMPA	ug/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to 6 °C in the dark.	6 months at -20 °C; Samples must be analyzed within 7 days of collection or thawing

Table B33: Sampling and Preservation - Synthetic Organic Compounds (Surfactants) in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Nonlyphenol Nonylphenol-ethoxylate	ug/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to 6 °C in the dark.	Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
2,4,6-Trimethylphenol					

Table B34: Sampling and Preservation - Synthetic Organic Compounds (Surfactants) in Sediment

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation*	Required Holding Time
Nonylphenol **Nonylphenol-ethoxylate**	ng/g	Pre-cleaned 250-mL I-Chem 300 Series amber glass jar with Teflon lid liner	500 g (two jars)	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
2,4,6-Trimethylphenol					

*Unless otherwise specified by method

Table B35: Sampling and Preservation - Synthetic Organic Compounds (Surfactants) in Tissue

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation*	Required Holding Time
Nonylphenol **Nonylphenol-ethoxylate**	ng/g	Polyethylene bags (Teflon sheets in zip bags) or glass jars with Teflon lids	200 g	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
2,4,6-Trimethylphenol					

*Unless otherwise specified by method

Table B36: Sampling and Preservation - Synthetic Organic Compounds (Carbamate Pesticides) in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Aldicarb **Captan** **Carbaryl** **Carbofuran** **Diuron** **Linuron** **Methiocarb** **Methomyl**	ug/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to ≤6 °C in the dark; pH 5-9.	Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.

Table B37: Sampling and Preservation - Synthetic Organic Compounds (Triazines) in Water

Analyte	Units	Recommended Container	Recommended Sample Volume	Recommended Preservation	Required Holding Time
Ametryn **Atraton** **Atrazine** **Prometon** **Prometryn** **Propazine** **Secbumeton** **Simazine** **Simetryn** **Terbuthylazine** **Terbutryn**	ug/L	1000-mL I-Chem 200-Series amber glass bottle, with Teflon lid-liner	1000 mL/per individual analyses (QC samples or other analytes require additional sample bottles)	Cool to 6 °C in the dark.	Samples must be extracted within 7 days of collection and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
Triphenyl phosphate					

Table B38: Sampling and Preservation - Synthetic Organic Compounds (Organotins) in Sediment

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
Dibutyltin	ng/g	Pre-cleaned 250-mL I-Chem 300 Series amber glass jar with Teflon lid liner	500 g (two jars)	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Tributlytin	ng/g	Pre-cleaned 250-mL I-Chem 300 Series amber glass jar with Teflon lid liner	500 g (two jars)	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.

Table B39: Sampling and Preservation - Synthetic Organic Compounds (Organotins) in Tissue

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
Dibutyltin	ng/g	Polyethylene bags (Teflon sheets in zip bags) or glass jars with Teflon lids	200 g	Cool to 6 °C	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Tributlytin	ng/g	Polyethylene bags (Teflon sheets in zip bags) or glass jars with Teflon lids	200 g	Cool to 6 °C	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.

Table B40: Sampling and Preservation - Synthetic Organic Compounds (Polybrominated Diphenyl Ethers) in Sediment

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
PBDE 17 **PBDE 28** **PBDE 47** **PBDE 66** **PBDE 85** **PBDE 99** **PBDE 100** **PBDE 138** **PBDE 153** **PBDE 154** **PBDE 183** **PBDE 190**	ng/g	Pre-cleaned 250-mL I-Chem 300 Series amber glass jar with Teflon lid liner	500 g (two jars)	Cool to 6 °C in the dark	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
DDD (p,p')					

Table B41: Sampling and Preservation - Synthetic Organic Compounds (Polybrominated Diphenyl Ethers) in Tissue

Analyte	Units	Recommended Container	Recommended Sample Mass	Recommended Preservation	Required Holding Time
PBDE 17 **PBDE 28** **PBDE 47** **PBDE 66** **PBDE 100** **PBDE 99** **PBDE 85** **PBDE 154** **PBDE 153** **PBDE 138** **PBDE 183** **PBDE 190**	ng/g	Polyethylene bags (Teflon sheets in zip bags) or glass jars with Teflon lids	200 g	Cool to 6 °C	1 year at -20 °C; Samples must be extracted within 14 days of collection or thawing and analyzed within 40 days of extraction.
Recommended Surrogates (% Recovery)					
DDD (p,p')					

Table B42: Sampling and Preservation - Field Measurements[a]

Water Quality Parameter	Points Per Calibration[b]	Pre-Measurement Calibration Adjustment Frequency[e]	Accuracy Check (Post-Calibration Check) Frequency	Allowable Drift (Measurement Accuracy)[c, d, e]
Depth	2	n/a	Quarterly	± 0.02 or 2%
Dissolved Oxygen	1	Before every monitoring day (and more often when changing elevation)	After every monitoring day or next morning	± 0.5 or 10%
pH	2	Before every monitoring day	Every evening or next morning	± 0.2
Salinity	2	Per drift rate (instrument-specific)	Per drift rate (instrument-specific	± 4 or 10%
Specific Conductivity	2	Per manufacturer's instructions	Per manufacturer's instructions	± 4 or 10%
Temperature	2	n/a	Once annually	± 0.5 or 10%
Total Chlorophyll	Follow manufacturer's instructions	Per manufacturer's instructions	Per manufacturer's instructions	Follow manufacturer's instructions
Turbidity	2	Per manufacturer's instructions	Per manufacturer's instructions	± 2 or 10%
Velocity	Follow manufacturer's instructions	Per manufacturer's instructions	Per manufacturer's instructions	Follow manufacturer's instructions

a: This table may not include all field analyses. Please refer to method or manufacturer instructions for guidance
b: Unless otherwise specified by method or manufacturer instructions.
c: Manufacturers often provide accuracy specifications that relate to the intrinsic capabilities of the instrument. These must not be confused with measurement output or drift between two consecutive calibration adjustments.
d: Unit or percentage, whichever is greater
e: Recalibration is recommended if an elevation change of 500 feet occurs (especially for Dissolved Oxygen).

Appendix C: Reporting Limits

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Table C1: SWAMP Reporting Limits - Conventionals in Water

Analyte	Water (mg/L)*
Ammonia (as N)	0.1
Biochemical Oxygen Demand	2
Boron	0.010
Chloride	0.25
Chlorophyll a Pheophytin a	0.002
Chemical Oxygen Demand (titrametric)	5
Cyanide	not listed
Dissolved Phosphorus (as P)	not listed
Fluoride	0.123
Iron	0.02
Nitrate (as N)	0.01
Nitrate + Nitrite (as N)	0.1
Nitrite (as N)	0.01
Oil and Grease (HEM)	1.4
Organic Carbon (Dissolved)	0.6
Organic Carbon (Total)	0.6
Orthophosphate (as P)	0.01
Phenols	not listed
Silica	0.1
Sulfate	1.0
Specific Conductivity	2.5 μS/cm
Total Alkalinity (as $CaCO_3$)	1
Total Calcium	0.05
Total Hardness (as $CaCO_3$)	1
Total Kjeldahl Nitrogen	0.5
Total Magnesium	0.02
Total Phosphorus (as P)	not listed
Total Potassium	0.1
Total Sodium	0.1
Turbidity	0.5 ntu

*Unless otherwise noted

Table C2: SWAMP Reporting Limits - Conventionals - Aqueous Solids

Analyte	Solids (mg/L)
Fixed & Volatile Dissolved Solids (500 C) 550 C	5.0
Suspended Sediment Concentration	0.5
Total Dissolved Solids	10
Total Suspended Solids (103-105 °C)	0.5
Volatile Suspended Solids	1.0

Table C3: SWAMP Reporting Limits – Conventionals - Pathogens

Analyte	MPN/100 mL*
Pathogens – E. Coli	2
Pathogens – Enterococcus	1 colonies/100 mL
Pathogens –Fecal Coliform	2
Pathogens – Total Coliform	2
Pathogens - Streptococcus	not listed

*Unless otherwise noted

Table C4: SWAMP Reporting Limits – Conventionals - Solids

Analyte	Solids
Sediment Grain Size Analysis	1%
Sediment Total Organic Carbon	0.01% OC
%Moisture	n/a
%Lipids	n/a

Table C5: SWAMP Reporting Limits – Inorganic Analytes

Analyte	Water (μg/L)	Sediment (mg/kg)	Tissue (mg/kg)
Aluminum	0.3	0.3	0.3
Arsenic	0.3	0.3	0.3
Cadmium	0.01	0.01	0.01
Chromium	0.1	0.1	0.1
Copper	0.01	0.01	0.01
Lead	0.01	0.01	0.01
Manganese	0.01	0.01	0.01
Mercury	0.0002	0.03	0.03
Methylmercury	0.00005	0.00002	0.0100
Nickel	0.02	0.02	0.02
Selenium	0.30	0.10	0.30
Silver	0.02	0.02	0.02
Zinc	0.10	0.10	0.10

Table C6: SWAMP Reporting Limits - Volatile Organics

Analyte	Water (µg/L)	Sediment (mg/kg)
1,1-Dichloroethane		
1,1-Dichloroethylene		
1,1-Dichloropropene		
1,1,1-Trichloroethane		
1,1,2-Trichloroethane		
1,1,1,2-Tetrachloroethane		
1,1,2,2-Tetrachloroethane		
1,2 -Dibromoethane		
1,2-Dichlorobenzene		
1,2-Dichloroethane		
1,2-Dichloropropane		
1,2-cis-Dichloroethylene		
1,2-trans-Dichloroethylene		
1,2,3-Trichlorobenzene,		
1,2-Dibromo-3-chloropropane		
1,2,3-Trichloropropane		
1,2,4-Trichlorobenzene		
1,2,4-Trimethylbenzene		
1,3-Dichlorobenzene		
1,3-Dichloropropane		
1,3,5-Trimethylbenzene		
1,4-Dichlorobenzene	0.08	20
2-Chlorotoluene		
2,2-Dichloropropane		
4-Chlorotoluene		
Benzene		
Bromobenzene		
Bromochloromethane		
Bromodichloromethane		
Bromoform		
Carbon tetrachloride		
Chlorobenzene		
Chloroform		
Dibromochloromethane		
Dibromomethane		
Ethylbenzene		
Fluorobenzene		
Hexachlorobutadiene		
Isopropylbenzene		
Methyl tert-butyl ether(MTBE)		
m/p-Xylene		
Naphthalene		
n-Butylbenzene		
n-Propylbenzene		

Table C6: SWAMP Reporting Limits - Volatile Organics (continued)

Analyte	Water (µg/L)	Sediment (mg/kg)
o-Xylene p-Isopropyltoluene sec-Butylbenzene tert-Butylbenzene Tetrachloroethylene Toluene Trichloroethylene Total Xylene	0.08	20

Table C7: SWAMP Reporting Limits - Semi-Volatile Organics

Analyte	Water (µg/L)	Sediment (mg/kg)
1,2-Dichlorobenzene 1,2,4-Trichlorobenzene 1,4-Dichlorobenzene 2-Chloronaphthalene 2-Chlorophenol 2-Methylnaphthalene 1,2,4-Trichlorobenzene 2-Methylphenol 2-Nitroaniline 2-Nitrophenol 2,4-Dichlorophenol 2,4-Dimethylphenol 2,4-Dinitrophenol 2,4-Dinitrotoluene 2,4,5-Trichlorophenol 2,4,6-Trichlorophenol 2,6-Dinitrotoluene 3-Nitroaniline 3,4-Methylphenol 4-Bromophenyl phenyl ether 4-Chloro-3-methylphenol 4-Chloroaniline 4-Chlorophenyl phenyl ether 4-Nitroaniline 4-Nitrophenol 4,6-Dinitro-2-methylphenol Acenaphthene Acenaphthylene Anthracene Benz[a]anthracene Benzo[a]pyrene Benzo[b]fluoranthene Benzo[g,h,i]perylene Benzo[k]fluoranthene Bis(2-chloroethoxy)methane Bis(2-chloroethyl) ether Bis(2-ethylhexyl) phthalate Butyl benzyl phthalate Carbazole Chrysene Dibenzofuran Diethyl phthalate Dimethyl phthalate Di-n-butyl phthalate	10	0.3

Table C7: SWAMP Reporting Limits - Semi-Volatile Organics (continued)

Analyte	Water (µg/L)	Sediment (mg/kg)
Di-n-octyl phthalate Hexachlorobenzene Hexachlorobutadiene Hexachlorocyclopentadiene Hexachloroethane Indeno[1,2,3-cd]pyrene Isophorone Naphthalene Nitrobenzene n-Nitrosodi-n-propylamine Pentachlorophenol Phenanthrene Phenol Pyrene Total Xylenes	10	0.3

Table C8: SWAMP Reporting Limits - Synthetic Organic Compounds Polychlorinated Biphenyls as Congeners/Aroclor Compounds

Analyte	Water (µg/L)	Sediment (ng/g)	Tissue (ng/g)
PCB 5 PCB 8 PCB 15 PCB 18 PCB 27 PCB 28 PCB 29 PCB 31 PCB 33 PCB 44 PCB 49 PCB 52 PCB 56 PCB 60 PCB 66 PCB 70 PCB 74 PCB 87 PCB 95 PCB 97 PCB 99 PCB 101 PCB 105 PCB 110 PCB 114 PCB 118 PCB 128 PCB 137 PCB 138 PCB 141 PCB 149 PCB 151 PCB 153 PCB 156 PCB 157 PCB 158 PCB 170 PCB 174 PCB 177 PCB 180 PCB 183	0.002	0.2	0.4

Table C8: SWAMP Reporting Limits - Synthetic Organic Compounds Polychlorinated Biphenyls as Congeners/Aroclor Compounds (continued)

Analyte	Water (μg/L)	Sediment (ng/g)	Tissue (ng/g)
PCB 187	0.002	0.2	0.4
PCB 189	1.0	10	20
PCB 194	0.002	0.2	0.4
PCB 195	0.002	0.2	0.4
PCB 200	0.002	0.2	0.4
PCB 201	0.002	0.2	0.4
PCB 203	0.002	0.2	0.4
PCB 206	0.002	0.2	0.4
PCB 209	0.002	0.2	0.4
Aroclor 1248	2.5	25	50
Aroclor 1254	1.0	10	20
Aroclor 1260	1.0	10	20

Table C9: SWAMP Reporting Limits - Synthetic Organic Compounds Polynuclear Aromatic Hydrocarbons

Analyte	Water (µg/L)	Sediment (ng/g)	Tissue (ng/g)
1-Methylfluorene 1-Methyl-naphthalene 1-Methyl-phenanthrene 2-Methylfluoranthene 2-Methyl-naphthalene 2,3,5-Trimethyl-naphthalene 2,6-Dimethyl-naphthalene 3,6-Dimethyl-phenanthrene 4-Methyl-dibenzothiophene Acenaphthene Acenaphthylene Anthracene Benz(a) anthracene Benzo(a) pyrene Benzo(b) fluoranthene Benzo(e) pyrene Benzo(g,h,i) perylene Benzo(k) fluoranthene Biphenyl C1-Chrysenes C1-Dibenzo-thiophenes C1-Fluorenes C1-Fluoranthene/ Pyrenes C1-Naphthalenes C1-Phenanthrene/ Anthracene C2-Chrysenes C2-Dibenzo-thiophenes C2-Fluorenes C2-Naphthalenes C2-Phenanthrene/ Anthracene C3-Chrysenes C3-Dibenzo-thiophenes C3-Fluorenes C3-Naphthalenes C3-Phenanthrene/ Anthracene C4-Naphthalenes C4-Phenanthrene/ Anthracene Chrysenes Dibenz(a,h) anthracene Dibenzo-thiophene Fluoranthene Fluorene	10	20	100

Table C9: SWAMP Reporting Limits - Synthetic Organic Compounds Polynuclear Aromatic Hydrocarbons (continued)

Analyte	Water (µg/L)	Sediment (ng/g)	Tissue (ng/g)
Indeno(1,2,3-c,d) pyrene Naphthalene Perylene Phenanthrene Pyrene	10	20	100

Table C10: SWAMP Reporting Limits - Synthetic Organic Compounds - Organochlorine Pesticides

Analyte	Water (µg/L)	Sediment (ng/g)	Tissue (ng/g)
Aldrin	0.002	1	2
alpha-HCH	0.002	1	2
cis-Chlordane	0.002	2	4
beta-HCH	0.002	2	4
trans-Chlordane	0.002	2	4
Dacthal	0.002	2	4
DDD (o,p')	0.002	2	4
DDD (p,p')	0.002	2	4
DDE (o,p')	0.002	2	4
DDE (p,p')	0.002	2	4
DDMU (p,p')	0.002	3	6
DDT (o,p')	0.002	3	6
DDT (p,p')	0.005	5	10
delta-HCH	0.002	2	4
Dieldrin	0.002	2	4
Endosulfan I	0.002	2	4
Endosulfan II	0.002	10	20
Endosulfan sulfate	0.002	10	20
Endrin	0.002	2	4
Endrin Aldehyde	0.005	n/a	n/a
Endrin Ketone	0.005	n/a	n/a
gamma-HCH	0.002	1	2
Heptachlor	0.002	2	4
Heptachlorepoxide	0.002	1	2
Hexachlorobenzene	0.001	0.3	0.6
Methoxychlor	0.002	5	10
Mirex	0.002	3	6
cis-Nonachlor	0.002	2	4
trans-Nonachlor	0.002	1	2
Oxadiazon	0.002	3	6
Oxychlordane	0.002	1	2
Tedion	0.002	2	4
Toxaphene	n/a	20	40

Table C11: SWAMP Reporting Limits - Synthetic Organic Compounds - Organophosphate Pesticides

Analyte	Water (μg/L)	Sediment (ng/g)	Tissue (ng/g)
Aspon	0.050	n/a	n/a
Azinphos ethyl	0.050	n/a	n/a
Carbophenothion	0.050	n/a	n/a
Chlorfenvinphos	0.050	n/a	n/a
Chlorpyrifos	0.050	2	4
Chlorpyrifos methyl	0.050	n/a	n/a
Ciodrin	0.050	n/a	n/a
Coumaphos	0.050	n/a	n/a
Demeton-s	0.050	n/a	n/a
Diazinon	0.050	20	40
Naled	0.050	n/a	n/a
Dichlofenthion	0.050	n/a	n/a
Dichlorvos	0.050	n/a	n/a
Dicrotophos	0.050	n/a	n/a
Dimethoate	0.050	n/a	n/a
Dioxathion	0.050	n/a	n/a
Disulfoton	0.050	n/a	n/a
Ethion	0.050	6	12
Famphur	0.050	n/a	n/a
Fenchlorophos	0.050	n/a	n/a
Fenitrothion	0.050	n/a	n/a
Fensulfothion	0.050	n/a	n/a
Fenthion	0.050	n/a	n/a
Fonofos	0.050	n/a	n/a
Azinphos methyl	0.050	n/a	n/a
Leptophos	0.050	n/a	n/a
Malathion	0.050	n/a	n/a
Methidathion	0.050	n/a	n/a
Parathion, ethyl	0.050	2	4
Parathion, methyl	0.050	4	8
Molinate	0.050	n/a	n/a
Phorate	0.050	n/a	n/a
Mevinphos	0.050	n/a	n/a
Phosmet	0.050	n/a	n/a
Phosphamidon	0.050	n/a	n/a
Ethoprop	0.050	n/a	n/a
Sulfotep	0.050	n/a	n/a
Bolstar	0.050	n/a	n/a
Terbufos	0.050	n/a	n/a
Tetrachlorvinphos	0.050	n/a	n/a
Thiobencarb	0.050	n/a	n/a
Thionazin	0.050	n/a	n/a

Table C11: SWAMP Reporting Limits - Synthetic Organic Compounds - Organophosphate Pesticides (continued)

Analyte	Water (μg/L)	Sediment (ng/g)	Tissue (ng/g)
Tokuthion	0.050	n/a	n/a
Merphos	0.050	n/a	n/a
Trichlorfon	0.050	n/a	n/a
Trichloronate	0.050	n/a	n/a

Appendix D: Corrective Action

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Table D1: Corrective Action - Conventional Analytes (Water)

Laboratory Quality Control	Corrective Action
Calibration Standard	Affected samples and associated quality control must be reanalyzed following successful instrument recalibration.
Initial/Continuing Calibration Verification	The analysis must be halted, the problem investigated, and the instrument recalibrated. All samples after the last calibration verification must be reanalyzed.
Laboratory Blank	The sample analysis must be halted, the source of the contamination investigated, the samples along with a new laboratory blank prepared and/or re-extracted, and the sample batch and fresh laboratory blank reanalyzed. If reanalysis is not possible due to sample volume, flag associated samples as estimated.
Reference Material	Affected samples and associated quality control must be reanalyzed following instrument recalibration.
Matrix Spike	The spiking level should be approximately 2-5 times the ambient concentration of the spiked sample. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected, the matrix spike result must be qualified.
Matrix Spike Duplicate	The spiking level should be approximately 2-5 times the ambient concentration of the spiked sample. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected and reference material recoveries are acceptable, the matrix spike duplicate result must be qualified.
Laboratory Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. Other failures should be reanalyzed as sample volume allows.
Internal Standard	As method requires. The instrument must be flushed with rinse blank. If, after flushing, the responses of the internal standards remain unacceptable, the analysis must be terminated and the cause of drift investigated.
Field Quality Control	**Corrective Action**
Field Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. All failures should be communicated to the project coordinator, who in turn will follow the process detailed in the method.
Field Blank, Travel Blank, Equipment Blank	If contamination of the field blanks and associated samples is known or suspected, the laboratory should qualify the affected data, and notify the project coordinator, who in turn will follow the process detailed in the method.

Table D2: Corrective Action - Conventional Analytes (Total Solids, Suspended Sediment Concentration, and Percent Lipids)

Laboratory Quality Control	Corrective Action
Calibration Standard	n/a
Initial/Continuing Calibration Verification	n/a
Laboratory Blank	Please refer to method requirements.
Reference Material	Please refer to method requirements.
Matrix Spike	n/a
Matrix Spike Duplicate	n/a
Laboratory Duplicate*	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. Other failures should be reanalyzed as sample volume allows. A matrix spike duplicate may not be analyzed in place of a laboratory duplicate.
Internal Standard	n/a
Field Quality Control	**Corrective Action**
Field Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. All failures should be communicated to the project coordinator, who in turn will follow the process detailed in the method.
Field Blank, Travel Blank, Equipment Blank	If contamination of the field blanks and associated samples is known or suspected, the laboratory should qualify the affected data, and notify the project coordinator, who in turn will follow the process detailed in the method.

*Not applicable to suspended sediment concentration analyses

Table D3: Corrective Action - Inorganic Chemistry

Laboratory Quality Control	Corrective Action
Calibration Standard	Affected samples and associated quality control must be reanalyzed following successful instrument recalibration
Initial/Continuing Calibration Verification	The analysis must be halted, the problem investigated, and the instrument recalibrated if necessary. If deemed appropriate, all samples after the last acceptable continuing calibration verification may be reanalyzed.
Laboratory Blank	The sample analysis must be halted, the source of the contamination investigated, the samples along with a new laboratory blank prepared and/or re-extracted, and the sample batch and fresh laboratory blank reanalyzed. If reanalysis is not possible due to sample volume, flag associated samples as estimated.
Reference Material	If deemed appropriate, affected samples and associated quality control may be reanalyzed following instrument recalibration.
Matrix Spike	The spiking level should be approximately 2-5 times the ambient concentration of the spiked sample. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected, the matrix spike result must be qualified.
Matrix Spike Duplicate	The spiking level should be approximately 2-5 times the ambient concentration of the spiked sample. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected and reference material recoveries are acceptable, the matrix spike duplicate result must be qualified.
Laboratory Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. Other failures should be reanalyzed as sample volume allows.
Internal Standard	As method requires. The instrument must be flushed with rinse blank. If, after flushing, the responses of the internal standards remain unacceptable, the analysis must be terminated and the cause of drift investigated.
Field Quality Control	**Corrective Action**
Field Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. All failures should be communicated to the project coordinator, who in turn will follow the process detailed in the method.
Field Blank, Equipment Blank	If contamination of the field blanks and associated samples is known or suspected, the laboratory should qualify the affected data, and notify the project coordinator, who in turn will follow the process detailed in the method.

Table D4: Corrective Action - Organic Chemistry

Laboratory Quality Control	Corrective Action
Calibration Standard	Affected samples and associated quality control must be reanalyzed following successful instrument recalibration.
Initial/Continuing Calibration Verification	The analysis must be halted, the problem investigated, and the instrument recalibrated. All samples after the last acceptable continuing calibration verification must be reanalyzed.
Laboratory Blank	The sample analysis must be halted, the source of the contamination investigated, the samples along with a new laboratory blank prepared and/or re-extracted, and the sample batch and fresh laboratory blank reanalyzed. If reanalysis is not possible due to sample volume, flag associated samples as estimated.
Reference Material	Affected samples and associated quality control must be reanalyzed following instrument recalibration.
Matrix Spike	The spiking level should be approximately 2-5 times the ambient concentration of the spiked sample. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected, the matrix spike result must be qualified.
Matrix Spike Duplicate	The spiking level should be approximately 2-5 times the ambient concentration of the spiked sample. Appropriately spiked results should be compared to the matrix spike duplicate to investigate matrix interference. If matrix interference is suspected and reference material recoveries are acceptable, the matrix spike duplicate result must be qualified.
Laboratory Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. Other failures should be reanalyzed as sample volume allows.
Internal Standard	Analyze as appropriate per method. Troubleshoot as appropriate. If, after trouble-shooting, the responses of the internal standards remain unacceptable, the analysis must be terminated and the cause of drift investigated.
Surrogate	Analyze as appropriate per method. All affected results should be qualified. The analytical method or quality assurance project plan must detail procedures for updating surrogate measurement quality objectives.
Field Quality Control	**Corrective Action**
Field Duplicate	For duplicates with a heterogeneous matrix or ambient levels below the reporting limit, failed results may be qualified. All failures should be communicated to the project coordinator, who in turn will follow the process detailed in the method.
Field Blank, Travel Blank, Equipment Blank	If contamination of the field blanks and associated samples is known or suspected, the laboratory should qualify the affected data, and notify the project coordinator, who in turn will follow the process detailed in the method.

Table D5: Corrective Action - Toxicity Testing

Negative Controls	Corrective Action
Laboratory Control Water	If tested with in-house cultures, affected samples and associated quality control must be retested within 24 hours of test failure. If commercial cultures are used, they must be ordered within 16 hours of test failure for earliest possible receipt, and retests must be initiated within 8 hours of receipt. The laboratory should try to determine the source of contamination, document the investigation, and document steps taken to prevent recurrence.
Conductivity Control Water	Affected samples and associated quality control must be qualified.
Additional Control Water	A water sample that has similar qualities to the test sample may be used as an additional control based on the objectives of the study. Results that show statistical differences from the laboratory control should be qualified. The laboratory should try to determine the source of contamination, document the investigation, and document steps taken to prevent recurrence. This is not applicable for TIE method blanks.
Laboratory Control Sediment	Affected samples and associated quality control must be re-tested within 24 hours of test failure if tested with in-house cultures. If commercial cultures are used, they must be ordered within 16 hours of test failure for earliest possible receipt, and re-tests must be initiated within 8 hours of receipt. The laboratory should try to determine the source of contamination, document the investigation, and document steps taken to prevent recurrence.
Additional Control Sediment	A sediment sample that has similar qualities to the test sample may be used as an additional control based on the objectives of the study. Results that show statistical differences from the laboratory control should be qualified. The laboratory should try to determine the source of contamination, document the investigation, and document steps taken to prevent recurrence.
Positive Controls	**Corrective Action**
Reference Toxicant Tests	If LC50 exceeds +/- two standard deviations of the running mean of the last 20 reference toxicant tests, the test should be qualified or repeated.
Field Quality Control	**Corrective Action**
Field Duplicate	For duplicates with a heterogeneous matrix, results that do not meet SWAMP criteria should be qualified. All field duplicate results that do not meet SWAMP criteria should be communicated to the project coordinator, who in turn will notify the sampling team so that the source of contamination can be identified and corrective measures taken prior to the next sampling event.
Field Blanks	If contamination of the field blanks and associated samples is known or suspected, the laboratory should qualify the affected data and notify the project coordinator, who in turn will notify the sampling team so that the source of contamination can be identified and corrective measures taken prior to the next sampling event.
Equipment Blanks	If contamination of the field blanks and associated samples is known or suspected, the laboratory should qualify the affected data and notify the project coordinator, who in turn will notify the sampling team so that the source of contamination can be identified and corrective measures taken prior to the next sampling event.

Table D6: Corrective Action - Field Measurements

Field Quality Control	Corrective Action
Depth, Dissolved Oxygen, pH, Salinity, Specific Conductance, Temperature, Turbidity, Velocity	The instrument should be recalibrated following its manufacturer's cleaning and maintenance procedures. If measurements continue to fail measurement quality objectives, affected data should not be reported and the instrument should be returned to the manufacturer for maintenance. All troubleshooting and corrective actions should be recorded in the calibration and field data logbooks.

Appendix E: Glossary

Unless otherwise noted, the following definitions are from the Environmental Protection Agency's *Glossary of Quality-Related Terms*: http://www.epa.gov/quality/glossary.htm

Accuracy	The closeness or agreement of the observed value or test response to the true or acceptable reference value or the test response from a reference method. It is influenced by both random error (precision) and systematic error (bias). The terms "bias" and "precision" are often used in lieu of "accuracy".
Analytical Batch **SWAMP QA Program Definition**	A group of 20 or fewer samples and associated quality control that is processed by the same instrument within a 24-hour period (unless otherwise specified by method). An analytical batch may comprise multiple sample batches.
Analytical Run **SWAMP QA Program Definition**	The quantification of a single discrete sample or its associated quality control.
Assessment	A general evaluation process used to evaluate the performance, effectiveness and processes of a management and/or technical system.
Batch	The collection of samples of the same group which is to be analyzed in one test run or inspected together within a specific time limit and traceable as a unit.
Bias	The constant or systematic distortion of a measurement process that manifests itself as a persistent positive or negative deviation from the known or true value. This can result from improper data collection, poorly calibrated analytical or sampling equipment, or limitations or errors in analytical methods and techniques.
Blank	A specimen that is intended to contain none of the analytes of interest and which is subjected to the usual analytical or measurement process to establish a zero baseline or background value.
Calibration	A comparison of a measurement standard, instrument, or item with one having higher accuracy to detect, quantify, and record any inaccuracy or variation; the process by which an instrument setting is adjusted based on response to a standard to eliminate the inaccuracy.
Calibration Standard	Reference solution of known value used to correct an instrument reading.
Certified Reference Material **SWAMP QA Program Definition**	A substance whose property values are certified by a procedure which establishes its traceability and uncertainty at a stated level of confidence.
Comparability	A measure of the confidence with which one data set, element, or method can be considered as similar to another.
Completeness	A measure of the amount of valid data obtained from a measurement system.

Continuing Calibration Verification **SWAMP QA Program Definition**	A periodic standard used to assess instrument drift between calibrations.
Control Limit	The variation in a process data set expressed as plus/minus standard deviations from the mean, generally placed on a chart to indicate the upper and lower acceptable ranges of process data and to judge whether the process is in or out of statistical limitations.
Corrective Action	Any measures taken to rectify conditions adverse to quality and/or to eliminate the causes of an existing nonconformity, defect, or other undesirable situation in order to prevent reoccurrence.
Data Validation	An analyte- and sample-specific process that evaluates the information after the verification process (i.e., determination of method, procedural, or contractual compliance) to determine analytical quality and any limitations.
Data Verification	The process of evaluating the completeness, correctness, and conformance/compliance of a specific information set against the method, procedural, or contractual specifications for that activity.
Equipment Blank	An aliquot of reagent water that is subjected in the laboratory to all aspects of sample collection and analysis, including contact with all sampling devices and apparatus. The purpose of the equipment blank is to determine if the sampling devices and apparatus for sample collection have been adequately cleaned before they are shipped to the field site. An acceptable equipment blank must be achieved before the sampling devices and apparatus are used for sample collection.
Field Blank	A clean analyte-free sample which is carried to the sampling site and then exposed to sampling conditions, returned to the laboratory, and treated as an environmental sample. This blank is used to provide information about contaminants that may be introduced during sample collection, storage, and transport.
Field Duplicate (Co-located)	An independent specimen collected from the same point in time and space as the previous specimen.
Field Duplicate (Subsample)	A test specimen that is homogenized before being divided into two or more portions with the same laboratory analyzing all portions.
Field Measurements	Those activities associated with performing analyses or measurements in the habitat being examined.
Holding Time **SWAMP QA Program Definition**	The period of time a sample may be stored following collection, preservation, extraction, or analysis. While exceeding the holding time does not necessarily negate the veracity of analytical results, it causes the qualification of any data not meeting all of the specified acceptance criteria.
Indicators	Items, elements, or measures used to determine or identify a basic condition or how well a process or program is meeting its objectives.

Initial Calibration Verification **SWAMP QA Program Definition**	A standard used to assess instrument drift at the beginning of an analytical batch.
Intercomparison	An exercise in which samples are prepared and split by a reference laboratory, then analyzed by one or more testing laboratories and the reference laboratory. The intercomparison, with a reputable laboratory as the reference laboratory, serves as the best test of the precision and accuracy of the analyses at natural environmental levels.
Interference	An element, compound, or other matrix effect present in a sample which disturbs the detection of a target analyte leading to inaccurate concentration results for the target analyte.
Internal Standard	Pure analyte(s) added to a sample, extract, or standard solution in known amount(s) and used to measure the relative responses of other method analytes that are components of the same sample or solution. The internal standard must be an analyte that is not a sample component.
Laboratory Blank	An aliquot of reagent water that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, internal standards, and surrogates that are used with samples. The laboratory blank is used to determine if method analytes or interferences are present in the laboratory environment, the reagents, or the apparatus.
Laboratory Duplicate	Two or more representative portions taken from one homogeneous sample by the analyst and analyzed in the same testing facility.
Laboratory Control Sample	A specimen of known composition prepared using contaminant-free reagent water, or an inert solid, that is spiked with the analyte of interest at the midpoint of the calibration curve or at the level of concern; and then analyzed using the same preparation, reagents, and analytical methods employed for regular specimens and at the intervals set in the Quality Assurance Project Plan.
Matrix	The material of which the sample is composed or the substrate containing the analyte of interest, such as drinking water, waste water, air, soil/sediment, biological material, etc. Also called medium or media.
Matrix Spike	A test specimen prepared by adding a known concentration of the target analyte to a specified amount of a specific homogenized specimen where an estimate of the target concentration is available and subjected to the entire analytical protocol.
Matrix Spike Duplicate	A sample prepared simultaneously as a split with the matrix spike sample with each specimen being spiked with identical, known concentrations of targeted analyte.
Measurement Quality Objectives	The individual performance or acceptance goals for the individual Data Quality Indicators such as precision or bias.
Method	A procedure, technique, or tool for performing a scientific activity.

Method Blank	A blank prepared to represent the sample matrix as closely as possible and analyzed exactly like the calibration standards, samples, and quality control (QC) samples. Results of method blanks provide an estimate of the within-batch variability of the blank response and an indication of bias introduced by the analytical procedure.
Method Detection Limit	The minimum concentration of an analyte that undergoes the entire measurement process and can be reported with a stated level of confidence that the analyte concentration is greater than zero.
Non-Direct Measurements	Data obtained from existing sources rather than measured or generated directly.
Parameter	A statistical quantity, usually unknown, such as a mean or a standard deviation, which characterizes a population or defines a system.
Performance-Based Measurement System	A set of processes wherein the data needs, mandates, or limitations of a program or project are specified and serve as criteria for selecting appropriate methods to meet those needs in a cost-effective manner.
Precision	A measure of mutual agreement between two or more individual measurements of the same property, obtained under similar conditions.
Quality Assurance	An integrated system of management activities (planning, implementation, assessment, reporting, and quality improvement) that focuses on providing confidence in the data or product by ensuring that it is of the type and worth needed and expected by the client.
Quality Assurance Officer	The individual designated within an organization having management oversight and responsibilities for planning, documenting, coordinating, and assessing the system effectiveness for ensuring the value of the work.
Quality Assurance Project Plan	A document that describes the intended technical activities and project procedures that will be implemented to ensure that the results of the work to be performed will satisfy the stated performance or acceptance criteria. The amount of information presented and the planned activities to ensure the value of the work will vary according the type of study and the intended use of the data.
Quality Assurance Program Plan	A document describing in comprehensive detail the necessary decisions and decision criteria to be used by an overall regulatory program.
Quality Management Plan	A document that describes an organization's system in terms of its organizational structure, policy and procedures, staff functional responsibilities, lines of authority, and interfaces for those planning, implementing, documenting, and assessing all activities conducted.
Reference Material **SWAMP QA Program Definition**	A substance whose properties are sufficiently homogeneous and established to be used for calibration and measurement.
Reporting Limit	The minimum value below which data are documented as non-detected.

Sample Batch	Twenty or fewer field samples prepared and analyzed with a common set of quality assurance samples.
Sensitivity	The capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest.
Spike	A known quantity of an analyte added to a sample for the purpose of determining recovery or efficiency (analyst spikes), or for quality control (blind spikes).
Split	Two or more representative portions taken from one specimen in the field or in the laboratory and analyzed by different analysts, methods, or laboratories.
Standard Deviation	The measure of the dispersion or imprecision of a series of accepted results around the average, equal to the square root of the variance.
Standard Operating Procedure	A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps and that is officially approved as the method for performing certain routine or repetitive tasks.
Surrogate	A pure substance with properties that mimics the analyte of interest (organics only) and which is unlikely to be found in environmental samples. It is added into a sample before sample preparation.
Travel Blank **SWAMP QA Program Definition**	Analyte-free water placed in the same type of container as its associated field samples. It may be pre-preserved prior to shipment, but is not opened during the sample collection. Consequently, it helps isolate contamination associated with sample transport.
Working Standard **SWAMP QA Program Definition**	A dilution of a stock standard.

Appendix F: List of Abbreviations and Acronyms

AB	Assembly Bill
ASTM	American Society for Testing and Materials
BDAT	Bay, Delta, and Tributaries Project
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CCV	Continuing Calibration Verification
CEDEN	California Environmental Data Exchange Network
CRM	Certified Reference Material
CWA	Clean Water Act
DFG	Department of Fish and Game
DI	Deionized
DIT	Division of Information Technology
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DMT	Data Management Team
DWR	Department of Water Resources
EC	Electrical Conductivity
EDTA	Ethylenediaminetetraacetic Acid
EPA	U.S. Environmental Protection Agency
FTP	File Transfer Protocol
GC	Gas Chromatography
GC-ECD	Gas Chromatography-Electron Capture Detection
GC-MS	Gas Chromatography – Mass Spectrometry
HEM	Hexane-Extractable Material
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry

ICV	Initial Calibration Verification
IEP	Interagency Ecological Program
IMS	Information Management System
LCS	Laboratory Control Sample
LOEC	Lowest Observed Effects Concentration
MDL	Method Detection Limit
MLML	Moss Landing Marine Laboratories
MPN	Most Probable Number
MQO	Measurement Quality Objective
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MTBE	Methyl Tert-Butyl Ether
n/a	Not Applicable
NHD	National Hydrography Dataset
NIST	National Institute of Standards and Technology
NOEC	No Observed Effects Concentration
NPDES	National Pollutant Discharge Elimination System
OIMA	Office of Information Management and Analysis
PAH	Polycyclic Aromatic Hydrocarbons
PBDE	Polybrominated Diphenyl Ethers
PCB	Polychlorinated Biphenyls
PMSD	Percent Minimum Significant Difference
ppm	Parts per Million
ppb	Parts per Billion
ppt	Parts per Trillion
QA	Quality Assurance

QAPP	Quality Assurance Project Plan
QAPrP	Quality Assurance Program Plan
QC	Quality Control
QMP	Quality Management Plan
RF	Response Factor
RFP	Request for Proposal
RL	Reporting Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
RWC	Receiving Water Concentration
RWQCB	Regional Water Quality Control Board
SCCWRP	Southern California Coastal Research Project
SDTP	Standardized Data Transfer Protocols
SFEI	San Francisco Estuary Institute
SOP	Standard Operating Procedure
SOW	Statement of Work
SPARC	Scientific Planning and Review Committee
SPCC	System Performance Check Compounds
SRM	Standard Reference Material
SRWP	Sacramento River Watershed Program
STORET	Storage and Retrieval
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TAC	Test Acceptability Criteria
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon

TRL	Target Reporting Limit
UCD	University of California at Davis
USGS	U.S. Geological Survey
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
YCT	Yeast, Cerophyl®, and Trout Chow

Appendix G: Online Resources

Hosted by the State Water Resources Control Board

State Board SWAMP Page:

http://www.waterboards.ca.gov/water_issues/programs/swamp/

Launch page to program guidelines, documents, and links

SWAMP Quality Assurance Program Plan:

http://www.waterboards.ca.gov/water_issues/programs/swamp/qapp.shtml

This QAPrP and associated appendices in Adobe PDF and Microsoft Word formats

SWAMP Quality Assurance:

http://www.waterboards.ca.gov/water_issues/programs/swamp/qapp.shtml

SWAMP quality assurance homepage and links

SWAMP Email List:

http://www.waterboards.ca.gov/resources/email_subscriptions/swrcb_subscribe.shtml

Subscriptions to the online mailing lists of various State Board efforts

SWAMP Advisor:

http://swamp.waterboards.ca.gov/swamp/qapp_advisor/

Online tool for SWAMP QAPP creation

Hosted by the Moss Landing Marine Laboratories

SWAMP Standard Operating Procedures:

http://mpsl.mlml.calstate.edu/swsops.htm

SWAMP data management and quality assurance SOPs

SWAMP Quality Assurance Comparability:

http://mpsl.mlml.calstate.edu/swqacompare.htm

Guidelines, links, and a Help Desk pertaining to SWAMP quality assurance comparability

SWAMP Data Management Comparability:

http://mpsl.mlml.calstate.edu/swdbcompare.htm

Guidelines, links, and a Help Desk pertaining to SWAMP data management comparability

SWAMP Information Management System Documentation:

http://mpsl.mlml.calstate.edu/swdbase.htm

Documents pertaining to SWAMP IMS guidelines and training

SWAMP Data Submission Documentation:

http://mpsl.mlml.calstate.edu/swdataformats.htm

Documents pertaining to SWAMP IMS data submission formats and conventions

Regional SWAMP Report Templates:

http://mpsl.mlml.calstate.edu/SWAMP_Regional_Report_QA_Section_Template_022908.doc

Narrative and tabular templates for the QA section of regional SWAMP reports

Hosted Externally

Bay, Delta, and Tributaries Project:

http://bdat.ca.gov/Php/ceden

Centralized data sharing network for SWAMP data

EPA Quality System Documents:

http://www.epa.gov/quality/qa_docs.html

Agency-wide Guidance and Requirements documents for internal and external quality systems

Appendix H: Approval Signatures

The following approvals were submitted separately, preventing their inclusion in the signature block in Element A1: *Title and Approval Sheet* of this document. Originals are kept on file by the Surface Water Ambient Monitoring (SWAMP) Quality Assurance Team (QAT) according to Element A9: *Documents and Records*.

Surface Water Ambient Monitoring Program
Quality Assurance Program Plan
09/01/08

Element A1: *Title and Approval Sheet* (1 of 12*)

Emilie Reyes, Surface Water Ambient Monitoring Program Coordinator
State Water Resources Control Board
Office of Information Management and Analysis
Surface Water Ambient Monitoring Program Unit

Signature

Date 11/05/08

*Original signatures are maintained by the SWAMP Quality Assurance Team, and are scanned into this appendix for reference with Element A1: *Title and Approval Sheet.*

Surface Water Ambient Monitoring Program
Quality Assurance Program Plan
09/01/08

Element A1: *Title and Approval Sheet* (2 of 12*)

William Ray, Quality Assurance Office Manager
State Water Resources Control Board
Office of Information Management and Analysis

WO
Signature

7/14/08
Date

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Surface Water Ambient Monitoring Program
Quality Assurance Program Plan
09/01/08

Element A1: *Title and Approval Sheet* (3 of 12*)

Beverly H. van Buuren, Surface Water Ambient Monitoring Program Quality Assurance Officer
Moss Landing Marine Laboratories
Quality Assurance Research Group

Signature 07/21/08
Date

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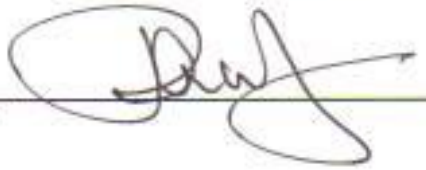
Surface Water Ambient Monitoring Program
Quality Assurance Program Plan
09/01/08

Element A1: *Title and Approval Sheet* (4 of 12*)

Rich Fadness, Quality Assurance Officer (or Designee)
Regional Water Quality Control Board 1 (North Coast Region)



Signature

7-10-08
Date

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Surface Water Ambient Monitoring Program
Quality Assurance Program Plan
09/01/08

Element A1: *Title and Approval Sheet* (5 of 12*)

Wil Bruhns, Quality Assurance Officer (or Designee)
Regional Water Quality Control Board 2 (San Francisco Bay Region)

Signature

7/21/08
Date

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Surface Water Ambient Monitoring Program
Quality Assurance Program Plan
09/01/08

Element A1: *Title and Approval Sheet* (6 of 12*)

Karen Worcester, Quality Assurance Officer (or Designee)
Regional Water Quality Control Board 3 (Central Coast Region)

Karen Worcester
Signature

7-17-08
Date

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Surface Water Ambient Monitoring Program
Quality Assurance Program Plan
09/01/08

Element A1: *Title and Approval Sheet* (7 of 12)

Jau Ren Chen, Quality Assurance Officer (or Designee)
Regional Water Quality Control Board 4 (Los Angeles Region)

Jau Ren Chen
Signature

7/15/08
Date

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Surface Water Ambient Monitoring Program
Quality Assurance Program Plan
09/01/08

Element A1: *Title and Approval Sheet* (8 of 12*)

Leticia Valadez, Quality Assurance Officer (or Designee)
Regional Water Quality Control Board 5 (Central Valley Region)

Signature

7/15/2008
Date

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Surface Water Ambient Monitoring Program
Quality Assurance Program Plan
09/01/08

Element A1: *Title and Approval Sheet* (9 of 12*)

Bruce Warden, Quality Assurance Officer (or Designee)
Regional Water Quality Control Board 6 (Lahontan Region)

Bruce Warden 7-30-08

Signature Date

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Surface Water Ambient Monitoring Program
Quality Assurance Program Plan
09/01/08

Element A1: Title and Approval Sheet (16 of 127)

Jeff Geraci, Quality Assurance Officer (or Designee)
Regional Water Quality Control Board 7 (Colorado River Basin Region)

Signature

8/14/08
Date

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Element A1: Title and Approval Sheet

Surface Water Ambient Monitoring Program
Quality Assurance Program Plan
09/01/08

Element A1: *Title and Approval Sheet* (11 of 12*)

Pavlova Vitale, Quality Assurance Officer (or Designee)
Regional Water Quality Control Board 8 (Santa Ana Region)

Pavlova N. Vitale
Signature

7-21-08
Date

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Surface Water Ambient Monitoring Program
Quality Assurance Program Plan
09/01/08

Dat Quach, Quality Assurance Officer (or Designee)
Regional Water Quality Control Board 9 (San Diego Region)

Linda Pardy (Designee) 8-26-2008

Signature Date

*Original signatures are maintained by the SWAMP Quality Assurance Team, and are scanned into this appendix for reference with Element A1: *Title and Approval Sheet.*

Appendix I: References

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Appendix J: Document Addenda

This quality assurance program plan (QAPrP) is formally revised at least every five years, and is reviewed and updated on an annual basis. Updates necessitated between these reviews are communicated via the addenda included in this appendix. This table summarizes the addenda that appear chronologically in the following page(s).

Addendum Date	Subject	Summary
October 8, 2008	Reporting Limits	Programmatic reporting limit (RL) requirements are temporarily retracted while a new system is developed.

Surface Water Ambient Monitoring Program Quality Assurance Program Plan:

Addendum

The purpose of this form is to document and communicate updates to the *Surface Water Ambient Monitoring Program Quality Assurance Program Plan* (QAPrP) that occur independently of formal reviews or revisions.

QAPrP Version: September 1, 2008

Addendum Effective Date: October 8, 2008

Subject: Retraction of Programmatic Reporting Limits

Description: As printed, the QAPrP mandates the programmatic reporting limits specified in its Appendix C: *Reporting Limits*. An October 8, 2008 SWAMP Roundtable decision temporarily retracts this policy pending updates to the specified limits.

Element Number: B4
Element Name: Analytical Methods
Page(s): 29

Current Text:

"If a project's RLs exceed those presented in Appendix C, a waiver must be completed as described in the introduction to this document."

Updated Text:

"If a project's RLs exceed those presented in Appendix C, there is no need to obtain a waiver as described in the introduction to this document."

For SWAMP Use:

Approval Date:
SWAMP Coordinator Name: Kevin Taberski acting for Emilie Reyes
SWAMP Coordinator Approval Signature: [signature] Date: 10/29/08

SWAMP
Surface Water Ambient Monitoring Program